Office Space per Worker: Evidence from Four European Markets

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Abstract. Most analyses of future office demand rely on employment forecasts, taking office space per worker as given. This study analyses the determinants of office space per worker. After listing a number of hypotheses, an economic explanation is developed. Office space per worker is perceived as a function of rent, expected growth of the firm and uncertainty of this growth, the lease period, substitution possibilities on the market and search and adjustment costs. Survey data from European office markets are analyzed vis à vis the hypotheses.

Introduction

Accurate predictions of office demand in the short and medium run are essential to real estate investors, project developers, real estate brokers, and planning authorities. It is therefore not surprising that this issue has received considerable attention in both market reports and scholarly work (see McClure, 1991, for a discussion).

Most analyses of office demand made by professionals or in academic research are based on some kind of forecast of employment for the different office-occupying sectors in the economy (for example, Rosen, 1984; Wheaton, 1987). The employment forecasts, in turn, are either based on extrapolation of past trends or on an external source, such as macroeconometric models. These forecasts are then multiplied by an office space per worker ratio, that may differ among sectors to get a prediction of total office demand in square feet (see, for example, Maisel, 1989; Malizia, 1991; Rosen, 1993). Accurate estimation of this ratio is therefore crucial to the accuracy of the forecast.

In this paper we will try to improve on this method of forecasting office demand in two ways. Firstly, we will present new evidence on the office space per worker ratios in the CBDs of four major European office markets. Secondly, and more important, we try to identify the economic factors that cause office space per worker ratios to differ among sectors and cities. In other words, we do not believe that only the type of office employment is important for determining the office space per worker ratios but that the structure of the office market in which office space is occupied is a major determinant of the office space per worker ratios as well. Changes in this structure as well as the cyclical behaviour of urban office markets may well cause office space per worker ratios to differ significantly over markets and over time. Not taking account of these differences will affect the accuracy of market and absorption analysis.

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183
We test our hypothesis by examining recently collected survey data for four major European office markets. By doing so we are able to distinguish between the influence of specific markets and specific sectors on the office space per worker ratio. Our results seem to confirm the observation that not only the sector of office employment but also the market in which the office space is occupied is important for determining the office space per worker ratio.

Although this is only a first attempt to describe the determinants of the office space per worker ratios we believe that further research on this issue can significantly increase our knowledge about the determinants of office demand and may well lead to better office demand forecasts.

The rest of the paper is organized as follows. Section two discusses a number of hypotheses regarding the use of office space that can be distilled from the small number of studies on the subject. Whether these facts and presumptions are true in general, is of course an empirical matter (to which we turn in sections four and five). The third section then proceeds by identifying the determinants of office use. We draw on the literature on the consumption of housing services which has close analogy to the problem of the amount of office space per worker.

In section four we discuss our survey data from four major European office markets and analyse some descriptive statistics. Section five looks at the dynamics of how firms react to changes in rental levels, using the results of another set of questions from our survey. Finally, section six summarizes and concludes.

Hypotheses

Based on the few studies that have been published on the subject, and the observations made during the survey, we list the following hypotheses:

1. **Office space per worker differs significantly per office-using sector.** Estimates show that, in general, business services and government organizations use less space per worker than financial and legal services (see, for example, Birch, 1986). Hypothesis 1 may therefore simply be due to the relative growth of these latter sectors.

2. **Office space per worker differs significantly per type of occupation.** The type of work being done (managerial, technical, professional or clerical occupations) is important in determining the amount of floor space being used. This may provide an explanation for Hypothesis 1. If financial and legal services simply have more employees that are higher on the “space intensity” scale, they have an overall higher use of office space per worker. In the end, it may therefore be the general rise in the number of managers vs. technical, professional and clerical staff that explains Hypothesis 1 (see Birch, 1986; Parker, 1989; Clapp, 1993).

3. **Other things being equal, office space per worker is higher in smaller buildings.** This is simply due to the fact that floor space for general use, such as corridors, elevators and other facilities, has to be divided by a smaller number of overall footage. The structure of the office market stock in terms of type of buildings influences the average office space per worker.

4. **Office space per worker tends to be low in very expensive locations.** For example, Marunouchi Tokyo and the City of London—two of the most expensive locations in the world—are characterized by a very low use of office space. There is no empirical evidence, however, that the relation is linear.
5. *A number of studies indicate that the office space per worker increased significantly in Western countries over the last two decades.* However, the evidence is scattered. It is either based on small sample surveys or on rough estimates on a national scale, linking various data sources.²

6. *Office space per worker is dependent on the internal layout of the building.* In buildings with an open plan layout the space per worker is less than in offices with a room structure (Duffy, 1992; Dewulf and De Jonge, 1994).

