Predicting Turning Points in the Rent Cycle Using the Natural Vacancy Rate –
An Applied Study of the Dublin Office Market[*]

John McCartney, CSO.

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Abstract

All property markets have a natural vacancy rate (NVR). Theory suggests that when the actual vacancy rate exceeds this NVR the market will be unbalanced. Then, rents will fall to restore equilibrium. Conversely, when vacancies are below the NVR, rents will rise. By establishing a 'tipping point' between positive and negative rental growth, the NVR is a useful tool for analysing market cycles.

Standard econometric practice is to model the NVR as a constant. However, this paper finds that there was a large structural shift in the natural vacancy rate for Dublin office space in the late 1990s. Allowing for this, two discrete NVRs are estimated for Dublin. For the 1978-1998 period, the NVR is calculated at 5.2%. This is broadly in line with rule-of-thumb estimates used by industry practitioners. However, the estimated NVR for the 1999-2009 period is 15.0 % - more than twice the 7% rate that is normally assumed.

One interpretation is that Dublin's office market is set to recover sooner than expected. Currently, the actual vacancy rate is just over 23%. Rents will only stop falling when this figure has been reduced into line with the NVR. For a given rate of net absorption, this will be achieved more quickly if the NVR is 15% than if it were 7%.

Section 1 - Introduction

The vacancy rate promises to be a key variable for understanding commercial property markets because it encapsulates both supply and demand conditions. However, while it is commonly expected that a high vacancy rate will exert downward pressure on rents, applying this expectation to practical market analysis is less straightforward than one might imagine. In particular, a problem arises in defining exactly what is meant by a 'high' vacancy rate. Previous studies have demonstrated that the same vacancy rate (say 8% or 10%) can be consistent with rental growth in one market and falling rents in another (Krainer 2001, Voith and Crone, 1988). This suggests that, in itself, the absolute vacancy rate is not the best indicator of market conditions. Instead the gap between the actual vacancy rate and some market-specific 'natural' rate of vacancies is a better predictor of rental dynamics (see Sanderson, Farrelly and Thoday, 2006). Conceptually, the natural vacancy rate (NVR) is that which corresponds with market equilibrium and rent stability. When the actual vacancy rate exceeds this level the market is 'overbuilt' and rents will fall. Conversely, when vacancies are below their natural level, theory suggests that rental growth will occur.

Because the NVR establishes a 'tipping point' between positive and negative rental growth it is potentially a useful tool for analysing commercial property cycles. Despite this, however, the NVR does not feature prominently in European commercial property research, and it is seldom referred to in Ireland. Moreover, on those occasions when the NVR is utilised, its value is often approximated on a 'rule of thumb' basis (Sanderson, Farrelly and Thoday, 2006). These approximations can be highly arbitrary, resulting in potentially misleading analyses.

This article formally estimates the natural vacancy rate for Dublin's office market using an econometric approach. In doing so it follows a methodology that is well-established in the US literature. However, in a refinement of the traditional approach which treats the NVR as a constant, this paper allows for changes in the natural vacancy rate over time. The results of this exercise suggest that, until 1998, the NVR

for Dublin offices was around 5.2%. Thereafter, however, it increased dramatically and is now estimated at 15.0%. This is more than twice the level generally assumed by analysts as 'natural' for the Dublin office market. One important implication of this finding is that the Dublin office market may recover sooner than expected. Relative to the true NVR the market is less 'overbuilt' than is commonly perceived. Therefore, for a given rate of net absorption, rents are likely to stabilise earlier than was previously anticipated.

The remainder of this paper is structured as follows: Section 2 outlines the theoretical underpinnings of the NVR concept and reviews those factors that may influence the natural level of vacancies in any office market. The following section describes the standard econometric methodology for estimating an NVR, while Section 4 sets out the empirical framework used to estimate the NVR for Dublin offices. The results of the estimation are presented in Section 5 and, in Section 6, the implications of these findings are discussed before a brief conclusion.

Section 2 – The Theory of Natural Vacancy Rates

The Natural Vacancy Rate Hypothesis has its unlikely origins in labour market economics (Grenadier 1995, Voith and Crone 1988). A standard labour market theory is that overall unemployment can be decomposed into its voluntary and involuntary components. The voluntary component includes people who are out of work at any time because they are in the process of changing jobs (frictional unemployment). It also includes people who could get work at the current market wage but who choose to keep searching for jobs that pay above the norm. At market equilibrium, everyone who wants a job at the current market wage can have one – i.e. there is no forced unemployment. However, some voluntary unemployment is inevitable because there are always people moving between jobs and searching for better offers. Therefore we should expect some level of unemployment even when the market is in equilibrium. This is the natural rate of unemployment.[1] Periodically, actual unemployment will deviate from this natural level. When this occurs – for example due to business cycles which affect the demand for labour – theory suggests that real wages will adjust to restore equilibrium (Hendershott, MacGregor and Tse, 2002).

Application of this theory to the market for rented property was first proposed by Blank and Winnick in 1953, and since then it has become an established tool for real estate analysis, particularly in America (see Hendershott, MacGregor and Tse 2002, Rosen and Smith 1983). In essence, it is argued that, even when property markets are in equilibrium, we should expect some vacant space. There are two reasons for this. Firstly, just as frictional unemployment is a characteristic of labour markets, frictional vacancies are an inevitable feature of property markets. At any given time some buildings will be temporarily vacant, either because they are between lettings or because they are newly built and awaiting their first occupancy (see Gabriel and Nothaft, 2001). Secondly, just as some workers choose not to accept jobs at the going rate because they hope to get better offers, some landlords will choose not to let their properties at current market rents because they hope to find tenants who are prepared to pay more. Landlords could pursue this objective by conducting extended searches for tenants whose specific requirements most closely match the characteristics of their

[1] Similar explanations of the natural rate of unemployment can be found in most basic economics textbooks – see, for example Begg, Fischer and Dornbusch (2002).

particular buildings. Alternatively, they could simply bide their time and wait for overall market rents to rise above current levels.

The proportion of total space that remains vacant due to these factors – frictional vacancies and landlords waiting for better offers - is known as the natural vacancy rate (NVR). Because this rate of vacancies is compatible with market equilibrium (i.e. every landlord who wants to let space at the current market rate can do so), the NVR is the vacancy rate which is consistent with rent stability (Jud and Frew, 1990).

