An Empirical Analysis of Development Cycles in the Dublin Office Market 1976-2007*

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Abstract

Commercial property has taken centre-stage in recent debates about Ireland's banking system and the health of our economy. However, these debates have been hampered by a lack of empirical research on non-residential real estate. This article sheds light on one key segment of the commercial property sector – the Dublin office market. Using 32 years of annual data, a simple regression model is elaborated which explains office completions. This indicates that office starts react to two key demand signals – rental growth and lettings activity, with completions following after an 18 month construction lag. Reliance on these simple demand signals, combined with a lengthy construction lag, leads to periodic supply overshoots. In turn, this contributes to the boom-bust pattern that has characterised office building in Dublin over many years. We are now entering the 'bust' phase of this cycle. Office completions remained strong in 2008 but the Dublin market is now overbuilt. Our model predicts that output will fall by 48 per cent next year and by a further 14 per cent in 2010. All else equal this will deduct 0.5-0.6 per

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cent directly from GNP and will lead to the loss of approximately 7,500 construction jobs.

1. Introduction

The residential property market has provoked lively debate in all sections of Irish society. Reams have been written about house prices in the popular press and property has become the staple fare of dinner party conversation. Policy makers, consultants and academics have also engaged with this subject and numerous reports and scholarly papers have been produced. To a large extent these endeavours have been facilitated by the availability of official data on Ireland's housing market. Although these are far from perfect – for example we do not have complete information on the overhang of unsold properties – useful statistics are available on many aspects of the residential market.

Unfortunately, the same cannot be said for commercial property where a lack of data has impeded our analysis of market dynamics. This is problematic, because non-residential real estate represents a significant part of Ireland's economy that mainstream economics knows relatively little about. Commercial building, not including infrastructure, directly accounted for around 4 per cent of GNP in 2007.[1] However, if we factor in expenditure on the fit-out of new buildings, not to mention spending associated with construction wages, property management and legal services, the total contribution to our economy is significantly higher.

The objective of this article is to shed new light on one important segment of Ireland's commercial property sector – the Dublin office market.[2,3] Specifically, the paper aims to derive a statistical model which explains the quantum of new office space completed in any given year. It is hoped that this model will facilitate more accurate estimates of construction output in our macroeconomic forecasts. Moreover, by revealing the dynamics which underpin cycles in the Dublin market, the analysis in this article should help to inform the business decisions of office developers, investors and the institutions that fund them.

Section 2 of the article briefly describes the Dublin office market. *Inter alia,* it provides information on the existing stock of buildings, the historical flow of new completions, annual trends in take-up, rental growth rates and the geographical distribution of office space within the city. The second section discusses factors that might influence developers' decisions to construct new office space. This conceptual discussion underpins the

[1] Based on output estimates by DKM Economic Consultants, expressed as a percentage of GNP after adjustment for imported intermediate consumption.
[2] Data limitations mean that the spatial level of analysis for most previous studies has been the single metropolitan area (McDonald, 2002).
[3] To give some idea of this paper's coverage, figures from estate agents DTZ Sherry FitzGerald indicate that Dublin accounted for around three-quarters of the total office space in Dublin, Cork, Galway and Limerick at end-2007. Consistent with this, in their latest review of the construction industry, DKM Economic Consultants assume that Dublin represents 80 per cent of Ireland's total office market.

derivation of a simple regression model that aims to explain Dublin office completions. Details of this model, and the empirical data that are used to estimate it, are provided in Section 3. The estimated model is then presented in Section 4, and the results are used to forecast Dublin office completions for the 2008-2010 period. The broader implications of this analysis are discussed in Section 5, before a brief summary and conclusion.

2. A Brief Description of the Dublin Office Market[4]

Dublin offices fall into two broad categories. On one hand, there are traditional Georgian office buildings. These are mainly located in the Central Business District to the south of the river Liffey, encompassing the postal areas of Dublin 2 and 4. Georgian office stock is also present in Dublin 1 which lies just to the north of the Liffey. Most of Dublin's Georgian office buildings were constructed between 1750 and 1840.[5] They typically encompass a net lettable area of 230-560 square metres (sq. m) and consist of four storeys over basement. However, these converted dwellings now account for a small and declining fraction of the overall office market. Their restricted scale, fragmented layouts and inflexible structures make them less appealing to larger IT intensive occupiers and some have now been restored to residential use. The Georgian market is explicitly excluded from the analysis in this paper.

Instead, we focus on purpose-built 'Modern Offices' which have been constructed since 1960.[6] Within this heading, current industry convention is to classify the modern stock into "Second Generation" buildings (c. 1960-1990) and "Third Generation" premises (1990-date). The former characteristically have solid concrete floors, single glazing and conventional heating systems. The latter feature raised access flooring (to facilitate IT wiring etc.), air conditioning and double glazing. In addition, these more recent buildings have flexible floor plates which can accommodate alternative layouts and sub-divisions.[7]

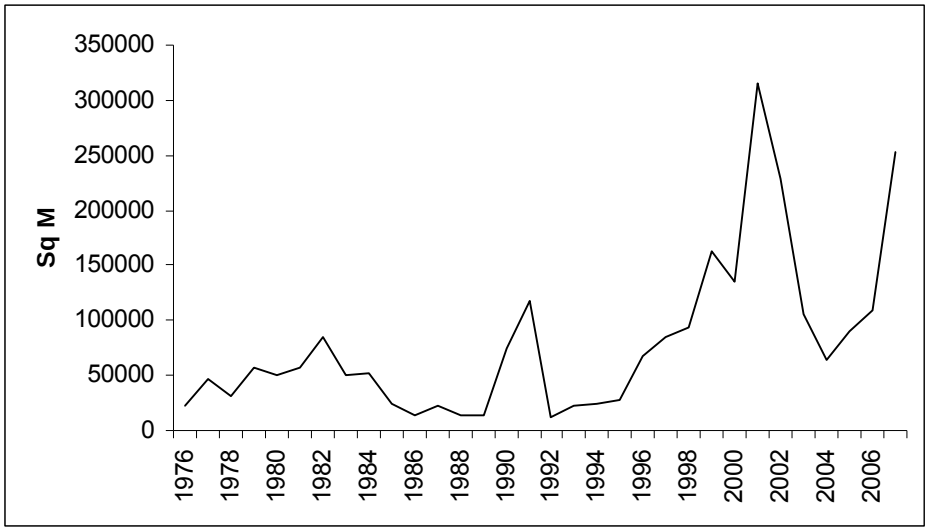
At end-June 2008, the total stock of modern office space in Dublin was estimated at 3,118,907 sq m. Perhaps underlining the extent of Ireland's economic growth in recent years, more than two-thirds of this space has been constructed since 1990 and can, therefore, be deemed to be "Third Generation".

Between 1976-2007 Dublin office completions averaged 79,125 sq m per annum. However, as the graph below demonstrates, office construction has been highly cyclical during this time, with four distinct peaks since

[4] Unless otherwise stated, the figures herein derive from an office market database maintained by chartered surveyors Lisney.
[5] Kealy *et al.* (2006) and O'Brien and Guinness (1994) provide detailed reviews of Dublin's Georgian architectural history.
[6] McDonald (1985) notes that prior to 1960 there was just one large modern office block in Dublin – Busáras on Store Street.
[7] An additional category of environmentally sustainable "Fourth Generation" offices is now beginning to emerge (see Lisney, 2007; Power, 2008). As yet, however, only a few examples of these buildings exist in the Dublin market.

