# RENTAL PRICE ADJUSTMENT IN THE CANADIAN OFFICE MARKET

By

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ABSTRACT

The rental price adjustment mechanism is a fundamental component of the model for forecasting future office space requirements. This is an important area of study given the increasing significance of office buildings in the urban environment. This has resulted from the large growth in service oriented employment. Very little academic work has been completed in this area because of the lack of sufficient data. To date, only the U.S. market has been examined.

The objective of this thesis is model the rental price adjustment mechanism in the Canadian office market. The intent is to further test the theory in this area, provide a comparison with the results obtained in the U.S., and provide some insight into the workings of the Canadian office market.

This thesis reviews the relevant literature on inventory theory, and empirical work performed on the housing market and on data from the U.S. office market. The review points to a series of propositions about the rental price adjustment mechanism in the office market, the most important being the strong relationship between rents and vacancies. The extensions to the model developed in this paper are the specification of the vacancy variable in non linear terms and an attempt to include some proxy for growth expectations. The

model is tested using data from Montreal, Toronto, Edmonton, Calgary, and Vancouver. The data has been collected primarily from the Royal LePage Market Survey.

Visual inspection of the data uncovers unique characteristics in each individual office market. The underlying reasons point to the importance of integrating growth expectations in the model. The regression results support some degree of asymmetric price behaviour, however the specification of the vacancy variable in non linear terms is not conclusive. Inflation expectations seem to be important as landlords attempt to pass inflationary rises on to the tenants. Operating costs and interest rates do not appear to be significant factors in the model. This leads to the conclusion that they are not important in the cost of holding inventory in the short run. Finally, the proxy used for growth expectations is not significant. The most likely reason for this result is that the variable is not properly specified. The low explanatory power of the model may be attributed to the misspecification of the growth proxy and limitations in the data set. Both of these factors should be considered in future work in this area.

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## 1.0 INTRODUCTION

Relative to the housing market, there has been very little empirical work done on the dynamics of the office market. The few papers that have been written have all dealt with cities in the U.S..[1] The objective of this thesis is to model the price adjustment mechanism in the Canadian office market. The analysis should provide some further empirical evidence to test the theories advanced in this area, provide an interesting comparison with those results found in the U.S., and provide some insight into the internal workings of the Canadian office market.

The objective of this thesis begs the fundamental question; Why is the study of the price adjustment process of interest? The answer is rooted in the growing importance of the office market.

Semple and Green (1983) point out that modern corporations wield a tremendous influence over the economic, social and political institutions of society. This influence may be thought as spatially concentrated where the headquarters of each firm is located. Headquarters are most commonly found in office buildings clustered together in large

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[1]See K. Rosen (1984), J. Hekman (1985), and J.D. Shilling et al. (1987)

urban areas. As a result, the size and nature of the office market becomes important as it represents the influence that a city wields over its economic region. Furthermore, because of its physical presence, tendency to cluster, and ability to concentrate employment activity in one area, the office market has a major impact on the urban structure and social fabric of the city.

In the last two decades the office market in Canada has grown dramatically. A lot of this is due to the burgeoning growth in service oriented employment which has increased at the expense of a declining manufacturing sector.[2] In addition, studies show that the increase in managerial and professional positions has actually increased the average amount of office floorspace used by an employee.[3] Therefore, the growth and impact of the office building has made it an important subject of study.

One of the fundamental concerns is accurately forecasting the amount of office space that is needed in a city. Eger and Smith (1987) point out that predicting office construction requires an understanding of the unique

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[2]See D. Hooper et al (1983) and G. Gad (1976)

[3]A consolidation of studies by the Toronto Planning Department (1960) (1970) (1980) (1983) (1984) (1985), the IBI Group (1975), and G. Gad (1971 - 72) show a trend towards increasing floor space per worker in Toronto.

characteristics of the local market and its linkages with the national economy, the particular urban location, the size and growth of the city, the availability of funding, interest rates, tax concessions, and a myriad of other exogenous variables all operating on a reasonably thin market. The complexity of the task has made forecasting a hazardous profession. Whitehead (1987) and Hayes (1985) discuss the tendency of developers to overreact to the turbulent economic cycles. Supply and demand for office space often seem to pass each other like proverbial ships in the night.

One of the most essential components of predicting the future flow of office space are rental rates and the mechanism by which they adjust.[4] Rosen (1984) argues that most current prediction models for rental rates rely on simple trendline techniques which have little or no economic or statistical justification. The mechanism by which rents move in the market goes beyond such a simple "back of the envelope" analysis. In fact, as suggested by Shilling et al. (1987), the price adjustment mechanism represents one of the more classical problems in economics.

In a perfect world, with no market frictions, uncertainty, or impediments, firms will respond to

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[4]K. Rosen (1984) constructs an office stock adjustment model and discusses all the various elements which are involved.

fluctuations in demand by either varying price or varying output. However, the introduction of more realistic assumptions creates the opportunity or necessity for firms to hold inventory. This substantially changes the supply and demand decision process. Firms can react to fluctuations in demand by drawing down or building up inventory instead of varying price or output.

The office market is a good illustration of the use of inventory in the price adjustment process. There is normally a 2 to 4 year lag time between the conception and completion of an office building.[5] This fact prevents developers from immediately responding to demand fluctuations and creates a fixed supply of office space in the short run. Therefore, in order to buffer unanticipated events, landlords must keep an inventory of office space. When a demand shock hits, the landlord has the choice to vary the inventory level or the level of rents. The choice will depend on his expectations, the nature of the particular office market, and the exogenous factors which effect it.