Less obvious from the literature, are the following hypotheses:

7. *Office space per worker is lower in CBDs.* This may be simply due to rents being generally higher in CBDs (see Parker, 1989).

8. *There is a positive relation between “capacity to pay” and use of space.* In cases where the costs of the office space is relatively small as a percentage of total costs, the incentive for the firm to use the office space efficiently is smaller than for the firm for which cost of accommodation is a significant share of total costs. This might explain the relatively high level of office space per worker in the manufacturing sector compared to business services.

9. *Office space per worker differs with age of the building.* Modern buildings have a better net/gross ratio and have generally a more efficient layout (see also Hypothesis 6).

In this article we investigate whether the first four of our hypotheses hold in our survey for four European prime office markets. In the next section, before presenting our results, we develop an economic framework that provides a basis for a more thorough understanding of the underlying factors.

**An Economic Explanation of Office Space per Worker**

Office space per worker can be seen as just another input into the production process of the office-using firm. The demand for office space per worker is therefore *conditional* on the objectives of the firm (say, profit maximization). In this framework, the amount of space per worker is chosen just as the amount of other capital per worker by equalizing marginal cost to marginal return. In the case of capital the standard perfect-foresight neoclassical model assumes that the amount of capital is chosen in such a way that the marginal productivity of capital is equal to its user costs (Jorgenson, 1963).

A similar condition holds for office space: firms must choose the amount of office space in such a way that the marginal productivity of office space is equal to its marginal cost. This relationship is similar to the traditional theories on land use as proposed by Ricardo and others in which the marginal productivity of land is equal to its marginal cost in the long run. However, as in the case of housing consumption, there are a large number of additional factors that makes the demand for office space not only determined by rent. Uncertainty, different types of transaction costs and institutional factors may lead to considerable deviations from the optimal amount of office space per worker that would be expected in a simple Robinson Crusoe neoclassical model.

In many ways there is a close analogy between the choice of office space per worker and the choice of the amount of housing services to consume. We draw here on the existing theory on housing services to develop a model of the determinants of office space per worker.
Before we do that, it is already important to note that our analysis is mostly demand oriented. Supply (which may well adopt to a changing office use ratio) is either assumed fixed or follows demand. (An analysis of the supply side is important but it is beyond the scope of this article.) The amount and way in which there is a mismatch between demand and supply at any point in time, will differ among office markets depending on the natural vacancy rate.

The fact that the reality of the office market is different than the perfect-foresight neoclassical model is without dispute. First, firms face uncertainty with respect to the amount of products or services they can sell in the coming years (the stage of the business cycle) and the productivity of the employees during that period. That is, they are uncertain with respect to how many employees they have to provide with accommodation. They have to form expectations about these variables when they sign a lease contract.

The lease contract itself is a commitment of the firm to lease office accommodation that if at all, can only be ended at considerable cost. The combination of the lease contract and the uncertainty about the number of employees to accommodate means that both the expectations about demand and the length of the lease period are important in determining the office space per worker ratio. The latter factor is also important in the European context, since the length of the lease contract varies considerably among countries. It must be noted that the contract rent is not always reflecting the true costs. Effective rent, which includes rental concessions, is a better yardstick. However, the information to adjust the rents was not available to us. Differences in the length of the lease can be seen as incorporated in the rents.3

Secondly, the literature on housing services4 shows that adjustment costs and search costs are important determinants of the demand for housing services. Adjustment costs can take various forms. When moving into an office building at the beginning of a lease period, a firm usually invests in office equipment and in the layout or interior of the building. These investments can be quite considerable, as in the case of trading rooms for financial firms. At the end of the lease period, the choice of whether to renew the contract or to move to a new office building is influenced by the investments that are made in the old building, since moving to a new building will usually mean that the firm has to make additional costs or even invest anew in equipment and layout. Moving costs themselves can also be characterised as adjustment costs.

Search costs, the costs involved with selecting new office space, also influence the office space per worker outcome. The argument is similar to the adjustment costs argument mentioned above. High costs lower the flexibility of firms—in terms of their objective function—to substitute existing space for new space. Therefore they are likely to rent higher amounts of space in the first place, allowing them to extend within the existing office space rather than having to look for new space if demand is unexpectedly high.