1976.[8] This pattern closely follows international norms, with similar cycles having been observed in many other cities across the world (McDonald, 2002; Mueller, 1999). Over our study period, the first three peaks in Dublin office building occurred at approximately 10-year intervals, with completions spiking in 1982, 1991 and 2001. Again this closely mirrors the international experience. For example, Wheaton (1987) studied a number of American cities and found that the typical office market cycle lasted for 10-12 years. The Dublin market now appears to be approaching another peak. Just over 250,000 sq m of new office space was completed in 2007. This represented a rise of around 130 per cent on the previous year's new construction and was the second highest total ever recorded. Current forecasts indicate that at least as much new space will be completed in 2008.[9]

Figure 1: Dublin Office Completions, 1976-2007



In value terms, latest estimates indicate that offices accounted for one-quarter of commercial building output in 2007.[10] This puts the value of office building behind that of retail, but almost on a par with agriculture and tourism combined, and well ahead of industrial.

Table 1: Output Share of Commercial Building 2007

Commercial Sector	%
Retail	35.62
Agriculture/Tourism	27.28
Office	24.82
Industrial	12.28
Total	100

Source: Adapted from DKM Economic Consultants (2008).

[8] Malone's 1981 analysis of the Dublin office market indicates that the cyclical pattern of completions pre-dates this paper's study period. Distinct output peaks were evident in 1964 and again in 1972/1973.

[9] Lisney *Dublin Office Market Update*, July 2008.

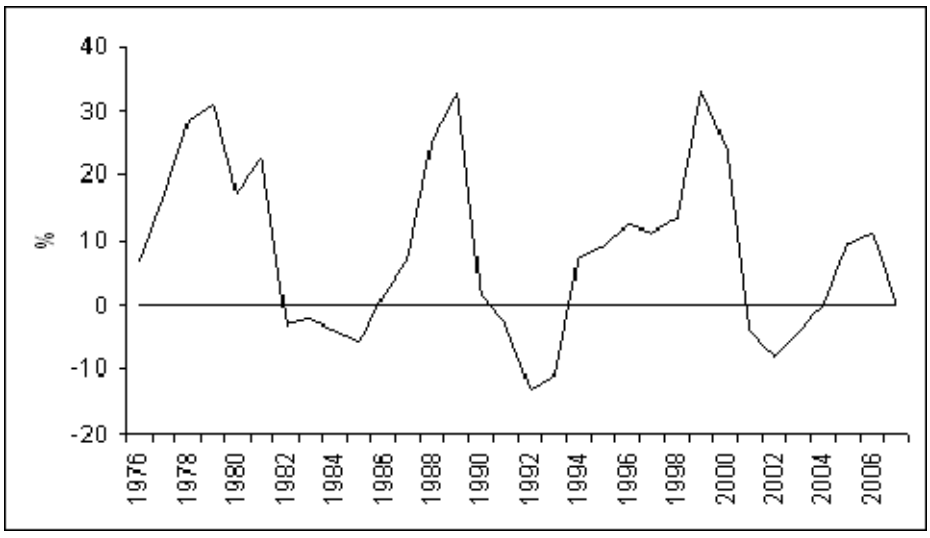
[10] Derived from DKM Economic Consultants (2008) *Review of the Construction Industry 2007 and Outlook 2008-2010*. Table A2.1.

Average take-up (i.e. office letting) during the 1976-2007 period was 97,135 sq m per annum. The fact that take-up exceeds completions should not be surprising because some proportion of new lettings will always involve occupiers relocating. Similar to completions, take-up exhibits a cyclical pattern with four peaks and troughs visible over the last 32 years.

During the 1970s and 1980s the main takers of Dublin office space were State bodies, the large indigenous banks and an assortment of professional practices. However, while these occupiers remain prominent, an expanding cohort of financial services firms has begun to account for an increasing share of the market, particularly since the development of the International Financial Services Centre (IFSC) in the late 1980s. Reflecting this, the share of Dublin office take-up accounted for by financial services companies increased from 6.5 per cent in 1999 to 45 per cent in 2007.

Unsurprisingly, given the peaky nature of completions and take-up, Dublin office rents have also exhibited a highly cyclical pattern. Between 1976-2007 there were four clear cycles in the market and, as illustrated in the graph below, the amplitude of these cycles has been substantial. Nominal rent growth reached a high of 33.3 per cent in 1999, but it also exceeded 30 per cent in the previous cyclical peaks of 1979 and 1989. In each case, however, these peaks were followed by periods of negative rental growth lasting for 3-4 years. The largest fall occurred in 1992 when rents declined by 13.2 per cent, but rental growth bottomed-out at –9.1 per cent on average over the last three troughs. Emphasising the extent of volatility within the rent cycle, the average peak-to-trough downswing in rental growth over the last three cycles has been 41.5 percentage points.

Figure 2: Annual Growth in Dublin Office Rents, 1976-2007



In terms of geographical distribution, the bulk of Dublin's modern office space is located in the city centre. However, as the capital has developed, substantial office building has also occurred in the suburbs. Currently, suburban locations account for 1,115,039 sq m, or 35.8 per cent, of Dublin's office stock. Within this, the South suburbs is the largest sub-

market, accounting for 18.0 per cent of all modern office space in Dublin. The North suburbs and West suburbs account for 10.2 per cent and 7.5 per cent of stock respectively.

3. A Conceptual Model of Office Development

To understand the dynamics of office building it is necessary to consider the issue of development risk. In theory, rational developers will only undertake a new office project when the expected value of the completed property exceeds the development costs. However, while this might sound straightforward in principle, neither the costs nor the value of an office development are easy to estimate in advance (Herring and Wachter, 1999). On the costs side, various factors can lead to unexpected outlays. For example, planning delays and construction hold-ups (perhaps due to unforeseen environmental or geological problems) can result in significant budget overruns (Gordon, 2003).

On the benefits side, the uncertainties may be even greater. As well as affecting costs, 'planning risk' can radically alter project returns. For example, if planning authorities refuse a proposed development or impose significant conditions, the value of the scheme can be dramatically reduced.

The value of new developments will also be affected by future demand for office space, which may be difficult to predict when a scheme is first being conceived. The capital value of a proposed building is usually calculated by discounting the expected stream of future rents to a present value (Harvey, 1981; Hendershott, 1996a). This calculation requires developers to make forecasts about several critical unknowns. Not only must they choose a discount rate (effectively an interest rate forecast), they must also estimate future office rents, which are clearly a function of market demand. In addition, because rental income only derives from space that is actually let, developers must also make some assessment about future rental voids, which will also reflect office demand (Herring and Wachter, 1999; McDonald, 2002).

It is reasonable to assume that, in the absence of definitive information on future conditions, developers will try to mitigate their risk by carefully monitoring current market conditions and seeking evidence of a demonstrable appetite for new office space before embarking upon projects (Gordon, 2003). Intuitively, then, one would expect office development to be a strongly demand-led activity (Harvey, 1981), and this appears to be supported by previous empirical work (see McDonald, 2002 and references therein). If this hypothesis is correct, then indicators of demand should help to explain office completions in the Dublin market.