As in labour markets, the actual vacancy rate in commercial property markets often deviates from this natural rate. These digressions are partly driven by exogenous business cycles. However, they are also driven by endogenous cycles in construction development - Long lead-times in commercial building contribute to spells of over-development followed by periods of sharp construction retrenchment.[2] At times when the market is over-supplied – either because of excessive construction or a slump in occupier demand - vacancies rise above their natural rate and rents gravitate downwards to restore equilibrium. In contrast, when the market is tight the actual vacancy rate falls below its natural level and then rents increase (Hendershott, 1995). At all times, however, the natural vacancy rate acts as the fulcrum around which rental dynamics are determined.

Given the theory outlined above, it is reasonable to argue that the NVR in any office market will be influenced by two sets of variables; those that that affect frictional vacancies and those that influence landlords' propensity to hold-out for higher rents. Looking at the first category, the length of the standard office lease is likely to impact upon frictional vacancies. In markets where lease terms are long and break-options are infrequent and/or costly to invoke, tenant turnover and frictional vacancies should be low. Holding everything else equal, this is consistent with a lower NVR (Grenadier 1995, Rosen and Smith 1983, Voith and Crone 1988, Wheaton and Torto, 1988).

Conversely, however, frictional vacancies should be positively related to the extent of speculative building. This is because, by its nature, speculatively built accommodation can lie vacant for a period prior to its first letting. The extent of speculative development partly depends on factors related to the local building industry. It tends to be higher in markets where construction activity is strong (de Leeuw and Ekanem 1971, Rosen and Smith 1983). It is also expected to be higher where there is vigorous economic growth as this gives developers confidence that they will be able to find tenants upon completion. Finally, where there are large economies of scale in capacity construction, developers may find it profitable to build more office space than they can pre-let (see McDonald, 2000). In addition to these factors, the extent of speculative building may also depend on market structure. Where occupiers have generic accommodation needs and their average space requirements are low, developers may have great difficulty getting tenants to commit to pre-lets. Here, they may have no choice but to build speculatively (see McCartney, 2008). Furthermore, where market supply is elastic (i.e. where developers can

[2] See Barras and Ferguson (1987), Phyrr, Roulac and Born (1999). The Dublin office market closely follows this classic cyclical pattern. MacLaran and O'Connell (2007, 2003), MacLaran (1993) and MacLaran, MacLaran and Malone (1987) provide detailed descriptions of previous development cycles in the Dublin office market, while McCartney (2008) presents an econometric analysis of Dublin development cycles over the 1976-2007 period.

quickly deliver new offices in response to price signals), construction is more likely to occur ahead of demand (Rosen and Smith 1983, Krainer 2001). Factors affecting the elasticity of supply include access to development credit, the nature of the local planning system and the availability of open building land; where these variables facilitate speculative construction, frictional vacancies and the NVR should be higher (Krainer, 2001).

As outlined above, the NVR not only includes frictional vacancies, but also vacancies arising from landlords' decisions to hold-out for higher rents. One strategy that landlords can pursue in order to achieve higher rents is to seek out tenants who are willing to pay more because their accommodation needs closely match the characteristics of the particular buildings on offer. Making these ideal matches often requires extended search activities and so, at an aggregate market level, this strategy is consistent with a high NVR. In practice, the extent to which landlords are prepared to undertake prolonged searches depends on the expected returns from finding the right tenant. These, in turn, are influenced by the heterogeneity of office occupiers. Where there is a wide variation in the rent that different occupiers are prepared to pay for the same property, the expected returns to search activity are high. Under these conditions the NVR should be high because more space will be held vacant to facilitate search (Grenadier 1995, McDonald 2000). In addition to diversity among tenants, however, qualitative variation in the office stock may also affect the natural vacancy rate. Where buildings are highly standardised and locational segmentation is low, landlords have little to gain by engaging in extensive search; Irrespective of occupier tastes, there is no reason for a tenant to pay more for one office than another under these conditions. As a result, landlords will be less likely to hold vacant space. Conversely, where the market contains an array of idiosyncratic properties the returns to search activity will be higher, and so should the NVR (Jud and Frew, 1990).

Searching out tenants that provide the best match for their buildings is one strategy that landlords can adopt to achieve higher rents. Another approach is simply to delay letting their properties in the hope that overall market rents will rise. Insofar as this involves landlords voluntarily holding vacant space it contributes directly to the natural vacancy rate. Obviously, rental expectations will have a critical bearing on the extent to which this 'hoarding' strategy is adopted - where landlords are optimistic about rents they have a stronger incentive to withhold space. Therefore a higher NVR is expected where economic and rental growth have traditionally been stronger (Rosen, 1984).

In addition to rent expectations, the terms of the standard lease contract may also influence hoarding. Firstly, the mechanism for rent revisions will be important. Where revisions are determined by market review real rents can increase substantially over the term of a lease. Here, the opportunity cost of signing contracts will be low and landlords will be disinclined to hold empty space. However, where escalation occurs through indexation the scope for real rental growth within leases will be quite restricted. Here, landlords who foresee a rise in market rents will assume higher opportunity costs from getting 'locked-in', and they will be more likely to carry vacant space.

Secondly, the scheduling of rent revisions will be important. Where indexation is used, rents are generally escalated annually. However, where market reviews are the

norm, the frequency of revisions differs. In France, for example, it is common for reviews to occur every three years, whereas in Ireland market reviews normally take place at five-yearly intervals.[3] Clearly, in a rising market, landlords will envisage higher opportunity costs where reviews take place less often. Consequently, they are more likely to hoard empty space and the NVR should be higher (see Ball, Lizieri and MacGregor, 1998).

A third contract-related factor that may influence the NVR is the issue of upward-only rent reviews. Heretofore upward-only clauses have been standard in Dublin office leases. By providing a sustained advantage to landlords who time their lettings to coincide with the top of the market, these arrangements encourage hoarding and are consistent with a higher NVR. During Ireland's current economic crisis upward-only reviews have become highly contentious and were prohibited on new leases from 28th February 2010.[4] As yet, it is too early to observe the impact of this intervention. In theory, however, it is likely to exert a downward influence on the NVR for Dublin offices.

Finally, it should be clear from the preceding discussion that real interest rates may also play a key role in determining the natural vacancy rate. Not only will high interest rates deter speculative building, they will also increase the cost to landlords of carrying empty office stock (Ball, Lizieri and MacGregor, 1998). All else equal, therefore, we should expect a lower NVR in markets with historically high interest rates.