Inventory or vacancies provide an additional benefit to the other participants in the office market. They allow tenants to lower search costs and to move between locations without planning far in advance. As well, they provide

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[5]See J. Hekman (1985)

developers with a degree of flexibility in timing the addition of future space.

The simple story above intuitively points to a relationship between rents and vacancies. The mechanism by which they interact is the essential topic of this thesis.

The following chapter provides a review of the relevant academic literature in the price adjustment area to provide support for the empirical model used in the analysis. Three topics are examined. The first is a review of basic inventory theory to investigate the basic economic principles underlying the price adjustment mechanism. Second, there has been a significant amount of literature written on the price adjustment mechanism in the housing market. A review of this work is done for comparative insight on the office market mechanism. Finally, there are three empirical studies on the price adjustment mechanism in the office market that have been written. These are all reviewed.

To test the price adjustment model in this thesis, I have chosen 5 cities in Canada; Montreal, Toronto, Edmonton, Calgary, and Vancouver. The intent is to provide a reasonably broad cross section of the office market in Canada and to look at cities which have exhibited interesting behaviour over the analysis period.

Toronto and Montreal represent the economic power of Eastern Canada and to a large extent all of Canada. Both cities have diversified economic bases which makes them particularly suitable for comparison with some of the larger U.S. cities. There is an interesting link between the office markets in Toronto and Montreal. Over the last 40 years, there has been a steady shift of corporate influence from Montreal to Toronto. The cause and effect of this event has had an impact on the price adjustment mechanism in both cities.

Calgary and Edmonton represent the glamorous petroleum industry in Canada. Both are interesting cities to study because of their incredible growth in the late 1970's and early 1980's. Office market growth in these two cities surpassed all previous records held by any city in North America.[6]

Finally, Vancouver was chosen because it is the largest city in western Canada and the third largest city in Canada. Similar to both Calgary and Edmonton, Vancouver is heavily dependent on the natural resource industry. Interestingly,

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[6]J. Whitehead (1987) provides an excellent description of the development industry in Calgary and Edmonton during this period.

Vancouver has the third highest ratio of office space per capita in North America.[7]

The biggest stumbling block in examining the office market in Canada is the lack of comprehensive data. Unlike the housing market, there is no government agency like the Canada Mortgage and Housing Corporation (CMHC) collecting unbiased disaggregated information on a regular and consistent basis. The most comprehensive source of time series data on the office market is the annual Royal LePage Market Survey. I have used this as my primary source of data and have used various other sources such as the Building Owners and Managers Association (BOMA) to improve the data where possible.

The third chapter reviews the office market in each of the five cities. As a starting point for discussion, time series data on nominal and real rents, and vacancies has been plotted for each city.[8] A further review of local and national events that took place during the analysis period provides some of the economic and political underpinnings in each city which will help shed some light on the data and the price adjustment mechanism.

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[7]See the Vancouver Planning Department:Quarterly Review

[8]An explanation of the data and its collection is provided in Chapter 4

Chapter four develops the empirical model and discusses the data collection and its transformation for use in the analysis. A pooled cross sectional time series regression is conducted for the price adjustment model and the results are discussed in the context of previous studies and the unique characteristics of each city.

The last chapter presents some concluding remarks. The intent is to summarize the major points in the analysis and review possible avenues of future research.

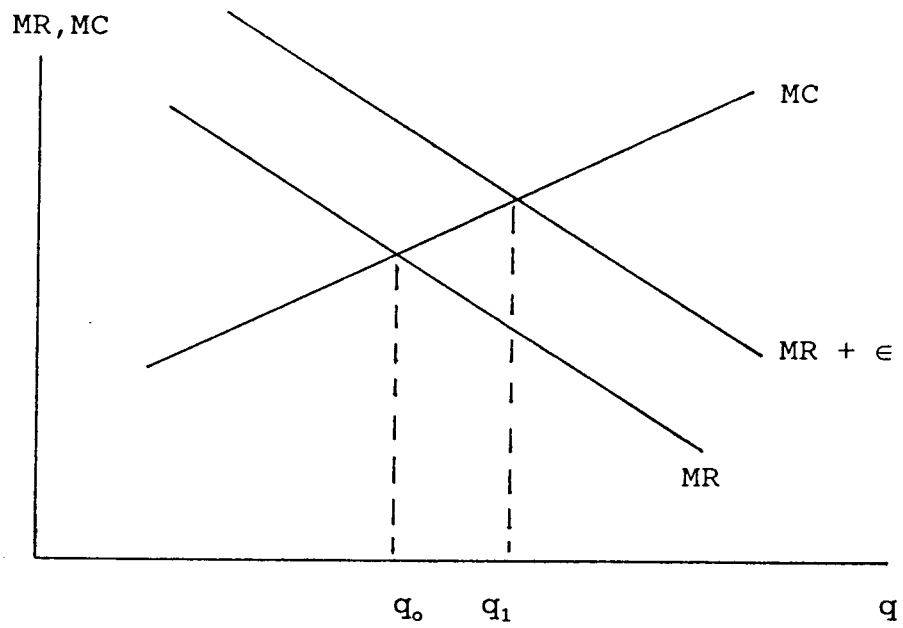
## 2.0 LITERATURE REVIEW

The literature review is divided into 3 sections. The first section deals with the literature on inventory theory. This provides a good economic benchmark on which to assess the theory on the price adjustment mechanism. The second section reviews some of the empirical studies conducted for price adjustment models in the housing market. Much of the work done in the office market relates to the theory proposed for the housing market. Finally, the third section reviews 4 papers which specifically address rental price adjustment in the office market.