INDICATORS OF OFFICE DEMAND

In their efforts to gauge market conditions, it is likely that developers and funding institutions will pay close attention to several key indicators. At the highest level, the requirement for office space should be positively correlated with overall economic growth. Therefore, we would expect developers to monitor economic conditions and undertake more office building projects in periods of strong growth.

Economic growth, however, is not the proximate cause of office demand. Rather, economic growth is associated with employment growth, which in turn creates a requirement for more office accommodation. Therefore labour market trends might provide developers with a more immediate signal of office demand. A priori, we would expect office construction to be positively associated with employment growth (Pollakowski, Wachter and Lynford, 1992).

Another indicator of market conditions might be recent lettings activity. Take-up is not a perfect proxy of demand because some proportion of each year's lettings represents a 'churn' of occupiers within the existing stock of space. In this sense, take-up does not measure the net additional requirement for new office space. But in itself, strong lettings can send a positive signal to developers. Where transactional activity is brisk and the market is fluid, developers and investors will have a better chance of securing occupiers for their buildings – even if this is at the expense of attracting tenants from other schemes.[11] Intuitively, therefore, we would expect office completions to be positively associated with take-up.

Although take-up contains valuable information for development stakeholders it is, as outlined above, an imperfect measure of net demand. For this reason, an additional variable – rental growth – might also be closely watched by developers and funding institutions. By capturing the interaction between lettings activity and the stock of available space, this indicator may give a more comprehensive picture of demand relative to supply.

The market signals listed above are likely to influence developers' decisions to initiate office-building projects. Consequently, they should be a good predictor of office *starts*. However, the aim of this paper is to explain variation in office *completions*. There are several reasons for this focus on completions rather than commencements. First, and most importantly, there are very limited data on office starts. From a practical perspective, this precludes the possibility of incorporating commencements as the dependent variable in our regression analysis. Second, the focus on completions is consistent with the methodology adopted in compiling our main macroeconomic statistics.[12]

Because office buildings take some considerable time to construct, the demand signals that contemporaneously influence starts can only be

[11] Indeed, this hypothesis is consistent with evidence from the London market which found that office rents are positively related to mobility within the market (Wheaton, Torto and Evans, 1997).

[12] The main source of official data on construction output is the Annual Review and Outlook for the construction industry, which DKM Economic Consultants produce on behalf of the Department of the Environment, Heritage and Local Government. Estimates of office output are based on completions, adjusted for construction lags. These estimates are incorporated, with adjustment, by the Central Statistics Office (CSO) into its gross fixed capital formation figures in the National Accounts.

expected to affect completions with a time lag. The time required to build-out an office scheme can vary depending on many factors, including the size of the building. However, industry experts suggest that, on average, major projects usually involve a construction phase of around 18 months (DKM Economic Consultants, 2008). Therefore, in formulating our model it is necessary to build in a time lag to reflect this. In practice, however, because the analysis is based on annual data, it is impossible to introduce a lag of precisely 18 months. Effectively, therefore, the choice is between one or two years. The decision between these options was determined on an empirical basis, as discussed in Section 4 below.

4. Developing a Statistical Model – Data and Variables

A simple linear model is elaborated below to explain Dublin office completions. This model is estimated using Ordinary Least Squares (OLS) regression, populated by 32 years of annual data (1976-2007 inclusive). This data set is smaller than would be ideal for a comprehensive econometric analysis. Indeed, data limitations are a recurring theme in the international literature, something which may derive from the fact that empirical research on commercial real estate markets invariably relies on data from private sources (McDonald, 2002). Some studies have attempted to address this problem by pooling data from multiple locations. For example, Pollakowski *et al.* (1992) analyse 10 years of annual data from 21 cities. However, although this approach provides additional observations for analysis, it does not alter the fact that office cycles typically have a 10-12 year frequency and ideally we should include more than one cycle in an analysis. Other studies have achieved larger samples by using bi-annual or quarterly data. However this approach may require the use of dummies to control for seasonality, and this could impose degrees-of-freedom constraints. Furthermore, unless a long run of quarterly data is available, the analysis may still be restricted to a single market cycle.[13] A reliable series of quarterly data is not available for the Dublin market over multiple office cycles. In this context, the 32-year annual dataset described below is acceptable for the simple analysis herein.

DEPENDENT VARIABLE

As outlined above, the dependent variable for our model is Dublin office completions. This is measured in square metres per annum. A gross measure (i.e. before same-year demolitions are netted out) is appropriate as our objective is to explain new building activity rather than stock movements. The data come from Lisney which updates an inventory of finished Dublin office buildings every three months.[14] Lisney defines a building as completed when it has been certified as 'practically complete' by the architect.

[13] For example, Fuerst (2006) uses 11 years of quarterly data.
[14] Therefore, the completions data used in this analysis are backed-up with an itemised list of identifiable buildings completed in each period.

INDEPENDENT VARIABLES

In specifying the right-hand-side of the equation, the aim is to derive a parsimonious model that explains as much of the variation in Dublin office completions as possible using the minimum number of independent variables necessary.

Given our hypothesis that office building is demand-led, a logical point of departure is to introduce variables which might signal to developers that there is a market requirement for more office space. Therefore, rental growth, which contains information on office demand relative to the stock of available space, was included in the model as an explanatory variable.[15] Rental growth is operationalised as the annual percentage change in the nominal rent for a square metre of modern Dublin office space. The data used derive from the *Lisney Rental Indices* which have been published since 1970.[16] Rents in this series are defined as the 'bald' headline rent on new leases, without adjustment for rent-free periods and other incentives.[17]

As discussed above, while rental growth is likely to influence building starts in real time, the dependent variable in this analysis is completions. The effect of rents on completions is likely to occur with some delay due to the time elapsed between commencing and finishing an office building. Given estimates of an 18-month construction phase, it was unclear a priori whether rental growth should be regressed against completions with a one or two-year lag adjustment term. Therefore a two-staged process was employed to shed light on this matter. First, line graphs of rental growth in periods t-1 and t-2 were overlaid on a plot showing growth in office completions. This simple visual test suggested that completions tended to follow trends in rental growth with a two-year lag. This was corroborated with an examination of the correlation matrix – whereas rental growth in t-1 had a zero-order correlation of 0.23 with the dependent variable, rental growth in t-2 exhibited a much stronger relationship of 0.50. Consequently, rental growth in period t-2 was entered into the right-hand-side of our equation.

Take-up is another variable which may potentially influence office development. Although it is an imperfect proxy of the net additional demand for office space, take-up does provide developers and funding institutions with key information on transactional activity. This, in itself, is likely to influence construction decisions. When letting activity is brisk,

[15] Some measure of rents has been included as an explanatory variable in virtually all previous econometric models of metropolitan office supply (Hendershott *et al.* 1999, McDonald, 2002; Pollakowski *et al.,* 1992; Wheaton *et al.,* 1997; McGough and Tsolacos, 1999).