It is important to see that adjustment costs and search costs may lead a firm to forgo adjusting the ratio of office space per worker to the neoclassical optimal amount of space. The way in which these two imperfections differ among markets and among sectors is therefore important to explain office space use among these categories.

The thinness of the market or the availability of substitution possibilities for the existing office space is another supply-side factor of significance in our simple model. Conditions in the local or regional office market themselves are clearly important in determining the office space per worker. This amounts to saying that the input market for office space is
sometimes in disequilibrium; there is suboptimal allocation due to insufficient supply. The effect of this mismatch can point two ways: either it can make firms use an amount of office space per worker that is greater than optimal (if no matching smaller offices are available) or it can make them use an amount of office space per worker that is smaller than optimal (if no matching greater offices are available). There are, of course, limits to the deviation from the optimal level. Large deviations will lead to relocation.

Although we can only capture these influences to some extent when we confront our hypothesis with the data, we feel that our approach can be fruitful to explain why differences in office space use exist and why these ratios change over time. In the next section we present some empirical evidence as a first test of our hypotheses.

Some Empirical Evidence

According to Rosen (1993, p. 164), the answer to the question about what the amount of office space per worker actually is will be “a major undertaking because of the data problems that accompany such an estimate.” One aspect of these problems is that the definitions of what office space consists of and what it does not, may differ considerably among countries.

Most published data refer to the “lettable” space. In the United Kingdom this is more narrowly defined than in most other countries (Exhibit 1). The lettable space will therefore be closer to the “usable” space. In a number of cases the characteristics of the building and the type of occupancy affect how the space is measured and which exact definition is used in the lease contract. An educated guess of how differences in measurement affect cross-country comparisons is that they can amount to up to 20%.

The survey data we use in this study are obtained by personal interviews, and are therefore less sensitive to definitional differences. The definition of lettable floorspace was significantly different in the U.K. (Exhibit 1). For that reason the data are corrected by factor 1.2, the estimated difference due to the inclusion of lobby and toilets, to make the figures more comparable. In the case of Belgium, we have assumed that the inclusion of stairs and lifts makes up for the exclusion of the lobby, compared to the case of Germany, the Netherlands and the United States.

Office Space Use and Sector

A number of market reports give some information about the unadjusted average office space per worker. According to the Brussels regional government the average in Brussels

### Exhibit 1

<table>
<thead>
<tr>
<th>Items Normally Included in Lettable Floorspace Definition</th>
<th>Belgium</th>
<th>Germany</th>
<th>Netherlands</th>
<th>U.K.</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrance lobby</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Stairs</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Lifts</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Toilets</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Structural walls</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

*Source: International Commercial Property Associates (1992).*
is 281 sq. ft (26.3 sq. m) (Region Bruxelles Capitale, 1991). In Frankfurt the average is 271 sq. ft (25.3 sq. m) (Zadelhoff Deutschland/IfS, 1991), in Amsterdam 278 sq. ft (26.0 sq. m), in Central London 158 sq. ft (14.8 sq. m) (Richard Ellis, 1988). Although the differences between these averages are interesting, they ignore the variations due to differences between sectors and levels of management.

For the United States, Shilton (1994) finds an average for twenty-one American metropolitan areas of 190.9 sq. ft (20.5 sq. m) and concludes that the standard rule of thumb of 250 sq. ft per worker appears to apply to Denver, Dallas, Sacramento, San Francisco, and Atlanta but that it does not hold for the majority of cities. His results are in line with earlier work for the U.S. BOMA (1979). BOMA (1988) and ULI (1988), however, find much higher averages—305 (primary office buildings) and 347 sq. ft (office parks), respectively.

In a more detailed study, Birch estimates an average of 213 sq. ft (19.9 sq. m) for banking, services and government, 228 sq. ft (21.3 sq. m) for manufacturing and TCU (transportation, communication and utilities) and 333 sq. ft (31.1 sq. m) for legal services (Clapp, 1993). He further estimates an average of 200 sq. ft (18.7 sq. m) for clerical staff, 250 sq. ft (23.4 sq. m) for technical and managerial occupations and 372 sq. ft (34.8 sq. m) for professional functions.

Our survey carried out in the centers of four European cities provides additional evidence about the differences in office space per worker between markets and sectors. The survey was based on personal interviews carried out in 1992 and the first part of 1993. The sample of firms reflected the relative importance of each sector in the local office market and was drawn randomly from a list of firms, provided by local sources such as Chambers of Commerce. About half of the top executives that were approached for an interview refused for various reasons. In case of a refusal, another firm in the same category was contacted. For a full description of the survey and method used, see Lie (1994). A total of ninety firms took part.