### 2.1 Inventory Theory

The office market is a good example of an industry where the use of inventory or vacancies induces peculiar price responses when the market is hit with a demand shock. The response deviates from the behaviour typically expected in the classical model of supply and demand. To digress for a moment, consider the hypothetical monopolistic firm in Figure 2.1 who faces a falling marginal revenue (MR) curve and a rising marginal cost (MC) curve. Assume that the commodity produced is completely divisible and that output and price can vary instantaneously. To maximize profit, the firm will produce

FIGURE 2.1



output, $q_o$ where the two curves intersect, MR = MC. The price, $p_o$ is determined by the demand curve at this output. When faced with a positive demand shock, $\epsilon$, the firm must increase the output to $q_1$ at the new intersection point. The price changes accordingly. If a firms marginal cost curve is steep, than there will only be a small change in output while price response will be strong. The reverse will occur if the slope of the MC is flat. Thus, firms respond to demand shocks by trading off between price and output. The choice is dictated by the slope of the MC curve.

Classical supply and demand models assume perfectly divisible products, no production lags or frictions, continuous transactions in the market place and instantaneous perfect knowledge. The amount of output taken at any quoted price is known instantaneously and demand shifts are immediately registered as a change of sales. Sellers have the complete information set which allows them to revise and observe the "true" demand function that faces them. Since both output and sales at the correct price are always in equilibrium there is never any need for inventory.

Of course, the scenario above is far from realistic. A more rigorous model must consider the many constraints and imperfections which face firms in the real world. For example, office space is only divisible to a limited degree. Although

it is possible to rent 1 square foot of space, economies of scale and minimum tenant requirements make it ludicrous to consider such an occurrence in the market. In addition, search costs for both landlords and tenants in the office market preempts continuous trading. Transactions in the office market therefore involve the exchange of finite quantities of rental space at discontinuous and discrete points in time. As a result, landlords are always between transactions and they can rarely observe current demand. When making new price and quantity adjustments, they may only rely on past contracts. The uncertainty created by the imperfect information creates the necessity for the landlord to forecast future demand. Stochastic assumptions need to be added to the decision framework. It is the introduction of uncertainty that leads us to the necessity for inventory.

Let us return to the simple model with the hypothetical firm. To add to the story, the firm must now face an uncertain demand schedule. Only the probability distribution of future price and output pairs are known. From E. S. Mills (1962) the demand function becomes,

$$X = f( p, V, u ) \quad \text{where,}$$

X: quantity demanded per unit time

p: price per unit of quantity

V: vector of information and prediction variables

u: random variable with zero mean and constant variance

If the model is solved to maximize profits subject to the demand function above and a normal cost function, the solution dictates that a firm should keep an optimum level of inventory[1]. This contradicts the classical notion of output and sales in equilibrium at any point in time.

To provide an intuitive sense of the application of this result in the office market we examine the simple model developed by Gordon and Hynes (1962). In the office rental market, the firm is the landlord whose product is vacant space. He is uncertain as to when the space will be rented. Assume that the probability of renting in any time period, $\pi$ is a function of R, the rent asked, $\pi = g(R)$. Time to rental, T is assumed to be related to $\pi$ through the geometric function, $\pi = e^{-1/T}$.[2] If we compute the expected value of T we arrive at $(1-\pi)/\pi$. If we ignore other costs and assume there is no discount rate, profit maximization occurs when revenue is maximized. The revenue function is given by,

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[1]For a discussion of this result see E.S. Mills (1962)

[2]Intuitively, the probability of the space being rented in an infinite period is 1 while the probability of the space being rented instantaneously is 0.

$$\frac{RL\pi}{\pi(L - 1) + 1} \quad \text{where,}$$

L is the term of the lease which is treated as a given exogenous variable.[3] Differentiating this function with respect to R provides the value $R^*$, where profit is maximized,

$$R^* = \frac{-g(R^*)\{g(R^*)[L - 1] + 1\}}{g'(R^*)} ,$$

Once the profit maximizing rent is known it is possible to step back and solve for the associated occupancy or vacancy level present at this rent,

$$\text{Expected Vacancy} = 1 - \text{Occupancy}$$

$$= 1 - \frac{L\pi}{\pi(L - 1) + 1} \quad \text{where } \pi = g(R^*)$$

$$\text{Expected Vacancy} = 1 - \frac{Lg(R^*)}{g(R^*)[L - 1] + 1}$$

This result shows that as long as the landlord does not change his estimate of the probability distribution associated with

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[3]If $\pi$ is the probability of renting in one month, then $(1-\pi)/\pi$ is the expected time in which it will be rented. We assume we start renting at the beginning of a month. The total time between successive rents is therefore, $L + (1-\pi)/\pi$. The proportion of time the space is rented or occupied is therefore, $L/(L + (1-\pi)/\pi)$. Multiplying this expression by R yields the revenue function.

the demand function, there exists an optimum level of vacancies which maximizes his profit. The vacancies help to buffer the random demand shocks that occur and decrease the need for sudden surges in output.

The interesting result is that now landlords can indirectly observe demand by watching vacancy levels. As long as the expected demand function does not change, the landlord simply reacts to random demand shocks by observing the deviation from the optimal vacancy level and than acts accordingly to return to this level. The optimal vacancy level will change as the landlord constantly reviews his past transactions and observations in the market and reformulates his assumptions about the future.