Few studies have attempted to empirically estimate the influence of these variables on the NVR. However, those that are available tend to confirm the relationships hypothesised above.[5] Rosen and Smith (1983) found that tenant mobility was positively related to the NVR in a range of American markets. Their analysis also confirmed that NVRs were higher in areas of rapid construction. These findings support the notion that friction leads to a higher natural vacancy rate. Similarly Sanderson, Farrelly and Thoday (2006) found that average real GDP growth positively influenced the NVR in European, Asian and American office locations. This is consistent with the arguments that positive rent expectations encourage speculative development and increase landlords' propensity to withhold vacant space. Finally, there is also support for the theory that market heterogeneity is associated with higher NVRs – Rosen and Smith (1983) found that higher rent dispersion had a positive relationship with the equilibrium vacancy rate.

Table 1 summarises the above discussion. It lists the variables that are expected to influence frictional vacancies and landlords' decisions to maintain un-let space respectively. By extension, these factors are also expected to influence the NVR.

[3] Berwin Leighton Paisner (2009) provide a detailed comparison of typical commercial property lease arrangements across Europe.

[4] S.I. No. 471 of 2009 – Land and Conveyancing Law Reform Act (2009) (Commencement) (Section 132) Order 2009.

[5] The general methodological approach is to estimate the NVR for each individual location using a rent adjustment equation populated with time-series data. The estimated NVRs then become the dependent variable in a cross sectional analysis. This approach clearly imposes very heavy data requirements, hence the rarity of these studies.

Table 1: Factors Expected to Influence the NVR

Factors Influencing Friction;		
Variable	*Expected Influence*	*Reason*
• Lease length	Shorter leases = higher NVR	Higher tenant turnover
• Rate of new construction	Higher completions = higher NVR	Higher proportion of speculative development
• GNP growth	Higher growth = higher NVR	Higher rent expectations, higher proportion of speculative development
• Average lot size	Smaller tenant requirements = higher NVR	Smaller lots difficult to pre-let ∴ low average lot size = more speculative development
• Elasticity of supply	More elastic supply = higher NVR	Higher proportion of speculative development
• Real interest rates	Lower rates = higher NVR	Low rates encourage speculative development
Factors Influencing Landlords' Propensity to Hold Vacant Space;		
Variable	*Expected Influence*	*Reason*
• Heterogeneity of occupier & office stock	More heterogeneous = higher NVR	Higher expected returns to search activity
• GNP growth	Higher growth = higher NVR	Positive rent expectations ∴ 'lock-in' imposes higher expected opportunity cost
• Revisions mechanism	Indexation = higher NVR	'Lock-in' imposes higher expected opportunity cost where indexation used
• Revisions frequency	Lower frequency = higher NVR	'Lock-in' imposes higher expected opportunity cost where revisions are infrequent
• Real interest rates	Lower rates = higher NVR	Low rates reduce cost of holding vacant space

Section 3 – Methodological Approach

The theory set out above suggests that, in any office market, rents will fall when the actual vacancy rate exceeds the natural vacancy rate for that specific market (which, in turn, is determined by the variables listed in Table 1). Conversely, rents should rise when the actual vacancy rate is below this NVR. Thus, rental growth can be expressed as a function of the gap between the actual and natural vacancy rates;

$$\Delta R = r(VR - NVR) \tag{1}$$

…where ΔR is the change in rents, VR is the actual or observed vacancy rate and NVR is the natural vacancy rate. In practice, many authors have modelled this relationship using variations of the following basic equation; [6]

$$\Delta R = \alpha + \beta_1 VR \tag{2}$$

From equation (2) it is straightforward to calculate the natural vacancy rate (see McDonald 2000, Sanderson, Farrelly and Thoday 2006); At equilibrium, rental

[6] Sanderson, Farrelly and Thoday (2006) estimate this basic equation for 29 office markets in Europe, Asia and the USA. Other authors have used more complex variations with additional independent variables. Comprehensive reviews of these models are provided by Ball, Lizieri and MacGregor (1998), Hendershott, MacGregor and Tse (2002), McDonald (2000, 2002).

growth equals zero and the actual vacancy rate coincides with the natural vacancy rate. Therefore, setting ΔR to zero and substituting NVR for VR, we solve to get;

$$NVR = \frac{-\alpha}{\beta_1} \tag{3}$$

Upon estimation we expect a negative coefficient β_1 and so equation (3) should result in a positive NVR.

From equation (3) we can derive that the constant term in the previous equation incorporates the NVR. Thus, assuming a negative sign on the vacancy rate coefficient, the Y-axis intercept can be written as $\alpha = \beta_1 NVR$. A correct interpretation is that the known vacancy rate (VR) in equation (2) is measured with reference to the natural vacancy rate, which is unknown *a priori*, but which is embedded within the intercept (see Ball, Lizieri and MacGregor 1998, Shilling, Corgel and Sirmans 1987, Rosen and Smith, 1983).

Implicit in this standard approach is an assumption that the NVR is constant over time (see Ball, Lizieri and MacGregor 1998, Tse and Fischer 2003).[7] Clearly, the validity of this assertion depends upon there being no structural shift in the factors which influence the equilibrium vacancy rate. While this may be plausible in some markets, it is questionable in the case of Dublin. Over the period of this study Ireland's economy underwent a pronounced restructuring, there was a fundamental change in the monetary policy framework, important developments took place in Dublin's urban planning context, and the term of the institutional office lease shortened significantly. One implication is that a constant NVR cannot be taken for granted in Dublin. In practice, this means that our rent equation should be assessed for parameter stability and, if necessary, adjusted to allow for a time-varying NVR.

As set out above, equation (2) describes the basic stock-flow model of rent adjustment that has traditionally been used to estimate natural vacancy rates. In recent years, however, further refinements have been incorporated into this framework. For example, current practice is to estimate rent adjustment equations using lags of the actual vacancy rate because contemporaneous values may be endogenous. Furthermore, as our understanding of the rent adjustment process has evolved, additional explanatory variables have been added to improve fit and enhance the dynamic properties of the model (see Hendershott 1995, Hendershott, MacGregor and Tse 2002). Reflecting some of these nuances, this paper estimates the NVR for Dublin's office market using the following rent adjustment equation;

$$\Delta RR_t = \alpha - \beta_1 VR_{t-1} + \beta_2 \Delta GNP_{t-1} - \beta_3 \Delta I_t - \beta_4 \Delta S_t + \varepsilon_t \tag{4}$$

In this specification, which is set out with the expected signs of the variables in place, ΔRR is the annual change in real office rents and VR is the actual vacancy rate, measured relative to the NVR in the constant term. As outlined above, VR is lagged