In Exhibit 2, the adjusted space ratios are shown and compared to the unadjusted figures from the market reports mentioned above. In all four cities the space consumption per worker was high in the group formed by manufacturing, transportation, communic-

<table>
<thead>
<tr>
<th>Sector</th>
<th>London</th>
<th>Frankfurt</th>
<th>Brussels</th>
<th>Amsterdam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Published Avg</td>
<td>158</td>
<td>271</td>
<td>281</td>
<td>278</td>
</tr>
<tr>
<td>(14.8)</td>
<td>(25.3)</td>
<td>(26.3)</td>
<td>(26.0)</td>
<td></td>
</tr>
<tr>
<td>Survey Avg</td>
<td>180</td>
<td>273</td>
<td>310</td>
<td>257</td>
</tr>
<tr>
<td>(16.8)</td>
<td>(25.5)</td>
<td>(29.0)</td>
<td>(24.0)</td>
<td></td>
</tr>
<tr>
<td>Banking</td>
<td>149</td>
<td>295</td>
<td>362</td>
<td>246</td>
</tr>
<tr>
<td>(13.9)</td>
<td>(27.6)</td>
<td>(33.8)</td>
<td>(23.0)</td>
<td></td>
</tr>
<tr>
<td>Business Services</td>
<td>152</td>
<td>245</td>
<td>239</td>
<td>261</td>
</tr>
<tr>
<td>(14.2)</td>
<td>(22.9)</td>
<td>(22.3)</td>
<td>(24.4)</td>
<td></td>
</tr>
<tr>
<td>Insurance</td>
<td>123</td>
<td>257</td>
<td>293</td>
<td>257</td>
</tr>
<tr>
<td>(11.5)</td>
<td>(24.0)</td>
<td>(27.4)</td>
<td>(24.0)</td>
<td></td>
</tr>
<tr>
<td>MTCU&lt;sup&gt;b&lt;/sup&gt;</td>
<td>312</td>
<td>407</td>
<td>318</td>
<td>321</td>
</tr>
<tr>
<td>(29.2)</td>
<td>(38.0)</td>
<td>(29.7)</td>
<td>(30.0)</td>
<td></td>
</tr>
</tbody>
</table>
tion, and utilities (MTCU) companies. Lower than average use of space was measured in the business services and insurance sector, with the exception of Amsterdam, where these sectors had an average use of space per worker.

The average figures for the four locations are very much affected by the sectoral economic structure of these locations. Central London is dominated by the financial sector. To a lesser extent this is also the case in Frankfurt. The standard deviation of use of space in the financial sector is large (Zadelhoff Deutschland/IfS, 1991). Space per worker is limited in dealing rooms (of which there are many in Central London). In Brussels the government and international institutions are the most important sectors. Organizations like the European Commission use much space per worker. This is to a large extent caused by the ancillary space for meeting rooms, and so on. In Amsterdam South business services are dominant. This sector is not an extensive user of space.

The figures presented here are somewhat different from Birch’s results for the U.S. The difference between the banking sector and the manufacturing and utilities sector is less pronounced in the U.S. The legal sector, which has a high use of space in the U.S., is included in the business service sector in the European survey. This sector is characterized by a relatively modest use of space.

Concluding, there is limited evidence to support the first hypothesis from section two. There are major differences in office space use for the same sectors between European markets and the U.S. On both continents, however, the manufacturing sector exhibits a relatively high use of space, especially compared to the business services sector.

Office Space Use and Occupation

Further explanation of the differences in the use of space per worker can be found in the employment structure. A high proportion of high and middle management functions will result in a high floorspace average (Parker, 1989; Clapp, 1993; Maisel, 1989; Dewulf and De Jonge, 1994). We proxied the employment structure in each firm by asking for the percentage of employees with a higher education degree. The results are given in Exhibit 3. No clear picture emerges from this exhibit. The relationship between the two variables is more like a U-curve than anything else. Business services use relatively little space per worker, but at the same time employ a relatively highly educated workforce, which is contrary to our second hypothesis. The insurance industry and the MTCU sector are more in line with the hypothesis: a small percentage highly educated staff and low use of space and, respectively, a highly educated staff and high average use of space.