The necessity for inventory is also found in the literature on search models. In the office market we have landlords searching for tenants and vice versa. For a tenant there are costs associated with relocating. In addition, to the direct costs of moving there are substantial costs incurred in acquiring information about the market so the tenant can find the desired space. The landlord also has high information costs and is required to advertise in order to find the desired tenant. The real estate brokerage industry is used by both parties for a large part of this process. Capozza and Schwann (1986) mention that this search behaviour has

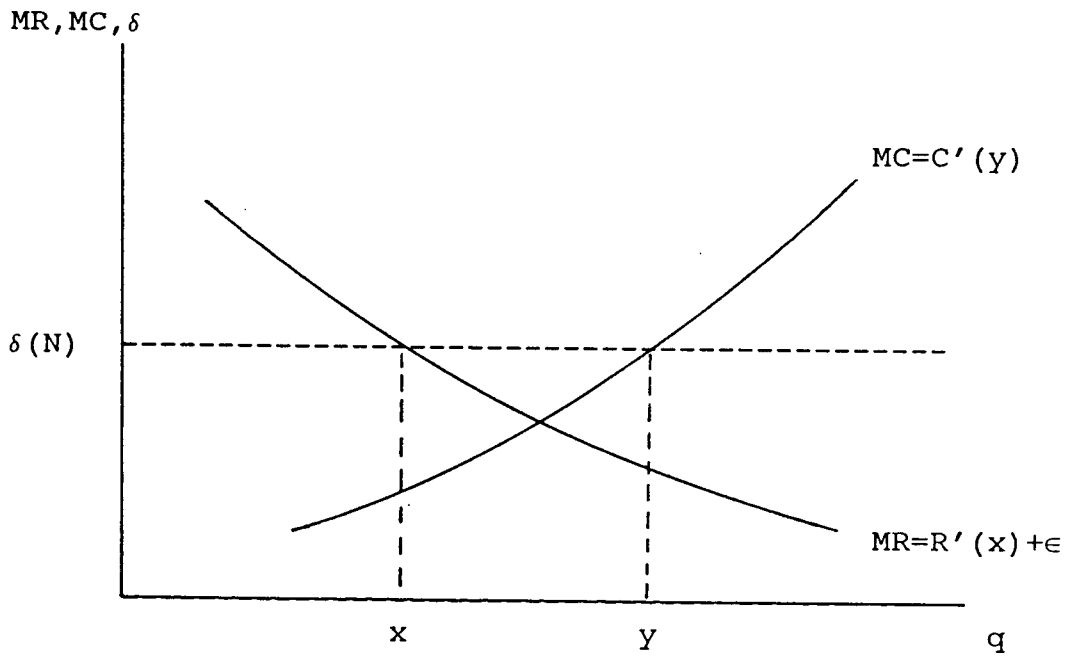
implications for adjustments in the rental market. At any point, landlords will want to hold an optimal level of vacancies to minimize search costs.

The insight provided by Gordon and Hynes (1962) and, Capozza and Schwann (1986) is that inventory or vacancy is a necessary and efficient result in a market where firms are faced with imperfect information, uncertainty and search costs. It provides the firm with an effective mechanism to smooth output fluctuations and minimize search costs.

To carry on with the story of the price adjustment mechanism lets look at the effect on a firm when it can hold inventory. Blinder (1982) provides a nice illustration of this inclusion. Figure 2.2 provides a picture of what is occurring.

When a firm can keep inventory it is no longer required to equilibrate output, $y$ with the current quantity demanded, $x$ . Any excess output produced is simply placed in inventory. This result still allows for MR = MC which ensures profit maximization for the firm. A firm simply decides how much output to produce and how much inventory to sell by considering what Blinder calls the shadow price of inventory, $\delta(N)$. As the figure shows, $x$ is determined where MR = $\delta(N)$. Intuitively, you sell all your inventory up to the point where

FIGURE 2.2



the incremental revenue received is equal to the value of the unit value of the stock in inventory. In a similar manner, y is determined where MC = $\delta$(N). Intuitively, you produce output and add to inventory until the incremental cost is equal to the unit value of the stock in inventory. With this picture in place, it is possible to observe what occurs when the firm is faced with a demand shock, $\epsilon$ that shifts the marginal revenue curve to the right. Blinder shows through simple algebra that for any given MC curve the relative response of x and y depend on the sensitivity of $\delta$(N) to the shock $\epsilon$. If $d\delta/d\epsilon$ is close to 1, than price and output response will both be large. Alternatively, if $d\delta/d\epsilon$ is close to 0 than price and output response is small and the firm will rely on the inventory stock to buffer the demand shock. Thus, if a firm can store output it is possible for both price and output responses to be small when faced with a demand shock. Blinder labels the phenomenon as "sticky prices". The trade off between price and output found in the classical model is now no longer required.

From this simple picture, Blinder builds a theoretical model to say something about the price adjustment mechanism. He assumes a monopolistic firm who faces a stochastic demand function. The firm knows the probabilities associated with demand but he must select both price and output before actually observing the demand shock for the current period.

Optimal firm behaviour is obtained by maximizing the following equation,

max {E(Revenues - Production Costs - Inventory Costs)}

subject to the conditions that,

1. d(Inventory) = Output - Sales
2. MR = expected shadow value of Inventory, $\delta$(N)
3. MC = expected shadow value of Inventory, $\delta$(N)
4. Expected shadow value appreciation of Inventory = the sum of expected marginal storage costs plus the implicit interest cost of carrying inventories

A model is derived that sheds some light on the price adjustment mechanism when inventory and uncertainty are present in the firms decision framework:

1. When output is not inventoriable firms have no choice but to react to changes in demand by trading off responses in output or price.

2. If output is inventoriable, then price and output response can move in tandem. Large price changes may be associated with large output changes. Conversely, both price and output may change very little. Instead the

firm will absorb demand shocks through inventory adjustment.

3. The total cost of holding inventory is the opportunity cost associated with the lost revenue forfeited in the current period and the direct storage costs. This must be balanced against the expected revenue in a future period. As a result, firms with rapidly increasing marginal inventory holding costs are less likely to use inventory adjustment.[4]

4. Firms with constant marginal inventory holding costs who face transitory demand shocks will rely heavily on inventory to buffer the shock and will vary price and output very little. This behaviour will reverse if the shock is persistent.