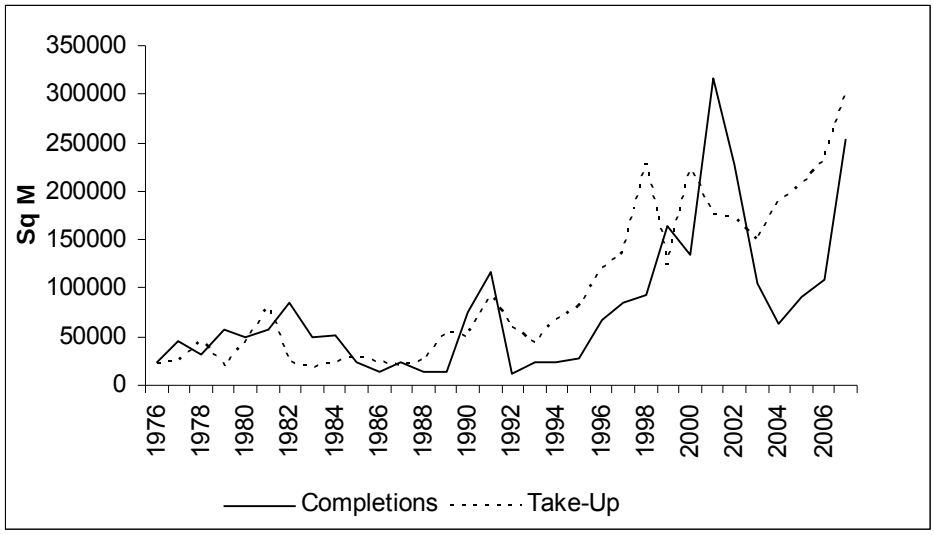
[16] The Lisney Rental Indices are a weighted average of rental movements in 12 office locations across Dublin. A full methodological description of these indices is available in *Lisney Rental Indices* (March 2007).

[17] In theory, net effective rents, which adjust for factors such as rent-free periods, capital contributions to fit-out costs etc. may be a more precise indicator of market conditions (McDonald, 2002). In practice, however, these are notoriously difficult to measure due to complex lease variations and the confidential nature of the information required to make accurate adjustments.

developers will perceive that there are greater opportunities to find tenants for a new building – either by attracting new occupiers or by 'poaching' tenants from existing buildings. For this reason, a take-up measure was also introduced to our explanatory model.

As with rental growth, the take-up variable in our equation is operationalised using Lisney data.[18] It is measured gross (i.e. no adjustment for space vacated in relocations), in square metres, and refers to leases actually signed in any given year.[19] As per our discussion of the rental growth variable above, take-up is expected to influence completions with a lag. Again, however, it is unclear whether the appropriate lag period should be one or two years. As before, a two-staged process was employed to determine this matter. In the first step, a line graph of take-up was superimposed on a graph of completions. Figure 3 indicates that, in this case, the lagged effect was closer to one year than two. This was confirmed in step two. The correlation matrix showed that the relationship between completions and take-up in period t-1 (0.76) was stronger than in period t-2 (0.63). Therefore, take–up was included in our equation with just a one-year lag.

Figure 3: Take-up and Office Completions – A One Year Lag



It is interesting to consider why rental growth appears to take longer to influence developer behaviour than take-up. One possibility is that there is an information asymmetry between take-up and rents. Developers and investors have a strong incentive to publicise new lettings because this creates a favourable impression of their buildings and can help to attract additional occupiers. In practice, therefore, lettings tend to be quickly reported in the national press and can be brought to bear in developers' construction decisions almost immediately. However, the incentive to publicise rental information may be much weaker, particularly if rents have been heavily discounted. As a result, it has been suggested that rental

[18] Published in Lisney *Annual Review* various years (1974-2007).

[19] Lisney tracks take-up by updating a list of office leases signed in each quarter. As with completions, this means that the data are backed-up by an itemised list of lettings.

information may leak more slowly into the market, causing a delayed effect on completions. While this is an interesting theory, it is not entirely convincing for two reasons. First, contrary to the suggestion that rental information is slow to surface, indicative rental indices for the Dublin office market are available with relatively short reporting lags from various sources, including Investment Property Databank Ltd. (IPD), Lisney and Jones Lang LaSalle. Second, even if it were true that rental information seeps out slowly, this would only explain the delay between actual rental movements and movements in measured rent. The adjustment term in our model refers to a different lag – the delay between measured rental growth and a supply reaction.

In light of this, a more cogent – albeit speculative – explanation is that developers are not just interested in whether rents are growing in the year that starts are initiated. They may also be interested in how quickly rents are growing in that year (t-1) relative to rental growth rates in the previous year (t-2). This second-derivative measure may be important to developers because it can help them to identify what stage the rental market is at on its long-term cycle. To illustrate, office rents can grow at an annual rate of 5 per cent twice in the cycle – once on the way up and once on the way down. But on the upswing, the 5 per cent growth will be preceded by weaker growth the year before, whereas on the downswing the previous year would have seen stronger growth. Clearly, developers might be more confident to initiate building works when the market is improving (i.e. rental growth accelerating between t-2 and t-1) than when it is in decline.

Contrary to a priori expectations, no specification of either GNP or GDP growth was significant in our regression model.[20] The most likely reason for this is multicollinearity – i.e. the relationship between overall economic growth and office completions is intermediated by factors already included among our explanatory variables. Two factors seem to support this diagnosis. First, while real GNP and GDP growth are both significant when regressed against completions without any other independent variables,[21] their effects evaporate when rent growth and take-up are also included in the model. Second, although both GNP and GDP are correlated with office completions, they are also correlated with the other explanatory variables in our model, particularly in two-year lagged form.

Intuitively, one would expect employment growth to create a demand for more office space, which in turn should encourage development. However, employment had little effect in our model. A similar finding was discovered by McGough and Tsolacos (1999) in the UK and one possible explanation is that the 'space occupied per employee ratio' may not be a constant. For example, trends towards more open plan office accommodation or efforts by firms to utilise their office space more

[20] GNP and GDP variables were introduced to the model in lags from 0-2 years. T-statistics on the relevant coefficients ranged from 0.23 to 1.45.
[21] T-statistics in two-year lagged specifications were 4.73 and 4.98 for GNP and GDP respectively.

intensively in the face of stronger economic activity could weaken the relationship between employment growth and office demand (D'Arcy *et al,*. 1999). Similarly, a change in the occupational mix – e.g. a growing cohort of managers who tend to be assigned more office space than clerical workers – may have a similar effect (Wheaton, Torto and Evans, 1997). However, as with economic growth, the insignificance of employment as a predictor of completions could also be due to collinearity in the right-hand-side variables. Although employment was strongly correlated with office completions (r = 0.59-0.64 depending on lag specification), it was also very closely associated with take-up (r = 0.87-0.91).

A final reason for the insignificance of employment could be the specification of the variables tested in our model. Neither total employment numbers (measured on a Principal Economic Status basis) nor the annual change in overall employment yielded significant results. However, the relationship between these measures and office building may be diluted by the fact that a great deal of jobs creation has occurred outside of office-based sectors. For example, just 25 per cent of overall employment growth in the last eleven years has occurred in the office-intensive sectors of 'Financial and Other Business Services' and 'Public Administration and Defence'. A further problem arises from the fact that much of the jobs growth outside these sectors has occurred in the building industry itself. Latest figures show that 21 per cent of overall employment growth since the commencement of the *Quarterly National Household Survey* in 1997 has been in construction. As many of the workers that make up this statistic have been engaged in office building, endogeniety may be an issue (i.e. there may be bilateral causality between overall employment growth and office output). Endogeniety can lead to biased and inconsistent OLS estimators and it is possible that this affected our estimated employment coefficient. An obvious solution to these specification problems is to obtain a data series which isolates office-based employment (see Rankin and White, 2008; Wheaton, Torto and Evans, 1997). However, this is not a straightforward exercise. Over the last 32 years there have been changes to both the survey instrument for collecting official employment data and to the sectoral classifications for identifying 'office-based' employment. Therefore, although it may be possible to develop an acceptable series for office based employment, this task is flagged for further research. In the meantime, no employment measure was included in our final model.