The use of education level as a proxy for employment structure may be misleading. It is not education, but level in the hierarchy that matters. Besides, the cross-cultural

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**Exhibit 3**

| Share of Personnel with Higher Education Degree (percentages) |
|-----------------|---------------|------------|-------------|
|                 | London | Frankfurt | Brussels | Amsterdam |
| Banking         | 58.8   | 33.6      | 39.8      | 33.3       |
| Business Services | 43.2  | 51.1      | 71.3      | 47.0       |
| Insurance       | 30.0   | 15.0      | 34.4      | 15.8       |
| MTCU            | 51.7   | 51.7      | 33.3      | 57.5       |
comparison has its problems because of the different definitions of a higher education degree which we were not able to resolve in the survey design. Perhaps a better proxy would be salary scales for which, unfortunately, we have no data.

**Office Space Use and Building Size**

In our dataset floorspace is measured per firm and not per building. To test for the relationship between building size and use of space per worker we therefore had to restrict our sample to those firms that occupied only one building. This reduced the sample from ninety firms to sixty-seven. The results are given in Exhibit 6.

The first category for office space is smaller than 10,000 sq. ft, the second category between 10,000 and 50,000 sq. ft, and the third category, above 50,000 sq. ft. Although our dataset is too small to draw firm conclusions, the average amount of space per worker seems to decline when building size goes up, which is in line with our third hypothesis.

**Office Space Use and Price**

In Exhibit 4, the relationship between office space use and rent level is presented. The rents are expressed in U.S. dollars, using the exchange rate at the time of the data collection, 1992. Most of the upper left region of Exhibit 4 is filled by data from London.

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**Exhibit 4**

*Office Space per Square Foot and Rent in US$*

<table>
<thead>
<tr>
<th>Avg Sq. Ft per Worker</th>
<th>Rent in US$ per Sq. Ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
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<tr>
<td>30</td>
<td>30</td>
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<td>40</td>
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<td>80</td>
<td>80</td>
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<tr>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

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190 THE JOURNAL OF REAL ESTATE RESEARCH

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All Sectors/All Cities

offices; into the lower right corner there are mostly Amsterdam and Brussels offices. Although the relationship is not very clear, there seems to be a negative relationship between rent level and office space per worker as assumed in Hypothesis 4.

Two Tales: A Look at Rent Changes

In the previous section some empirical results were presented, giving some support for the various factors we identified in our earlier framework. But this tells only part of the story: the dynamics of how firms react to rent changes is touched upon only in a superficial way. The discussed relations might give the impression that there is no
stickiness either in an upward or in a downward direction. To examine the dynamics of office use is therefore very relevant, the more so because of the importance of some of the factors mentioned in section three in this market.

We are able to shed more light on the dynamics by using another set of questions from the survey. Firms in the four European cities were asked what their reaction would be if the rent went up 10%, 25% or even 100%. We summarize the responses in this section (see also Exhibit 7).

A firm confronted with (market) rent increases has four options: (a) the firm can relocate altogether; (b) it can relocate part of the business; (c) it can try to accomplish a higher degree of space efficiency; or (d) it can decide to do nothing and pay the extra rent. The survey brought to light a few remarkable facts.

First, an increase of 10% would seldom cause a reaction. Secondly, in all four cities, a 25% rent increase does not force most firms to take action. This is striking, because in some cases a raise like this involves a substantial rent increase in absolute terms, especially in the London market, where in 1992 the average survey rent of prime offices was 81 US$ per sq. ft. Ninety percent of the London firms and 80% of the Brussels and Amsterdam firms made clear they would (or could) not take any action. In Frankfurt this was only 52%. A large number of firms were considering relocation anyway, so a rental increase would be an appropriate occasion to do so. An increase of more than 25% will bring about a change in the sectoral and occupational structure of central office locations, caused by either relocations (Brussels and Amsterdam) or a relocation of a part of the company to back offices (London and Frankfurt). The general picture is that insurance companies and a part of the business services sector will move to less expensive locations, while banks, head offices of manufacturing companies and law firms will pay the higher rent.

A third outcome is that efficient use of space (and, for instance, renting less space in a building) is seldom seen as a way of reducing costs. Only in London would an increase up to 50% lead to more space efficiency. In the other markets, where the average floorspace per worker is much higher, this was not seen as a solution. We suspect that cultural and legal differences would explain this difference to a large extent: what is considered an acceptable working environment in one city might not be seen as such in another city. Legal aspects are also important. In Germany for instance, regulations are very strict about access to daylight.

Finally, the survey results seem to indicate that when a certain threshold in rents is reached in London and Frankfurt, many firms will choose to relocate part of their operations to a back office (45% and 25% by a 100% increase). In Brussels and Amsterdam, companies will opt to move all together to a cheaper location.