[7] Only a small number of studies deviate from this assumption; Wheaton and Torto (1988) modelled the NVR as a linear time trend, while Tse and Fischer (2003) estimated a time-varying parameter model to allow for time effects. Sivitanides (1997) used drivers of rental expectations to model variability in the NVR, while Zhou (2008) identified natural breaks in the data and estimated discrete NVRs for each time period.

one period because rents and vacancy rates may act simultaneously to clear the market, potentially making a contemporaneous measure of vacancies endogenous. In addition to the vacancy rate variable, equation (4) also includes real GNP growth (ΔGNP), the change in real interest rates (ΔI) and the annual change in Dublin's total office stock (ΔS). GNP growth is expected to have a positive effect on real rental growth as it should ultimately lead to an increased demand for office space. In contrast, a rise in real interest rates should reduce rental growth because this dampens economic activity and office demand. Finally, growth in the office stock implies a greater supply of office property which, *ceteris paribus*, is negatively associated with rental growth. Within this framework, equilibrium occurs where real rental growth is zero and where rents just cover the annual cost of capital (McDonald 2000). Here, just enough new space is delivered to replace fully depreciated buildings and therefore there is no net change in the office stock. At equilibrium, any movement in GNP or real interest rates will provoke another round of rent adjustment and so they are set to zero. Upon estimation of this equation, values for $\hat{\alpha}$ and $\hat{\beta}_1$ enable us to estimate a natural vacancy rate for the Dublin office market as described above.

Section 4 – Empirical Framework

Commercial property research has traditionally been constrained by a scarcity of good quality data (see Ball, Lizieri and MacGregor 1998, Hendershott *et al.* 1999). Data series are usually shorter than would be expected in mainstream economic analysis, while issues such as missing values and definitional discontinuities are common (Dunse *et al.* 1998, Leishman 2003). Because of these constraints European office markets are generally under-researched (D'Arcy *et al.* 1999, Brounen and Jennen 2009). If anything, these data challenges are more acute in Dublin than elsewhere because Dublin's office market is infantile compared with those in many American, British and European cities. To illustrate this, only two purpose-built offices of more than 186 sq m existed in the city by 1960. Moreover, ignoring owner-occupiers, a sizable rental market did not emerge in Dublin until the 1970s (see Malone, 1981).

Notwithstanding these challenges, however, the dataset used in this analysis covers a 32 year period (1978-2009), representing three-and-a-half full cycles of the Dublin office market. This constitutes a relatively long data series compared with many of those used in the international literature. For example, Gardiner and Henneberry's rent equations for the UK regions were based on just eight years of data (1988, 1991). Hendershott, Lizieri and Matysiak (1999) analysed London office rents using 20 annual observations, while Wheaton, Torto and Evans (1997) based their equation for London on a 21-year sample. Tse and Fisher (2003) estimated rent adjustment equations for London and Hong Kong using 22 and 23 years of data respectively, while Rosen's (1984) study of the San Francisco market and Hendershott's (1995) analysis of the Sydney office market also relied on 23 observations. Finally, Ng and Higgins (2007) modelled office rents in Singapore using thirteen-and-a-half years of semi-annual data (26 data points).

Rent equations for the Dublin office market have previously been developed by several authors. As part of a wider comparative study, Sanderson, Farrelly and Thoday (2006) estimated a simple rent adjustment equation for Dublin. However, this was predicated on just 12 years of annual data. An earlier paper by D'Arcy, McGough and Tsolacos (1999) used a 25 year dataset (1973-1997) to model real

rental growth. However, as their model did not include vacancy rates, it provides no basis for calculating an NVR.[8] Finally, McGreal *et al.* (2004) set out a model based on 26 annual observations (1975-2000). However, because rents were estimated in levels and their model did not include vacancy rates, it is also unsuitable for estimating an NVR.

The dependent variable in this paper is derived from the office component of the Jones Lang LaSalle Irish Property Index. Rents in this index are the Estimated Rental Values (ERVs) of a portfolio of properties typical of those held by institutional investors. This series, which is not adjusted for incentives such as rent-free periods or capital contributions to fit-out costs, is deflated using the Consumer Price Index (CPI) and entered into our model in differences. Vacancy rates come from Chartered Surveyors Lisney and are measured as a percentage of Dublin's total modern (post 1960) office stock. GNP growth is the annual change in real GNP, sourced from the Central Statistics Office. As is standard in rent equations, this variable is lagged to allow time for changes in economic activity to affect office demand and real rents. In this case a one-year lag structure gave the best fit. Real interest rates are prime lending rates supplied by the Central Bank and Financial Services Authority of Ireland, deflated by the CPI and differenced. The annual change in Dublin's office Stock, measured in thousands of square metres, is derived from absolute figures published by Lisney.

Section 5 – Results

Initially, equation (4) was estimated for the full period of analysis using Ordinary Least Squares (OLS) regression. The results of this exercise are presented in Table 2 below.

Table 2: Results of Fixed-Effects Regression (1978-2009)

	Coefficient	T- Statistic
Intercept	4.875**	2.616
VR_{t-1}	-1. 029***	-5.567
ΔGNP_{t-1}	0.630***	4.249
ΔI_t	-1.321***	-2.756
ΔS_t	-0.011	-0.818

R^2 = .792 $\bar{R}^2$ = .760 DW = 1.569 F = 24.751***

**P<0.05 ***P<0.01

Reassuringly, all of the regressors in this equation take on the expected signs and, with the exception of the Stock variable, are significant at 5% or higher. Reflecting this, an R^2 of .79 indicates that four-fifths of all variation in real rental growth is explained by the model. However, there are some niggling concerns about this regression. A general test of specification error, the Ramsey Reset Test, hints that the model may be under-fitted.[9] More worryingly, although the constant term is significant at 5% (indicating a positive NVR), the natural vacancy rate implied by this

[8] The authors reported that insufficient data was available at that time to include a vacancy rate variable.
[9] $F_{(1,25)}$ = 6.305, P=0.019.

equation is just 4.74%.[10] This seems implausibly low for several reasons. Firstly, the actual vacancy rate in Dublin's office market averaged 8.56% between 1978-2009. If the NVR was lower than this then, on average, real rents should have gravitated downwards. Instead, however, they have actually increased by almost three quarters of a percent per annum over the 32-year period. This suggests that, if our theory is correct, the true NVR should be higher than 8.56%.