In a review of the international literature, McDonald (2002) found that elasticity of supply estimates for metropolitan office markets cluster in the 2.0-4.0 range. One interpretation is that, in the past, factors such as the cost and availability of credit do not appear to have acted as a major constraint on office building. It is not entirely surprising, then, that neither nominal nor real interest rates had any significant effect on our regression results, and this is consistent with the findings of previous research in the UK.[22] Consequently, interest rates were excluded from our estimated model. This notwithstanding, however, it is now becoming clear that the crisis in

[22] See McGough and Tsolacos (1999) and Wheaton, Torto and Evans (1997).

financial markets could fundamentally alter lending practices and credit conditions in the future. Therefore, it may be necessary to incorporate this affect into our model going forward.

Bearing all of these discussions in mind, the final variables included in our model are summarised in Table 2 below.

Table 2: Variable Definitions and Summary Statistics

Variable	Variable Type	Description	Mean	S.D.
Completions	Dependent	Sq M of office space 'practically completed', year t.	79,125	72,759
Rental Growth	Independent	Percentage change in nominal office rents, year t-2.	8.73	13.29
Take-Up	Independent	Sq M of office space for which leases were signed, year t-1.	88,977	72,246

5. Regression Results

The model outlined above was estimated using OLS and the results of this exercise are presented in Table 3 below. Despite the fact that the analysis is restricted to 32 annual observations, the model provides a good fit. Looking first at statistics for the full equation, the R^2 is 0.82. This indicates that 82 per cent of all the variation in Dublin office completions since 1976 is explained by our model. This level of explanatory power is encouraging considering that just two independent variables are included in the analysis, and the regression R^2 compares well with those reported in the international literature.[23] A Durbin-Watson statistic of 1.37 indicates no correlation in the error terms at 1 per cent.[24]

Table 3: OLS Model of Dublin Office Completions

Dependent Variable: Completions (Sq M per annum)

Regression Statistics	
R^2	0.82
$\bar{R}^2$	0.80
F	64.89*
D.W.	1.37

Independent Variable	Description	Coefficient	T-Statistic (Absolute)
Constant		-11,159.70	1.14
Rent Growth	Δ% Y/Y	2,323.17*	5.34
Take-Up	Sq M Let	0.79*	9.84

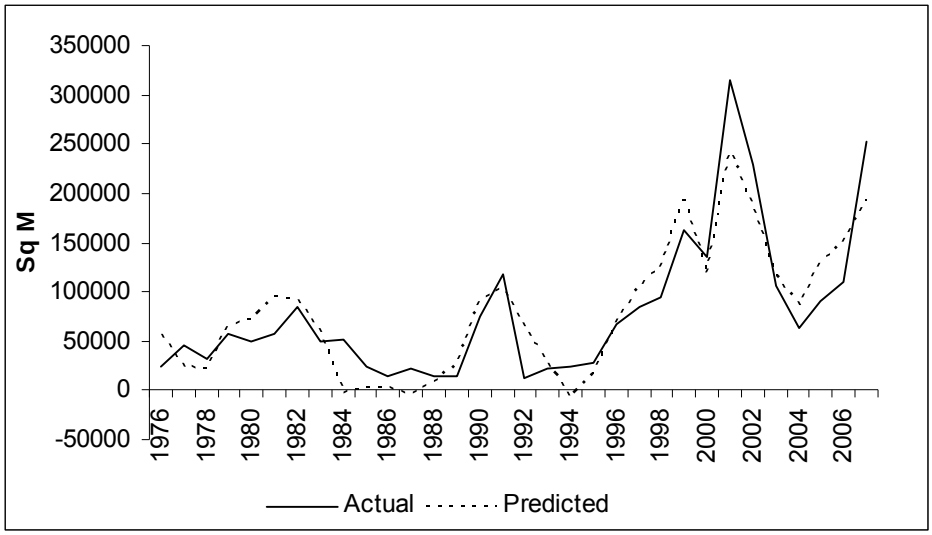
N = 32. * Significant at 1 per cent.

[23] R^2 values on previous office supply equations range from 0.19 (Rosen, 1984 – San Francisco) to 0.88 (Wheaton, Torto and Evans, 1997 – London). Pollakowski *et al.* (1992) estimate supply equations for 21 US cities with R^2 statistics of 0.49-0.69. Fuerst's (2006) equation for Manhattan yielded an R^2 of 0.60. Hendershott *et al.* (1999) estimate completions equations for London with adjusted R^2s of 0.50-0.82.

[24] A lagged-dependent version of the model was also tested. The results were similar to those reported above and the lagged dependent coefficient was not significant.

The graph below compares actual office completions in the 1976-2007 period against those predicted by the model. Not only does this picture confirm the explanatory power of the model, it also demonstrates that the model is very good at 'calling' turning-points in the building cycle. Over a 32-year period, the model has predicted three of the four construction peaks to the exact year. In the fourth case, it was just out, predicting a marginally higher completions rate in 1981 than in 1982 when completions actually peaked. This ability to identify peaks and troughs in the cycle is impressive, particularly considering the context – the Dublin market is small in absolute terms and completions in any given year can, therefore, be sensitive to one or two large individual projects (D'Arcy *et al.,* 1999).

Figure 4: Actual vs Predicted Office Completions, 1976-2007



Looking at the individual variables, lagged rental growth and lagged take-up have positive signs as expected, meaning that both are positively associated with higher office completions. In addition, both variables are significant at the 1 per cent level. This indicates that there is less than a one per cent probability that coefficients of the magnitude reported could occur if the underlying relationship with office completions was zero. This evidence appears to support the overarching hypothesis that developers' construction decisions are driven by signals of market demand.

The finding that lagged rents are positively associated with office development is consistent with empirical evidence from other metropolitan markets (see Fuerst 2006, Hendershott *et al.,* 1999). A simple interpretation is that strong rental growth in previous periods is taken as an indication that office space is scarce relative to demand.[25] This appears to give developers confidence that, if they construct new office buildings, occupiers can be found for the finished product. A closely related but more

[25] Some previous models have used vacancy rates as an alternative measure of the demand/supply balance (Rosen, 1984; Wheaton, Torto and Evans, 1997). However, consistent data on vacancy rates in Dublin are only available back to 1987. In trial regressions over this truncated period the vacancy rate was not significant in lags from 0-2 years (t-statistics = 0.37-1.33).

formal interpretation is that strong rental growth raises the present value of new buildings above construction costs, thereby making office development viable.

Interpretation of the take-up coefficient is similar in principle. To the extent that some portion of take-up derives from occupiers shifting around within the existing office stock, this is an imperfect measure of the requirement for additional space. However, it is an accurate measure of transactional activity, and when take-up is strong developers are likely to see greater opportunities to lease their buildings – either to relocating occupiers or to new entrants to the Dublin market. In this sense, even in a market that is not growing, strong take-up gives developers the chance to achieve lettings by attracting occupiers from other buildings.