5. There exists a long run optimal inventory level which depends on production costs, the rate of interest, inventory holding costs, and the expected long run position of the demand curve. The short run desired

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[4]A.S. Blinder (1982) and L.J. Maccini (1981) assume increasing convex inventory cost functions. This seems to be a reasonable assumption. Intuitively, as the inventory level increases, the cost of holding that inventory should marginally increase. The sensitivity of the price adjustment response will depend on the degree of convexity in a firms inventory cost function.

inventory will deviate from the long run target dependent on the current expected demand.

6. Price changes should be sluggish in industries where output is inventoriable. We should observe relatively small real price changes. Nominal prices may still change to keep in step with inflation expectations.

7. The exclusion of negative inventory creates asymmetric price behaviour. There is strong price response to positive demand shocks when inventory is low in order to choke off demand and low price response to negative shocks. This results in downward price rigidity.[5]

8. Similar price adjustment behaviour should be observed for competitive firms as well. Even though firms are "price takers not price makers" it does not prevent them from using inventory to buffer demand shocks and to participate in price speculation in the short run. Capozza and Schwann (1986) point out that price dispersion, imperfect information and heterogeneous product helps individual firms to find market niches which creates a degree of monopolistic behaviour.

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[5] Y. Amihud & H. Mendelson (1980) and P.B. Reagan & M.L. Weitzman (1980) show the same result.

Blinder's conclusion is that inventory provides flexibility in dealing with unanticipated events. It allows output smoothing and speculative behaviour.

The discussion of inventory theory allows us to make some propositions about the rental office market:

1. The office market faces a short run inelastic supply and operates in an uncertain world so it is reasonable to observe landlords holding inventories of vacant space.

2. Wide use of inventory adjustment rather than price and output response should provide information on the inventory cost function in the office market. Inventory adjustment indicates that marginal inventory holding costs in the office market within a fairly broad range of vacancies should be should be almost linear.

3. In the short run transitory demand shocks should be buffered through inventory adjustment.

4. In the short run, optimal vacancies should depend on inventory holding costs, the rate of interest, and expected demand. This may or may not be the same as the long run desired vacancy rate.

5. Inventory adjustment may help to explain sluggish price behaviour in the office market. We may observe nominal price movements in response to revised inflation expectations but not necessarily real price movements.

6. In the office market, negative inventory is not possible so we should observe strong price response to positive demand shocks at low inventory levels.

7. Normally lease terms are for 5 year terms or longer. Therefore we should expect landlords to hold vacancies to participate in price speculation.

## 2.2 Rental Price Adjustment in the Housing Market

Most of the current office market studies use similar models derived for the housing market. I will review two papers which are most relevant to the discussion in this thesis:

### Ken Rosen and Lawrence Smith, The Price Adjustment Process for Rental Housing and the Natural Vacancy Rate, (1983)

This paper confirms that rental price changes are significantly affected by excess supply and demand around a desired or natural vacancy rate in the rental housing market.

They define the natural vacancy rate as "that rate at which there is no excess demand nor excess supply and hence the rent is at its long run equilibrium position". The empirical results illustrate the crucial role of vacancies in the price adjustment process. In addition, the authors attempt to calculate the natural vacancy rates for 13 cities examined in the paper.

The authors point out that within any given year the change in housing stock is only 1.5% - 2% so supply is relatively fixed in the short run. Inelasticity of supply and market frictions provide the rational for a natural vacancy rate in the same fashion as there is a natural unemployment rate in the labour market[6]. Market frictions in the housing market include the interaction of landlords and tenants to minimize search and recontracting costs, inventory holding costs, variability of demand, credit imperfections and long term contracts. The authors posit a model that determines the real rent changes within the critical zone of occupancy;

$$dR = f( dE, V^n - V ) \quad \text{where,}$$

dR: is the rate of change in average nominal rents

dE: is the rate of change in total average operating costs where dE essentially reflects nominal price influences on dR

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[6]See also A. Alchian (1970)

$V^n$: is the natural vacancy rate. Over the short run it is assumed that the supply and demand functions are embodied in this term.

V: is the current average vacancy rate

In the empirical model tested they assumed the natural vacancy rate, $V^n$ was constant over the estimation period allowing it to be embodied in the constant term. An additional lagged vacancy variable was added to correct for any possible lagged responses.

The model was tested using data from 17 U.S. cities for the period 1969 to 1980. An estimation was made for each individual city and for a pooled cross section of all cities. For 13 of the cities, vacancies were significant in explaining the percentage change in rents at the 95% confidence level. The cross sectional model had the following results:

| | Constant | $dE_{t-1}$ | V | $V_{t-1}$ | $R^2$ |
|---|---|---|---|---|---|
| Coeff. | 9.08 | .05 | -.21 | -.28 | .24 |
| (t) | (15.9) | (2.51) | (2.26) | (3.16) | |

Unfortunately, the SSE and F statistic were not provided. The results seem to verify the effect of vacancy levels on price adjustments. Unfortunately, from the results it is not possible to tell if there is any asymmetric price behaviour below and above the natural vacancy rate.

The authors also used the price adjustment model to estimate a value for the natural vacancy in each city. This value was regressed against a series of independent variables thought to have some explanatory value. Some of the results are relevant to the office market discussion. It was found that rent dispersion was significant and had a positive effect on the natural vacancy rate. This suggests that a larger range of rental prices will normally increase the length of time required to find the desired rental unit. This would place pressure on the natural vacancy to rise to facilitate easier search. Both the change in housing stock and population over the estimated period were significant and had a positive effect on the natural vacancy. This indicates that price speculation and higher expectations of future demand allow landlords to increase the amount of vacant space they are willing to hold.