A second reason for doubting the NVR implied by these OLS results is illustrated in Table 3 below. This table shows the observed vacancy rate that prevailed in Dublin's office market on each occasion over the last 32 years when the market was in equilibrium (i.e. when rental growth was zero). Clearly, on the three instances when this occurred over the last decade, the actual vacancy rate was much higher than 4.75%. Given that the actual and natural vacancy rates should coincide when the market is in equilibrium, this suggests that the true NVR for Dublin office space in recent years is 12%-17% rather than 4.74%.

Table 3: Observed Vacancy Rate (%) at Previous Equilibrium Points

Year	VR[11]
2008	14
2006	12
2001	17
1995	5
1991	6
1987	5
1981	5

Interestingly, however, Table 3 also contains an indication of what might have caused our fixed-effects equation to under-estimate the true NVR. In contrast to the period since 2001, the early years of our study (1978-1995) consistently saw low vacancies when the market was in equilibrium. Based on this observation, it seems that something fundamental may have changed between 1995-2001 which caused an upward shift in the NVR. To explore this further, Chow Tests for parameter stability were performed for all possible break-points between 1995 and 2001. The largest F Statistic generated by this procedure occurred in 1999 and confirmed the hypothesis that our unrestricted equations for the 1978-1998 and 1999-2009 sub-periods were statistically different at 5%.[12]

While this establishes that the dynamic of rent adjustment in Dublin's office market altered around 1999, it remains unclear whether this change originates from a difference in the intercept term or the slope coefficients. If the former is true, and/or if the coefficient on the vacancy rate variable changed, then the NVR may have shifted between periods. To investigate this in more detail, equation (4) was re-estimated with the inclusion of five additional variables. The first was a dummy with values of zero for the 1978-1998 period and one thereafter. The coefficient on this

[10] Calculated as the negative of the intercept divided by the coefficient on the lagged vacancy rate – see Section 3 above.
[11] As equilibrium can occur at any time during the year, vacancy rates in this table do not necessarily correspond with their year-end values.
[12] $F_{(5, 21)} = 3.58$ vs. 5% critical value of 2.68.

variable measures any change in the intercept between periods. The other new variables are interactive terms created by multiplying our dummy by each of the existing slope variables. These "drifters" measure differences in the slope coefficients between periods. The results of this regression are reported in Table 4 below.

Table 4: Results of Dummy Variable Regression

	Coefficient	T- Statistic
Intercept	9.024**	2.690
VR_{t-1}	-1.637***	-4.128
ΔGNP_{t-1}	0.931***	4.283
ΔI_t	-0.921*	-2.064
ΔS_t	-0.074*	-1.818
Dummy	17.162**	2.326
$D.(VR_{t-1})$	-0.054	-0.108
$D.(\Delta GNP_{t-1})$	-0.802**	-2.623
$D.(\Delta I_t)$	-1.345	-1.193
$D.(\Delta S_t)$	0. 037	0.832

R^2 = .888 $\bar{R}^2$ = .840 DW = 1.894 F= 18.450***

*P<0.10 **P<0.05 ***P<0.01

This analysis confirms that the NVR in Dublin's office market did indeed shift upwards after 1998. To see this, recall from Section 3 that the intercept in our rent equation is simply $\alpha = \beta_1 NVR$; i.e. the coefficient on lagged vacancies multiplied by the NVR. Table 4 shows that the intercept term α changed significantly between periods (the coefficient on the dummy variable is significantly different to zero). However, the coefficient on the vacancy rate drifter was not significant, indicating a constant β_1. Logically, it follows that the observed change in our intercept must have derived from a structural shift in the natural vacancy rate.

Interestingly, the GNP drifter was also significant in this analysis. A negative sign on this variable indicates that Dublin office rents became less sensitive to changes in economic growth after 1998. One interpretation is that the income elasticity of demand for office property may have shifted downwards at this time.[13] This could have occurred for several reasons. On one hand, the occupied space-per-employee ratio may have become compressed. Certainly, this hypothesis is plausible given the relative growth rates of office-based employment and occupied space in the late 1990s. Between 1978-1996 office employment rose at a relatively constant rate, averaging approximately 3% per annum. However, over the following five years (1997-2001) it expanded at a much faster rate of 8.28% per annum.[14] This compares with an average increase in occupied space of 6.95% per annum in the same period. An alternative possibility is that increased productivity weakened the link between overall economic growth and the demand for office space. These issues merit a more detailed analysis and are flagged for future research. For now, however, in order to

[13] For a formal derivation of the income elasticity of demand for office space see Hendershott, Lizieri and MacGregor (2010).

[14] Over the period covered by this paper there is no continuous series for employment in the main office-based sectors of the Irish economy (administrative public sector, financial services and 'other business services'). Figures reported are the author's estimates based on an analysis of combined CSO sources.

derive a well-specified and parsimonious model, this GNP drifter was retained in our final rent equation, along with the differential intercept and the original variables from equation (4). However, the insignificant drifters in Table 4 were discarded to give the final model presented below.[15]

Table 5: Results of Parsimonious Regression

	Coefficient	T- Statistic
Intercept	8.889***	4.375
Dummy	16.942***	4.064
VR_{t-1}	-1. 724***	-7.449
ΔGNP_{t-1}	0.821***	4.658
$D.(\Delta GNP_{t-1})$	-0.501**	-2.345
ΔI_t	-1.190***	-3.064
ΔS_t	-0.049***	-3.247

$R^2 = .877$ $\bar{R}^2 = .846$ DW = 1.977 F = 28.479***

**P<0.05 ***P<0.01

As with the base model presented in Table 2, all of the variables in this regression display the expected signs. However, the overall fit of the model is improved by removing the restrictions that the intercept has to be constant between time periods and that lagged GNP growth has a fixed-effect across the full estimation period. As a result, the R^2 increases by almost nine percentage points to 0.88 and all variables become significant at 5% or better.[16]