FORECASTS FOR DUBLIN OFFICE COMPLETIONS 2008-2010

It is useful to apply our estimated equation to the task of forecasting office output in the years ahead. For 2008, the following values were substituted into the model;

- 2006 rental growth (i.e. rental growth t-2) = 11.34 per cent
- 2007 take-up (i.e. take-up t-1) = 299,009 sq m

This gave us the following equation;

2008 Completions = -11,159.70 + 2,323.17 (11.34) + 0.79 (299,009)

Solving for this equation yields a 2008 completions forecast of 251,402 sq m. If correct, this would mean that office output in 2008 would be on a par with 2007 which had the second highest level of completions ever recorded in the Dublin market. It should be noted, however, that this forecast understates Lisney's estimate that a total of 361,071 sq m will be completed in 2008.[26] The latter is based on actual completions in quarters one and two, plus works already underway at end-June 2008 that are scheduled for completion before year-end.

The forecasting process for 2009 is slightly complicated because take-up in t-1 (i.e. in 2008) is currently unknown. Therefore, office agents/researchers in Dublin's larger real estate companies were canvassed for a 2008 take-up estimate.[27] Their predictions were averaged to give an expected take-up of approximately 180,000 sq m. This number was then substituted into the model, along with the known figure of 0 per cent rental growth in 2007.

2009 Completions = -11,159.70 + 2,323.17 (0) + 0.79 (180,000)

[26] Lisney, *Dublin Office Market Update*, July 2008.

[27] A telephone poll was conduced in mid-June 2008. Five firms responded with a definitive figure; Savills HOK, DTZ Sherry FitzGerald, CBRE, Lisney and Bannon Property Consultants. The precise average of their forecasts was 179,032 sq m.

This exercise predicts office completions of 131,040 sq m in 2009, which would represent a 48 per cent downturn in office building over the next twelve months. While this estimate may appear quite extreme, it is entirely in line with past experience – the average fall-off in office completions in the years immediately following previous construction peaks (1983, 1992 and 2002) was 53 per cent.

Generating a 2010 forecast is less straightforward because it requires assumptions about both input variables – rental growth in t-2 (i.e. 2008) and take-up in t-1 (i.e. 2009). However, using realistic figures based on practitioner estimates and an analysis of previous market cycles, the model suggests that 2010 completions will be in the 100,000–125,000 sq m range. However, this early forecast should be taken as tentative, particularly in light of uncertainties around the deepening financial crisis and its affect on funding.

Overall, then, our regression analysis shows that office completions are a function of two simple factors – lagged rental growth and lagged take-up. Based on known and expected values for these variables, our model predicts that Dublin office completions will be at or near a cyclical peak in 2008, before dropping sharply in 2009 and 2010.

6. Discussion

Two key findings have emerged from the above analysis. First, it seems that office building in Dublin is strongly demand-led. The regression equation elaborated above supports the hypothesis that supply follows demand with a time lag. A second finding is that the Dublin office market is highly cyclical. Certainly this is the case for completions, with four output peaks clearly visible over the last three decades. But strong cyclicality is also evident in many of the other key variables e.g. rental growth, vacancy rates, occupancy and take-up.

Given these findings, one key question remains – What, if any, relationship is there between the demand-driven nature of Dublin office building and the cyclical pattern that appears to characterise the market over time? In answering this question, the international literature may provide assistance. As discussed above, Dublin is far from unique in having a strongly cyclical office market. Indeed, so common are commercial real estate cycles that numerous models have been developed to explain them.[28] One simple model, proposed by Mueller (1999), provides a useful framework for analysing the dynamics behind cycles in the Dublin market.

A SIMPLE DESCRIPTIVE MODEL OF OFFICE MARKET CYCLES

Mueller's model focuses on occupancy variations in real estate cycles.[29] Based on observed trends in 54 US markets over a 30-year time frame, it identifies four classic stages within the typical cycle:

[28] Phyrr, Roulac and Born (1999) review eight models of real estate cycles.
[29] Occupancy is the percentage of total office stock currently occupied. It is simply the vacancy rate subtracted from one hundred.

Stage 1 – Recovery

Beginning at the trough of the cycle, occupancy rates are well below their long-term average. Vacant space is abundant due to overbuilding towards the end of the previous cycle. This glut of surplus accommodation leads to negative rental growth which discourages new construction.

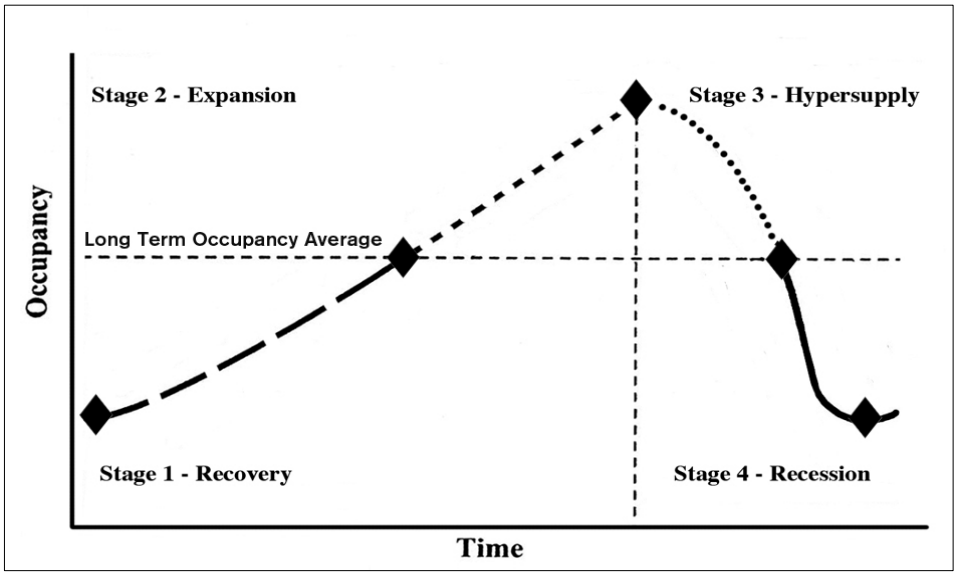
Stage 2 – Expansion

As time passes, natural economic growth helps to digest the overhang of surplus office space on the market. Occupancy rates slowly recover to their long-term average and, as availability becomes tighter, rents stop falling before stabilising and beginning to rise. Eventually, they exceed the point where new office development becomes viable. Office starts begin to occur, but due to long construction lead times, the new space is not immediately available to the market. As a result, rental growth continues to accelerate, peaking towards the end of this phase.

Stage 3 – "Hyper Supply"

Occupancy rates are above their long-term average and rental growth remains very strong, particularly in the early part of this phase. This attracts the attention of more developers and the number of new starts increases. As this phase continues, however, buildings that were commenced during the previous (expansion) stage now begin to find their way onto the market. Eventually, this growth in supply causes occupancy levels to ease back towards their average. As a result, rental growth also begins to cool-off. Belatedly, developers realise that the balance of the market has tipped towards oversupply and commitments to new construction slow or stop. However, projects already commenced in this phase are past the point of no return and will be built-out.[30]

Figure 5: Mueller's Four Stages of the Office Market Cycle



[30] Grenadier (1995) notes that the inability to reverse construction start decisions is a factor in over supply.