**Dennis A. Capozza,** New Evidence on Rents and Vacancies, **(1980)**

This paper tests two additional elements of price adjustment theory which should be embodied in the model specification; price asymmetry and inflation expectations. Capozza derives a simple model of the housing market where landlords are faced with an uncertain demand curve. A landlord sets rents initially, then observes the duration and level of

vacancies before he readjusts them for the next period. At no time can a landlord rent more units then he currently has in stock. The short run solution yields two equations for rent adjustment. Each are applied dependent on the whether the current vacancy level is above or below the long run desired vacancy level, $V^n$.[7] For vacancies levels below $V^n$, rental price changes are dependent only on the vacancy rate and the slope of the curve is relatively steep as the vacancy level decreases. For vacancies above $V^n$, rental price changes depend on marginal variable operating costs and the vacancy rate. The slope of the curve is much flatter than the former as you increase vacancies. If you combine the two equations you create a function that is similar to the kinked Phillips curve.

Capozza draws the following conclusions:

1. The change in rents is a decreasing function of vacancies.

2. Short run demand shifts suggest that there is a nonlinear or inverse relationship between changes in rents and vacancies.

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[7]Vacancy levels below the long run vacancy level are considered to be the range of full occupancy.

3. The relationship of rent changes to vacancies and operating costs is asymmetric. Vacancies influence rent changes less at high vacancies and variable operating costs are only relevant at high vacancy levels[8]. Fixed operating costs are not part of the relationship[9].

4. In a world of rational expectations and persistent inflation, landlords will try to set rents in real terms. As inflation has been prevalent since 1960 the rental price adjustment model should include a variable for inflation expectations to determine how well landlords have been able to keep pace with the price level.

To test the model, Capozza looked at the rental housing market in Los Angeles using available data for the period 1952 - 1976. His plot of percentage change in rents against vacancy shows a definite non linear relationship that provides evidence of price asymmetry. A series of regressions are done using the percentage change in nominal rents as the dependent variable. The independent variables are a combination of vacancy variables and various proxies for inflation

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[8]C.P. Rydell (1979) also argues that rents will be insensitive to demand when vacancies are high. Vacancies bear the burden of the demand shifts.

[9]To the extent that fixed operating costs are passed on to the tenant in the office market they may be relevant. See J.D Shilling et al. (1987)

expectations. The variables used for inflation expectation proxies are the long term government bond rate, $i_{Bond}$ and a moving average of past inflation rates, $MAvg_{CPI}$.[10] The more pertinent empirical results are given below:

| | Constant | V | 1/ V | $i_{Bond}$ | $MAvg_{CPI}$ | $R^2$ |
|---|---|---|---|---|---|---|
| Coeff. | 5.83 | -1.14 | | | | .23 |
| (t) | (4.55) | (-2.59) | | | | |
| Coeff. | -.60 | | 8.51 | | | .24 |
| (t) | (-.48) | | (2.67) | | | |
| Coeff. | -5.65 | | 10.83 | .89 | | .82 |
| (t) | (6.58) | | (6.76) | (8.47) | | |
| Coeff. | -1.25 | | 4.91 | | .64 | .83 |
| (t) | (-2.03) | | (3.04) | | (8.61) | |

The results show that the inverse of vacancies, 1/V is a better specification for the model. The significance of the vacancy term and the explanatory power of the model is substantially improved by the addition of the inflation

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[10]E. Fama (1976) shows that interest rates are a good proxy for inflation expectations. This follows from the Fisher hypothesis that all variation in the interest rate is due to inflationary expectations since the real rate is constant. The moving average term was estimated using an ARIMA (0,1,1) time series model.

expectation variable. It appears that landlords were able to pass 60% to 84% of the expected inflation over to tenants.

There are other studies of rental price adjustment in the housing market[11]. Several find empirical results which downplay the importance of vacancies in the rental price adjustment process. However, Capozza points out that this may be due to specification error in the regression model. For the most part, the housing market papers presented briefly here embody the evidence that is consistent with the papers on the office market and the arguments presented in this thesis.

## 2.3 Rental Price Adjustment in the Office Market

There are only 3 papers which have been written on the price adjustment mechanism in the office market. All have been completed within the last few years and there is certainly room for further and more rigorous analysis. As mentioned before the primary stumbling block to research in this area appears to be a lack of good data sets. A fourth paper reviews some of the problems found in collecting office market data.

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[11]See F. De Leeuw and N.F. Ekanem (1971), L.B. Smith (1974), A.A. Eubank and C.F. Sirmans (1979), R.C. Fair (1972), and D.M. Blank and L. Winnick (1953)

Ken T.Rosen, Toward a Model of the Office Building Sector, (1984)

Rosen is the first to try and build a complete model for forecasting the behaviour of the rental office market. He develops a statistical model of supply and demand where the key variables are the stock of occupied space, the new construction flow, the vacancy rate, and the rental rate.

Predicting office demand requires estimating the growth in office employment and properly specifying the rental price adjustment mechanism to estimate future rents. Office employment is the key demand variable. Rosen uses employment in the Finance, Insurance and Real Estate sectors as a proxy for office employment.[12] The rental price adjustment mechanism is posed in a similar fashion to that suggested by Rosen and Smith (1983) for the housing market. The vacancy rate affects rents in a non linear fashion. Rents fall (rise) more rapidly the further you move from the optimal vacancy rate. His model therefore takes the form;

$$dR = f( V_t - V^n_t, dP_{t-1} ) \quad \text{where,}$$

dR: is the change in average nominal rents

[12]See H. Kelly (1983) for a discussion of this assumption.