Figure 1: Actual vs. Predicted Change in Real Rental Index

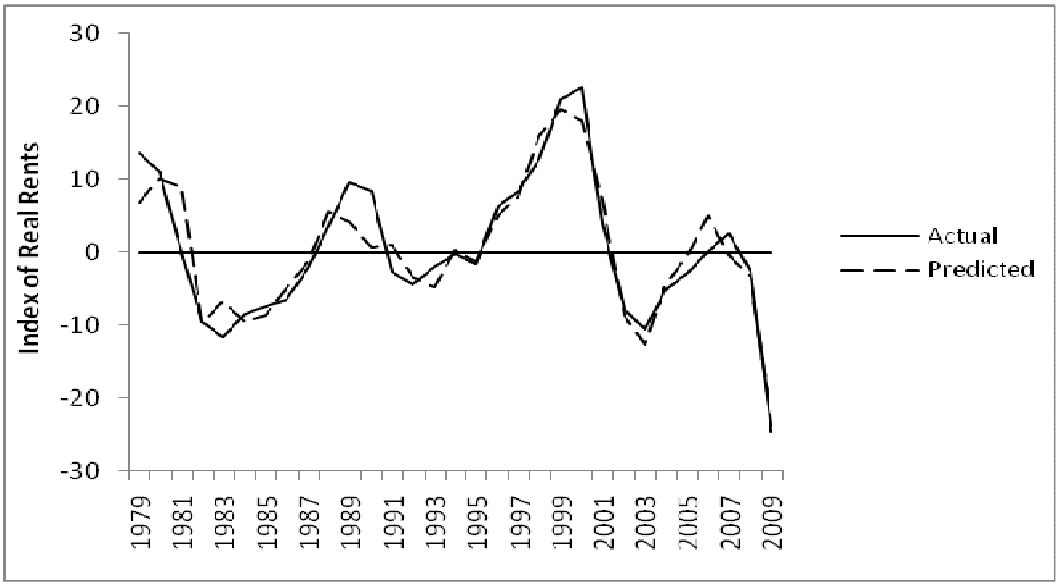


Figure 1 generally confirms the good fit of this model; predicted rental movements track actual rent changes very closely over the entire period of analysis – a timeframe

[15] To ensure that it was valid to drop the insignificant variables, an F-test of the joint restriction that the omitted variables had zero coefficients was conducted; $F_{(3,21)} = 0.679$ vs 1% critical value of 4.87.

[16] Wheaton and Torto (1988), Sivitanides (1997) and Zhou (2008) also achieved improvements in the fit of their models by allowing the NVR to vary through time.

covering three-and-a-half full cycles of the market. However, three specific features of the graph are especially noteworthy. Firstly, it illustrates our model's ability to 'call' turning points in the rental cycle. There have been six peaks and troughs in the Dublin office market since 1978 and the equation presented in Table 5 predicts all of these to within one year or better. Secondly, this graph underlines the robustness of our equation by illustrating how accurately it models the behaviour of Dublin office rents during the 2008-2009 market collapse - a period when real rents fell more than twice as quickly as at any previous time. Finally, the graph suggests a statistically well-behaved model with residuals distributed randomly over time and across the data range. Indeed, this visual impression is confirmed through the standard diagnostic tests. A Durbin-Watson statistic of 1.977 indicates no first order serial correlation in the error terms[17], while second order autocorrelation is also ruled out by an LM test.[18] The model displays no symptoms of multicollinearity while White[19] and Breusch-Pagan-Godfrey (BPG)[20] tests for heteroscedasticity confirm a constant error variance. Finally, the results of a Ramsey Reset Test on our final model indicate that earlier concerns about possible misspecification have been eradicated.[21]

Given these characteristics the model presented above appears to provide a sound basis for estimating the NVR for Dublin office property. The natural vacancy rate for our earlier period is derived simply by dividing the negative of the intercept in Table 5 by the coefficient on lagged vacancies, as per the standard methodology set out in Section 3. This indicates that the natural vacancy rate for Dublin offices in the 1978-1998 period was; -8.89/-1.72 = 5.15%. This figure is approximately in line with 'rule-of-thumb' estimates of the NVR which have traditionally been used by local industry practitioners.[22] However, as shown below, these estimates have been rendered obsolete by a pronounced shift in the NVR in the late 1990s.

The NVR for the 1999-2009 period can be calculated using a similar approach. This time, however, because the intercept changed between periods, the correct procedure is to add the constant from the earlier period to the differential intercept before applying a negative sign and dividing by the coefficient on lagged vacancies. As expected, this confirms a significantly higher NVR in the post 1999 period of; -(8.89+16.94)/-1.72 = 14.98%

Section 6 – Discussion

The standard methodology for estimating a rent adjustment equation treats the NVR as time-invariant. However, the empirical analysis herein confirms that the NVR in Dublin's office market did not remain constant over the 1978-2009 period. Instead it experienced a distinct step-change, rising from approximately 5% prior to 1999 to almost 15% thereafter.

[17] d = 1.977 vs. 1% critical value of 1.601.
[18] χ^2 = 4.398 vs. 1% critical value of 9.210 (2df).
[19] χ^2 = 12.599 vs. 1% critical value of 23.340 (12df).
[20] χ^2 = 7.635 vs. 1% critical value of 16.810 (6df).
[21] $F_{(1,23)}$ = 0.134, P = 0.717.
[22] The most commonly quoted figure is 7% (Knight Frank *Commercial Market Report*, November 2009, DTZ Sherry FitzGerald *Dublin Office Market*, Autumn 2009, Real Estate Opportunities PLC *Annual Report, 2005)*. However, many other commercial property agents, equity analysts, fund managers, bankers and property consultants have quoted equilibrium vacancy rates in the 5-8% range – see, for example; *The Irish Independent* 15th August 2001, 26th June 2002, 25th February 2004, *The Sunday Business Post* 22nd February 2009.

To understand the possible causes of this dislocation, it is useful to distinguish between structural changes and cyclical fluctuations. Zhou (2008) argues that normal market cycles impact on the actual vacancy rate and cause it to deviate temporarily from the NVR. In turn, these deviations trigger a rent adjustment process that returns the market to equilibrium. In contrast, structural changes cause a shift in the NVR itself. Zhou (2008) defines structural changes as those that are non-recurring, non-predictable and have a long-term impact on the functioning of the market. These structural changes may occur in any of the variables that affect the NVR; i.e. those which alter the level of frictional vacancies, those which influence landlords' preferences for vacant space, or those which affect both.

Several structural changes occurred around 1998/1999 which may have contributed to a level-shift in the NVR for Dublin offices. Firstly, there was a fundamental change in Ireland's monetary policy framework when the Euro currency was introduced in 1999. This precipitated a once-off reduction in real interest rates which, in turn, contributed to a major construction boom (Bergin *et al.* 2009, Williams 2006). This was clearly evident in the Dublin office market from 1999 onwards. While average new building completions ran at 47,568 sq m per annum between 1978-1998, output increased almost fourfold to 174,478 sq m per year in the period 1999-2009. As a result, Dublin's total stock of modern office space rose by 129% in just 11 years.[23] Much of this new development was speculative and net absorption – although buoyant by historical standards at 110,101 sq m per annum - could not keep pace with completions.[24] Consequently, frictional vacancies increased dramatically during this period and have remained elevated for the last decade. In addition to fuelling a construction boom it is obvious that lower real interest rates after 1998 may also have contributed to a higher NVR by reducing the cost to landlords of carrying empty space.