These results show that the space per worker does not easily adjust with rising costs. Practical problems, namely the difficulty in giving back or subletting part of the office space, in combination with using it more efficiently, cultural factors and the willingness (and capability) of some firms to pay for specific locations, make this variable a very sticky one.

Concluding Remarks

In this paper we developed a framework to analyze differences in office space use between firms and between metropolitan office markets. We believe that a better understanding of
Exhibit 7
Reaction to Notional Rent Increases*
(Survey Results for CBD Firms in London, Frankfurt, Brussels, and Amsterdam)

*Notional rent increases by ≤25%, 50% and 100%

<table>
<thead>
<tr>
<th>Reaction</th>
<th>Lon</th>
<th>Fra</th>
<th>Bru</th>
<th>Ams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Totally Relocate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partly Relocate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More Efficient Use</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
office space use can improve market forecasts and our knowledge about the dynamics of office markets in general. To set the scene, we suggested some hypotheses that follow from our own observations and the limited number of studies available on the subject.

We found a high space consumption in the group consisting of the manufacturing, transportation, communication, and utilities sectors. The business services and insurance sectors were characterized by a lower than average use of space per worker. Our data show a negative relation with rent level, but no clear relation with education level. Education is probably not a good proxy for type of occupation. Our hypothesis that firms must choose the amount of office space in such a way that the marginal productivity of office space is equal to its marginal costs is not denied, but the relation is strongly affected by a large number of market imperfections. The results of our survey also show that there is no smooth adjustment process in case of a increase in market rents on specific locations. Dissimilar market characteristics lead to different outcomes in the case of rental increases, but in the short and medium term, will not lead to dramatic changes in the amount of space per worker.

Further, more formal research on this topic aided by the availability of large micro data sets may provide more evidence for or against our hypotheses.

**Notes**

1In an interesting paper, Shilton and Webb (1991) use clustering techniques to identify cities with office employment growth.

2See for example Maisel (1989) for estimates of office space per worker in the U.S. for the period 1972–1988. This growth may have stabilized in the late 1980s. For the Netherlands Dewulf and De Jonge (1994) find an increase from an average of approximately 270 sq. ft (25 sq. m) in 1980 to 320 sq. ft (30 sq. m) in 1994. Shilton (1994) presents office space usage trends for a number of clustered American cities for the period 1980–1991 that indicate a growth in average floor space usage.

3For a discussion, see Corgel, Jaffe and Lie (1993).

4Following the seminal paper by Hanushek and Quigley (1978), and Venti and Wise (1984), a large number of paper have modelled housing markets with adjustment costs. For an overview, see Harmon and Potepan (1988).

5As indicated by an anonymous referee, there are also “cultural” differences between office markets. An example of this is the strong attachment to cellular offices in the German market, compared to a predominance of open-plan layouts in the British market. This obviously affects the level of space per worker.

6Manufacturing, Transportation, Communications, and Utilities. Governmental organisations are also included. The public sector owns most of the office space it occupies, with the important exception of Brussels, where a large number of governmental organisations rent space.

7The exchange rates at the time of the survey (1992) were as follows:

<table>
<thead>
<tr>
<th>Currency</th>
<th>Exchange Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>US$</td>
<td>32.3 Belgian Francs</td>
</tr>
<tr>
<td></td>
<td>1.76 Dutch Guilders</td>
</tr>
<tr>
<td></td>
<td>1.57 German Marks</td>
</tr>
<tr>
<td></td>
<td>0.65 British Pounds</td>
</tr>
</tbody>
</table>

8At that time the average prime rents were higher than the prime headline rents. The situation of “over-rented property” was caused by the fact that many long-term leases were signed in the boom years of the second half of the eighties, before the real estate market crash.

9In a related question in the survey, the firms were asked what their actions would be in case of an increase in the number of employees by 10%, 20% or 50% respectively. A (small) majority of firms would take no action in case of a 10% increase. Apparently, there is some excess capacity to absorb
an increase of this magnitude. An anonymous referee suggested that firms might rent more space than they need at the inception of the lease in order to stay within industry norms as they grow, in line with the argument we proposed in section four. An increase of 20% or more will lead in almost all cases to total or partial relocation. They survey did not address the question of what firms would do in the case of expected downsizing. We would expect however that problems in subletting will lead to a lower level of excess capacity at the inception of the lease, than in the case of expected growth.

References


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