Stage 4 – Recession

Completions of new office buildings that were started during the hyper supply stage now come to the market, compounding the oversupply that started to emerge towards the latter part of stage three. Occupancy rates are driven below their long-term average and rental growth turns negative. New office construction remains subdued.

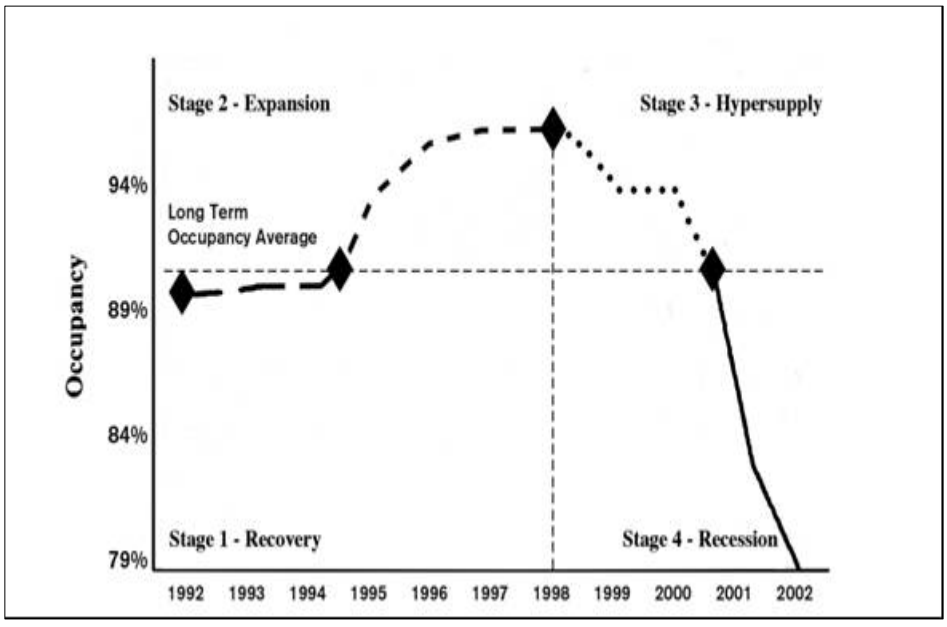
Having looked at Mueller's theoretical model, it is useful to apply this schematic to actual events in Dublin over the last office market cycle. This cycle lasted approximately a decade and spanned the years 1992-2002, trough-to-trough.

Dublin Market 1992-1995 – Recovery Stage

In 1992 the market was at its cyclical trough with occupancy levels down at 89.8 per cent. Because there was an abundance of un-let space, rents fell by 13.2 per cent that year. Reflecting this, developers were not attracted into the market, and very little construction took place (completions fell from 117,052 sq m in 1991 to around 23,000 sq m in 1993 and 1994 – an 80 per cent decline).

During this phase, however, the Irish economy performed well, with GDP growth averaging 5.3 per cent per annum in real terms. This generated a natural increase in the demand for office accommodation and take-up rose accordingly. As a result, the surplus of vacant space was gradually absorbed. Occupancy rates returned to their long-term average by 1995, while rents stopped falling and began to recover.

Figure 6: Dublin Office Market Cycle 1992-2002



Dublin Market 1995-1998 – Expansion Stage

Occupancy rates continued to climb during this period as a sustained increase in take-up consumed much of the surplus space that had been

available during the recovery phase. Rental growth, which had resumed in 1994, began to accelerate. This, combined with strong lettings activity, attracted some developers back into office building. From our earlier analysis we would expect this to have led to higher completions after a lag. In practice, this is exactly what happened – Dublin office completions rose by 140 per cent in 1996. Initially, however, construction lags meant that available space remained quite tight in this period. This led to continued rental growth, which averaged 11.5 per cent per annum between 1995-1998. In turn, this encouraged further development with commencements continuing to rise strongly.

Dublin Market 1998-2001 – Hyper Supply Stage

Occupancy and take-up reached their highest point in 1998 with rental growth peaking one year later at 33.3 per cent. Around that time, new completions (reflecting strong starts in the latter part of Stage 2) caught up with, and then overtook, demand. Inevitably this led to the beginnings of a rental slowdown. At first, however, this may not have been obvious to developers; even though rental growth slowed in 2000, it remained almost three times higher than the long-term average at 24 per cent. As a result, new office starts continued to occur, eventually leading to an all-time completions record of 315,455 sq m in 2001.

Dublin Market 2001-2002 – Recession Stage

By 2001 the Dublin market was showing clear signs of overbuilding. Partly, this was because some developers failed to recognise that strong rental growth in the previous period was only temporary – i.e. reflecting a short-lived scarcity of space pending the completion of office buildings that had already been commenced.[31] However, this problem was compounded by an abrupt softening of office demand due to three separate shocks that hit the economy in quick succession – the bursting of the dot.com bubble, the outbreak of foot and mouth disease and the September 11th 2001 attacks. These shocks meant that the high take-up levels which prompted strong office starts back in 2000 had evaporated by the time the buildings were completed. Occupancy fell to 84 per cent, while rental growth swung from +24.3 per cent in 2000 to -3.5 per cent in 2001. Paradoxically, despite this clear evidence of over supply, completions remained very strong in 2002. With the benefit of our regression model we can say that this occurred because office starts, which had been initiated on foot of strong demand signals in the latter half of 2000, continued to come on-stream as completions. This amplified the crisis with both rents and occupancy falling further in 2002.

The above example is not unique – similar patterns have been observed in many other countries and, indeed, in previous cycles of the Dublin market. However, it does help us to understand how the demand driven nature of office development contributes to market cyclicality. The up-front costs associated with office development are enormous. Consequently, developers want to be sure that there is a strong market for

[31] See Herring and Wachter (1999) for a more general discussion of this dynamic.

new office space before they commit major resources to a scheme. However, in the context of a significant construction lag, the two key indicators that they rely on to gauge market demand are imperfect. On one hand, the rental growth indicator can give misleading signals if it is viewed in isolation. Instead, this indicator needs to be assessed in conjunction with the amount of space-under-construction. To illustrate the importance of this, consider two examples from our recent past. Rental growth was elevated in both 1999 and 2006. But the amount of office space already under construction was also abnormally high in those years. In this context it should have been predictable that rents were likely to soften when the schemes under construction were finished and delivered to market. However, failure to adequately account for this contributed to significant overbuilding in 2001 and again in 2007-2008.

If rental growth is not, on its own, a perfect market signal, the limitations of take-up are even more obvious. While strong lettings may provide an accurate guide to the strength of the market when projects are commenced, an 18 month construction lag means that conditions can have changed dramatically by the time these schemes are completed. This factor also contributed to overshooting supply following the 2001 slowdown, and a similar oversupply is now emerging as the 'credit crunch' begins to undermine office demand.

POLICY IMPLICATIONS

As was witnessed in America during the 1980s, and as we are now beginning to see in Ireland, over development at the peak of office cycles can have a strongly adverse impact on the finances of developers, investors and lenders – not to mention national economies (see Herring and Wachter, 1999; Howarth and Malizia 1998; McDonald 2002; Phyrr, Roulac and Born, 1999). In light of this, and given the discussion above, it is natural to ask whether anything can be done to smooth out cyclical peaks and troughs.