Furthermore to its unprecedented scale, the geographical pattern of Dublin's 1999-2003 office building boom may also have contributed to the increased NVR. This boom was unusual in that, for the first time, it saw a large-scale suburbanisation of office development in Dublin (Bertz 2002, MacLaran and Killen 2002). This shift to the suburbs was precipitated by a combination of push and pull factors. On one hand, more stringent conservation policies in the Central Business District (CBD) and increased competition for city-centre sites from alternative uses (e.g. hotel and apartment development) pushed office development out of the traditional core area towards more peripheral locations. On the other hand, a fragmentation of Dublin's planning administration acted as a pull factor because it encouraged suburban local authorities to compete for rateable development by zoning increasing amounts of land for office use (Bertz, 2002).[25] This peripheralisation of office development may have contributed to an increased NVR in two ways. Firstly, given that frictional vacancies have traditionally been higher in Dublin's suburban markets than in the city centre, the increased weighting of suburban space within the overall office stock would have led to a higher NVR. Secondly by opening up large tracts of relatively inexpensive

[23] MacLaran and O'Connell (2003) provide a detailed description of 'Dublin's Fourth Office Development Boom' which took place between 1999-2003. After a short hiatus Dublin's fifth major office building boom followed between 2007-2009.

[24] Net absorption is simply the annual change in occupied space.

[25] This phenomenon is known as "fiscal mercantilism". Although the fragmentation of Dublin's planning administration into four local authorities occurred in 1994, the mid-1990s was a time of subdued development activity, so the effects were not seen until 1999 when Dublin's fourth office development boom began.

new building land, more facilitative planning arrangements in the suburbs increased the elasticity of supply for office space. To the extent that this may have encouraged speculative development, it is also likely to have contributed to the increased NVR.

The third major change was a rapid and pronounced restructuring of Ireland's economy away from manufacturing and towards services in the late 1990s. A recent paper by Quill and Teahon (2010) indicates that, from the mid-1980s to the mid-1990s, expansion in the Irish economy was largely driven by chemicals and electronics manufacturing. Together, these industries accounted for 31% of average annual GVA growth between 1987-1996. After that point, however, their contribution faded to just 17%, while services took over as the new locomotive of economic expansion. Thus, the contribution of financial, public and 'other' services rose from 19% of average GVA growth in the 1987-1996 period to 37% between 1997-2006. Given that these sectors are intensive users of office space, this structural shift generated positive rental expectations which may have encouraged more speculative development and hoarding of vacant space.

Finally, it should be noted that changes to the typical office lease may also have been important in the shift to a higher NVR. In particular, the term of the standard institutional lease contract has declined from the traditional 35 years to less than 10 years at present (see O'Neill, 2009). As a result, tenant turnover has risen, causing a permanent increase in the level of frictional vacancies.[26]

Overall, then, our finding of a sharp upward shift in the NVR for Dublin offices can be plausibly explained by structural changes in the macroeconomic, urban planning and institutional contexts of the late 1990s.

Having established that the NVR is now more than twice as high as was previously assumed, a remaining question is how this revelation should affect our analysis of the outlook for Dublin office rents. In this context Table 6 may be instructive. Currently, the total modern office stock in Dublin is just under three-and-a-half million sq m and, of this, 23.1% or approximately 808,000 sq m is vacant. Theory tells us that rents will continue falling until this figure is reduced into line with its 'natural' level. If we begin with the traditional assumption that the NVR is 7%, this means that vacancies would have to be reduced to 244,848 sq m (i.e. 7% of the current office stock) before we could expect the decline in real Dublin rents to be arrested. This implies that an 'overhang' of 563,152 sq m of excess space needs to be digested before the rent cycle will turn. To put some time frame on how long this might take we can make a technical assumption that the net absorption of office space will remain constant at its 32-year average of 69,181 sq m per annum. At this rate of digestion it would take a further eight years for real Dublin office rents to stop falling.

However, if we reject the traditional assumption of a 7% NVR and accept that the true figure is almost 15% as argued in this paper, then the outlook changes dramatically. In this situation vacancies would only have to come down to 523,976 sq m (i.e. 14.98% of the current total office stock) before rents should stop falling. From current levels,

[26] Tax incentives for commercial property development are another area where structural change may have occurred. However, because the main interventions took place more than a decade earlier, through the Urban Renewal and Finance Acts of 1986, this is considered an unlikely source of the NVR shift observed in 1999. For discussion of these tax incentives see Williams (2006) and references therein.

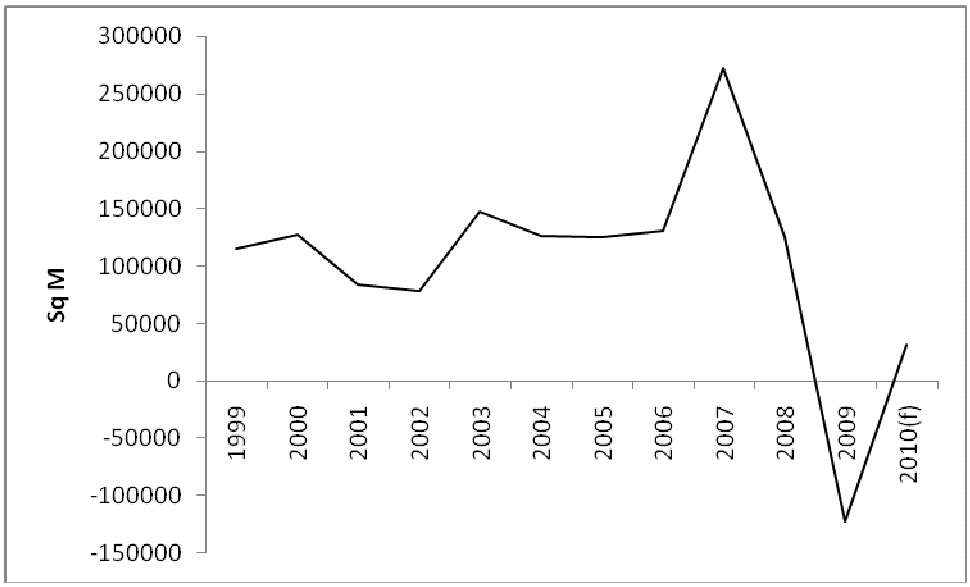
this means that only 284,024 sq m of vacant space would need to be digested and, assuming the same rate of absorption, this would be achieved in approximately four years.