$V^n_t$: is the optimal normal vacancy rate.[13]

$V_t$: is the current vacancy rate

$dP_{t-1}$: is the change in the consumer price level to adjust nominal rent changes to real rent changes. This appears to be the proxy for inflation expectations

Rosen used a fairly extensive data set from the San Francisco Office Space Network. Data is for the period 1961 to 1983. In his empirical model he assumed that the optimal vacancy rate was the average rate over the period, 7%. The results were as follows;

| | Constant | $(V^t - 7\%)$ | $dP_{t-1}$ | $R^2$ |
|---|---|---|---|---|
| Coeff. | 1.53 | -2.09 | 1.82 | .55 |
| (t) | (.39) | (-2.72) | (3.08) | |

Unfortunately, there is no further statistical information to provide further diagnostics. Although there is definitely some significance in the coefficients there are some apparent weaknesses in the analysis. First, the assumption of a constant optimal vacancy rate is probably a misspecification given the extensive period of estimation. Second, although he mentioned in the paper there is a nonlinear relationship

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[13]K. Rosen posits that $V^n_t = f(\ i,\ E(R_t)\ )$ which implies that higher interest costs will lower the normal vacancy rate and higher expected rents should raise the normal vacancy through price speculation. Expected demand flows through the rent variable.

between rent changes and vacancies the model does not test this result. The coefficient on the price level variable is rather interesting. The value, 1.82 implies that landlords were able to pass on rental increases that exceeded the rate of inflation. This may be a result of long lease terms and the necessity to capitalize inflationary increases over the full life of the lease.

John Hekman, Rental Price Adjustment in the Office Market, (1985)

The main focus in this paper is the proposition that developers over respond to high rents in the short run and formulate superficially high expectations of profit opportunities. His approach embodies a model of rental price adjustment.

Hekman makes the important point that the office markets between various cities can be extremely heterogeneous. The primary demand variable, the growth rate of office employment will vary between cities depending on the industry focus and the composition of employment. When estimating any model of the office market it is important to use a cross sectional analysis and capture any local effects.

Hekman assumes that the office market is competitive and that each landlord is a price taker. Since supply of

office space is determined by past investment decisions and does not respond to current rents it is reasonable to assume that supply is fixed in the short run. Rent changes are therefore affected only by the forces of demand. His model of rent adjustment is different from Rosen in that the dependent variable is the absolute value of rent rather than the change in rent;

$$R = f( V, GNP, E_i, U_i ) \quad \text{where,}$$

R: is the real rent for class A downtown buildings under construction. Quoted nominal rates are adjusted by the current price level

V: is the current vacancy level in existing Class A downtown office buildings.

GNP: is the gross national product. This is a measure of national demand.

$E_i$: is the level of employment in SMSA i. This variable is meant to provide a control for city size.

$U_i$: is the level of unemployment in SMSA i. This variable is intended to capture local demand effects.

The data is taken from The Office Network: National Office Market Report. Data is from 14 U.S. cities and the period is from 1979 to 1983. The results of the empirical tests on the cross sectional time series model are as follows;

| | Constant | V | GNP | E | U | $R^2$ |
|---|---|---|---|---|---|---|
| Coeff. | -4.47 | -.0019 | 3.64 | .00017 | .012 | .37 |
| (t) | (-1.88) | (-2.41) | (2.26) | (4.54) | (.80) | |

F = 9.70

Elasticities: E(R,V) = -.08, E(R,GNP) = 4.45, E(R,E) = .24

The results again show the significance of vacancies in determining rents. All the other variables have the correct sign and are significant with the exception of the unemployment variable. This variable is neither significant nor does it have the correct sign. Although specified differently than Rosen, the elasticities provide some insight on the price adjustment process. The vacancy elasticity implies that if you double vacancies, rents will only drop by 8%. This seems to be consistent with the proposition of price rigidity at high vacancies, however, this elasticity would predict the same low price response if vacancies suddenly decrease. This is not the expected result if you have a large positive demand shock. The large GNP elasticity suggests that rents are strongly affected by shifts in the national economy. The employment elasticity suggests that rents will only increase 24% as fast as city size.

Given the theory presented in this chapter it would seem that Hekman is not properly specifying the rental price adjustment model. Although his results are significant they do

not provide definitive verification to some of the propositions on adjustment. In addition, the estimation period, 1979 to 1983 would seem to be a bit short for a rigorous empirical test even though Hekman maintains the data set is superior to any so far tested.

**James Shilling, C. Sirmans and John Corgel, Price Adjustment for Rental Office Space, (1987)**

The paper rationalizes the office market model in light of the current literature on inventory.

1. Vacancies allow landlords flexibility in reacting to unanticipated events.

2. Differences in the marginal costs of holding vacancies, and fluctuations in expected demand explain variations in the normal vacancy rate.

Price adjustment should be strongest when vacancies are below the natural vacancy rate and weakest when they are above. This assumes that marginal costs of holding vacancies are relatively constant over the range of vacancies in the short run.

Some good intuitive insights into the office market are covered in this paper. As office space is produced slowly,

often starting 2 to 3 years in advance of opening it is optimal for both landlords and tenants to have vacancies to respond to unanticipated demand.[14] Vacancies may also provide tenants with lower search costs and remove the requirement to commit to space long in advance of the move. In the housing market the level of vacancies required for this constraint may be small.[15] No study has shown whether this result carries to the office market as well. The authors suggest the inventory holding cost function is fairly constant in the short run. This implies that the level of vacant space is not critical. Faced with a temporary demand shock and the prospect of long leases landlords may be better to wait and sit on the vacant space until a future period when rents are higher.