Clearly, developers can do little to prevent the economic shocks that sometimes lead to a sudden collapse in office demand between the commencement and completion of schemes. These events are inherently unpredictable and they are often global rather than domestic in origin. Nonetheless, several factors might minimise the extent to which these shocks result in an overhang of unwanted office space. A number of authors e.g. Grenadier (1995) and Wheaton (1999) have found that longer construction lags increase the probability of overbuilding. This makes perfect sense, since lengthy gaps between commencement and completion contribute to supply bottlenecks which can cause temporary, and potentially misleading, rental spikes. At the same time, longer construction lags leave more opportunity for demand shocks to occur. In this context, modern methods of construction (MMCs) and other innovations (e.g. administrative streamlining) which shorten the gestation of major office projects may help to reduce overbuilding at the peak of market cycles.

In addition, reducing the proportion of speculative construction should lessen the extent to which demand shocks result in large surpluses of empty

office space following construction peaks. In practice, however, achieving this might be easier said than done. It has traditionally been difficult for developers to pre-let office space in Dublin.[32] This probably derives from the small size profile of the typical Dublin office occupier. Larger tenants may be prepared to enter pre-letting arrangements because their accommodation requirements are difficult to satisfy from the stock of space that is available 'off-the-shelf'. However, these big occupiers only form a small part of the Dublin market. For example, between 2002-2007, deals of 5,000 sq m or more averaged only 3.7 per cent of annual transactions, and just 30 per cent of the total space let across Dublin each year. Instead, the bulk of activity involves small and medium sized occupiers who are much less willing to enter into pre-letting arrangements. There are several reasons for this. First, because the Dublin market traditionally provides ample opportunities to let finished office suites in the 500-2,000 sq m range, their accommodation requirements can usually be met from the frictional stock of office space available at any given time. For this reason, smaller occupiers have less incentive to pre-let. Second, smaller organisations do not have the same financial strength as State bodies and big global corporates. This may make them less willing to pre-commit to long-term leases, particularly in times of economic turbulence when their hiring plans are uncertain. Third, some smaller enterprises may see their size and flexibility as a strategic advantage which they are unwilling to relinquish by entering into leasing pre-commitments.

In addition to reducing construction lags and speculative building, a third recommendation might be for development stakeholders to take greater cognisance of space already under construction when appraising proposals for new office schemes. Our regression model suggests that developers rely heavily on rental growth when deciding whether or not to build. But rental growth can be temporarily elevated pending the completion of buildings that are already under construction. Therefore, to get the complete picture it is essential to supplement a rental market analysis with research on the amount of space in progress. A corollary of this is that real estate firms should continue to develop their supply-side data and provide the market with detailed and timely information on this critical factor (see D'Arcy *et al.*, 1999).

Even with these efforts, however, natural economic cycles and the inevitability of construction lags mean that some element of cyclicality in office building probably cannot be avoided. Therefore, a final suggestion is that development practitioners simply ensure that they take cognisance of market cycles when evaluating new office schemes (Phyrr, Roulac and Born, 1999). In itself, this may discourage behaviour which amplifies market peaks and troughs. For example, several authors emphasise the mean-reverting nature of office rents and argue that factoring this into discounted cash flow analyses can help to avoid excessive construction

[32] To illustrate the scale of the challenge, consider that, at end-June 2008, substantially less than 20 per cent of the 428,471 sq m total office space under construction in Dublin was reserved (Lisney *Dublin Office Market Update*, July 2008).

peaks based on over optimistic valuations during the good times.[33] Other authors, e.g. Carn *et al.* (1988) take an even more pragmatic view. They argue that natural cycles in the office market make the timing of development extremely important. Understanding these cycles will help developers, funding institutions and investors to identify 'development windows'. Not only might this improve the profitability of individual projects, it should also dampen the amplitude of office cycles themselves.

7. Conclusions

Econometric analysis of commercial real estate markets is a relatively new discipline which really only emerged in the 1990s. This was largely driven by a desire to better understand the boom-bust cycles which led to heavy losses for lenders, developers and investors in US office property during the 1980s (Howarth and Malizia, 1998; McDonald, 2002). In Ireland, the econometric approach is rare, and an office supply model has never previously been estimated.[34] However, given strong evidence that the Dublin office market is now overbuilt, considering persistent speculation about the role of commercial property lending in the Irish banking crisis, and in view of the fact that construction employment is already in sharp decline, this paper is timely. For sure, it does not address all the gaps in our knowledge of Irish commercial property markets. For one thing, its scope is quite narrowly focused. Furthermore, data constraints restrict us to a very simple analysis. But despite these limitations, this article adds value to our understanding of the Dublin office market by confirming two key conclusions. First, simple demand signals such as rental growth and take-up are the trigger for office starts, which then materialise as completions approximately 18 months later. Second, and partly because of this demand-driven behaviour, the Dublin office market is highly cyclical.

It is hoped that, by modelling these dynamics, this article will be of practical assistance in two ways. First, it should make it easier for our macroeconomic analysts to accurately forecast the office building component of gross fixed capital formation. The analysis herein shows that Dublin's office market is now entering the recession phase of its cycle. Over-building has driven occupancy rates well below their long-term average and, as a result, headline rents are falling. Consequently, although office completions remained strong through 2008, the flow of new starts has now dried up.[35] Inevitably, this means that completions will fall sharply over the next two years. The model presented above indicates that office output will fall by 48 per cent in 2009, followed by a further 14 per cent drop in 2010. Although severe, it should be noted that these estimates are consistent with the scale of retrenchment experienced following previous peaks in the office building cycle. In economic terms, a slowdown of this

[33] See Hendershott (1996a) who analysed the Sydney office market in the 1980s and 1990s. Also see Mueller (1999) whose conclusions were based on US data. A more general assertion of this point can be read in Herring and Wachter (1999). It is, however, unclear how factors such as upward-only rent review and infrequent break-clauses (as often found in Dublin office leases) might affect this conclusion.

[34] D'Arcy *et al.* (1999) do, however, estimate a rent adjustment equation for the Dublin office market using data from an earlier 1970-1997 period.

[35] See DTZ Sherry FitzGerald *Dublin Office Market Autumn Review* (2008).

magnitude will directly deduct between 0.5 per cent and 0.6 per cent from nominal GNP by 2010[36] and will cost the economy approximately 7,500 construction jobs.[37]

This article may also add value in a second way. By exposing the underlying reasons behind market cyclicality it should contribute to the knowledge-base of Ireland's commercial property stakeholders. Specifically, it is hoped that the perspectives outlined above may provide developers and funding institutions with additional information which can be applied to the appraisal and scheduling of proposed office schemes.

[36] *Ceteris paribus,* compared to forecast GNP of €158,228 million in 2008 (Barrett *et al.*, 2008). Estimates assume a similar decline in Ireland's smaller office markets. However, the impact would be magnified if similar dynamics were assumed in other areas of commercial building, and if indirect effects were taken into account.

[37] *Ceteris paribus*, compared to estimated office construction employment at Q3 2008, derived as follows; Total construction employment in Q3 2008 = 257,300 persons, of which 44.5 per cent (114,499) are engaged in non-residential building. Applying office share of non-residential output to this figure gives an estimate of 13,648 currently engaged in office construction.

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