Table 6: Impact of a Higher NVR on The Timeline for Rental Recovery

	7%	14.98%
Total Stock	3,497,835	3,497,835
Vacant Stock	808,000	808,000
Vacancy Target[27]	244,848	523,976
Overhang	563,152	284,024
Assumed Absorption	69,181	69,181
Years to Recovery[28]	8.14	4.12

The above analysis clearly demonstrates the central proposition of this paper; If the NVR for Dublin office property is higher than previously thought then the market faces a shorter journey back to equilibrium and, all else equal, a recovery should emerge sooner than expected. However, it should be understood that the timelines suggested in Table 6 are not intended as forecasts *per se*. Rather, their purpose is merely to emphasise the importance of the NVR in determining the position of the market relative to its equilibrium. If we wish to derive more considered forecasts we must remember that the timeline to recovery depends not just on the distance that the market has to travel back to equilibrium, but also on the speed at which it makes this transition. This transition speed is largely determined by the rate of net absorption, a detailed analysis of which is beyond the scope of our paper. Nonetheless, it is worth briefly considering how different rates of absorption might hypothetically affect the timeline to a recovery in Dublin office rents.

Figure 2: Net Absorption of Dublin Office Space 1999-2010(f)



[27] Calculated as the Total Stock multiplied by the relevant NVR percentage.
[28] Calculated as the 'Overhang' divided by Annual Absorption.

So far, we have used the simplistic assumption that absorption will remain constant at its long-run level. However, as shown in Figure 2, net absorption in the Dublin office market was negative in 2009 and, although it recovered somewhat in 2010, it remains very subdued by historical standards. If we envisage that Ireland's economy will develop in line with the ESRI's Low Growth macroeconomic scenario[29] it may be reasonable to assume that net absorption might average 90% of its long-run mean value over the medium term. Under this assumption just 62,263 sq m of vacant space would be digested each year and, as shown in Table 7, it would take 4.56 years to absorb the current excess. This would postpone a recovery in Dublin office rents until mid-2015.

Table 7: Sensitivity of Recovery Timelines to Net Absorption Rates

	90% LR Average	LR Average	120% LR Average
Overhang	284,024	284,024	284,024
Assumed Absorption	62,263	69,181	83,000
Years to Recovery	4.56	4.12	3.42

In contrast, if we assume that economic growth will be in line with the ESRI's High Growth Scenario then it may be reasonable to argue that, by 2015, absorption will recover to average levels seen in the decade prior to the recession. Assuming steady progress towards this target, an average absorption rate of 83,000 sq m per year is implied – approximately 20% above the long run average. At that rate of net absorption the market would attain equilibrium in less than three and a half years, meaning that real rental growth could resume from the middle of 2014.

While the figures in Table 7 provide more nuanced suggestions about how Dublin office rents might develop under alternative macroeconomic scenarios, some important caveats still need to be borne in mind. Firstly, these suggestions are predicated on the assumption that Dublin's total office stock will remain constant in the medium term. Certainly, it is unlikely that any further office completions will occur for a number of years after 2010.[30] However, it is possible that the total office stock could contract as we move towards 2013-2014, particularly if the High Growth Scenario is realised. This is because there are a number of dated office buildings in the city centre that are ripe for redevelopment and which would be temporarily withdrawn from the office stock if construction works were to commence. Assuming that these buildings were vacant prior to redevelopment, the immediate effect of this would be to reduce the gap between the actual and the natural vacancy rates, thereby shortening the timeline to a market recovery.

A further caveat is that, given the current economic turmoil, the NVR for Dublin offices could move again, just as it did in the 1990s. Clearly, this would affect the accuracy of any forecasts predicated on a rigid or outdated view of the NVR. Indeed, even at this stage it is possible to envisage several factors that could potentially cause

[29] Given the high degree of economic uncertainty that prevails, a recent ESRI paper set out two alternative recovery paths for the Irish economy – a High Growth Scenario and a Low Growth Scenario. See *Recovery Scenarios for Ireland: An Update* (Bergin *et al.*, 2010).

[30] This is corroborated by recent agency reports which indicate that the current development cycle in the Dublin office market will terminate after Q4 2010 - see CBRE *Marketview Dublin Office*, Q3 2010, Lisney *Office Update*, Autumn 2010, for example.

a structural shift in the NVR for Dublin office space. Firstly, Bergin *et al.* (2009, 2010) argue that the current recession is likely to result in a permanent loss of economic output relative to the country's previous potential. If so, then new office development and frictional vacancies could be permanently reduced, while more pessimistic rental expectations would reduce the incentive to hold vacant space. In a similar vein, the abolition of upward-only rent reviews could also reduce the hoarding of vacant space. These factors would potentially exert downward pressure on the NVR. Conversely, however, the shortening of lease terms could lead to a higher NVR by increasing tenant turnover. Finally, NAMA, given its scale, could affect the NVR in ways that are not yet known. For all of these reasons it is important that market analysts continue monitor the Natural Vacancy Rate over time.

Two final provisos relate to the interpretation of the analysis herein. Firstly, due to data restrictions it is only possible to analyse the market at an aggregated level. This may obscure trends and developments within particular sub-markets. For example, as the city centre was the first target for office developers in the 1960s, it now contains a high concentration of older buildings.[31] Therefore, when the next construction cycle begins, space withdrawals due to redevelopment could initially lead to a more rapid tightening of the city centre market and a quicker pick-up in rents there than elsewhere. Finally, it should be noted that the dependent variable in this paper is real rather than nominal rental growth. If, as expected, future inflation is positive, nominal rents are likely to begin growing some time in advance of real rents.

Section 7 – Conclusions

Commercial real estate has played a major role in the boom - and subsequent bust - of Ireland's economy. Yet, despite the obvious importance of this sector, there has been little empirical analysis of Ireland's commercial property markets. This paper focuses on one specific aspect of commercial property – office rents. Its primary purpose is not to generate rental forecasts. Instead its aims to provide a theoretical and methodological framework within which practitioners can form educated judgements about the position of the market relative to its equilibrium. That notwithstanding, the paper makes some suggestions about the likely timeline to a recovery in Dublin office rents. Based on the revelation that Dublin's Natural Vacancy Rate is now around 15%, and assuming a net consumption of office space which is broadly in line with the ESRI's macroeconomic scenarios, widespread growth in real office rents is likely to resume sometime between mid-2014 and mid-2015.

[31] See McDonald (1985) for a detailed history of early office development in Dublin.

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