The model used by the authors is similar to the one used by Rosen and Smith (1983) in the housing market;

$$dR = f( dE, V^n - V ) \quad \text{where,}$$

dR: the rate of change in real rents. The consumer price index is used to adjust nominal rents

dE: the rate of change in total real fixed and variable operating costs[16]

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[14] See also A. Alchian & W.R. Allen (1982)

[15] A. Alchian & W.R. Allen (1982) estimate that 3% of rent paid by apartment dwellers covers the cost of vacant apartment space.

[16] In this model dE is no longer measuring the nominal price change in rents as it was in the Rosen and Smith model. Instead, the variable measures the degree to which marginal

$V^n$: the normal vacancy rate. Over the short run it is assumed that the supply and demand functions are embodied in this term.

V: the current vacancy rate

In the empirical test, the authors also add an interaction term, dR*V to test any nonlinearities in the relationship and a lagged vacancy variable to catch lagged response. The data used comes from the Building Owners and Managers Association (BOMA) Experience Exchange Report. 17 Cities in the U.S. are tested for the period 1960 to 1975 and the data looks at downtown office space between 50,000 and 600,000 square feet. The model was tested for each city. No cross sectional analysis was done to take advantage of a larger data set.

The general results show dE as an insignificant variable. This indicates that fixed and variable operating cost are not a significant component of inventory holding costs. The lagged variable was not significant. The interaction term was significant in most cities indicating that the relationship between rent changes and vacancies is non linear. Unfortunately, this result was not emphasized by the authors. The vacancy variable was significant for all of the cities and the $R^2$'s were all in the .7 to .98 range. An

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operating costs affect inventory holding costs which in turn affect the price adjustment mechanism. Changes in operating costs should not affect rents if the leases are fully net unless the fixed portion (like real estate taxes which have to be paid whether space is vacant or not) is a significant factor.

attempt was also made to verify the normal vacancy rate for each city in a fashion similar to Rosen and Smith (1983), however, the results were insignificant and somewhat inconclusive.

**A. Eger and J. G. Smith, The Delphi Approach: A Survey of Canadian Office Construction in 1986, (1987)**

Although this paper does not deal directly with price adjustment it provides some good discussion on characteristics of the office market and some of the data collection problems.

The major problem with empirical studies in this area is the collection of rental price data. There is a tremendous range of rental contracts in the market and one must be careful when using secondary data sources. Since most sources provide average rents one must ensure that the data is carefully selected. For example, existing rents are not necessarily indicative of current market rents. Leases are usually for 5 year periods and therefore reflect old rents. Thus only quoted asking rents or recently contracted leases should be used.In addition, attention should be paid to the type of tenant behind the rental contract. There is a real disparity between rents paid by anchor tenants and the posted market rent paid by speculative tenants. Anchor tenants typically pay 20% - 30% less than market rents, typically occupy 40% - 60% of the total building space and often have

lease terms up to 20 years with little rent escalation. Finally, rents will range substantially through the various classes of office space and through the various locations of the office space in the city. These points indicate a need to qualify the type of tenant, the quality and location of space, and the contract date of the lease when recording the rental price.

Another major discrepancy in rental data is the common use of tenant inducements in the current office market. Free rent and cash inducements can reduce the effective rent to as little as 50% of the posted market rent.[17]

The authors suggest that their Delphi model which uses a survey of 135 public and private developers in 6 Canadian cities is a better method of recording actual behaviour and data than collecting secondary data from industry sources of questionable validity.

One of the interesting findings of their survey is that vacancy rates within a range of 5% to 15% are deemed to be normal. Rates may vary within this range for as long as 18 months before it will affect expectations.

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[17]See P. Goldstein (1985) and the Toronto Planning Department: 1986 Quinquennial Review.

## 3.0 THE OFFICE MARKET IN CANADA

This chapter reviews the office markets in five Canadian cities; Montreal, Toronto, Edmonton, Calgary, and Vancouver. As a starting point for discussion, time series plots have been constructed with the data on nominal and real rents, and vacancies for each city.[1] A further review of events that took place during the analysis period provides some of the economic and political underpinnings in each city which will help shed some light on the data and the price adjustment mechanism.

### 3.1 Montreal

The time series plot for Montreal is shown in Figure 3.1.1. Nominal rents increase consistently through the late 1970's and early 1980's in response to the rapidly declining vacancy rate. However, when the vacancy rate climbs to 16% in 1983, the nominal rents level off for a 3 year period before climbing again when the vacancy level drops to 11%. The most curious feature of the plot is the behaviour of real rents. Real rents should indicate the true price adjustment

[1] An explanation of the data and its collection is provided in Chapter 4.

mechanism.[2] Between 1977 and 1982 vacancy rates dropped rapidly to an all time low of 1%. Strangely enough real rents do not respond to the sharp dip. Theory predicts that real rents should increase rapidly to choke off demand and maintain an equilibrium vacancy level. Furthermore, in 1983, when vacancies begin to climb there is an immediate drop in real rents. No price rigidity is observed. Only when the vacancy drops to 11% in 1986 do real rents finally begin to climb back to pre 1982 levels.

The Royal LePage Market Survey and other various sources were used to provide a glimpse of the background events occurring in the analysis period. The city of Montreal was historically the commerce hub of Canada. However, over the years, this economic power has been gradually eroded and Toronto has emerged as the new dominant financial and commercial focus.[3] The most dramatic shift occurred in the 1970's as a direct result of significant political changes in the province of Quebec. In 1976, the Parti Quebecois government under Rene Levesque was elected with a mandate to separate Quebec from the rest of Canada. The radical government immediately proposed to make french the only business language and suggested a possible nationalization

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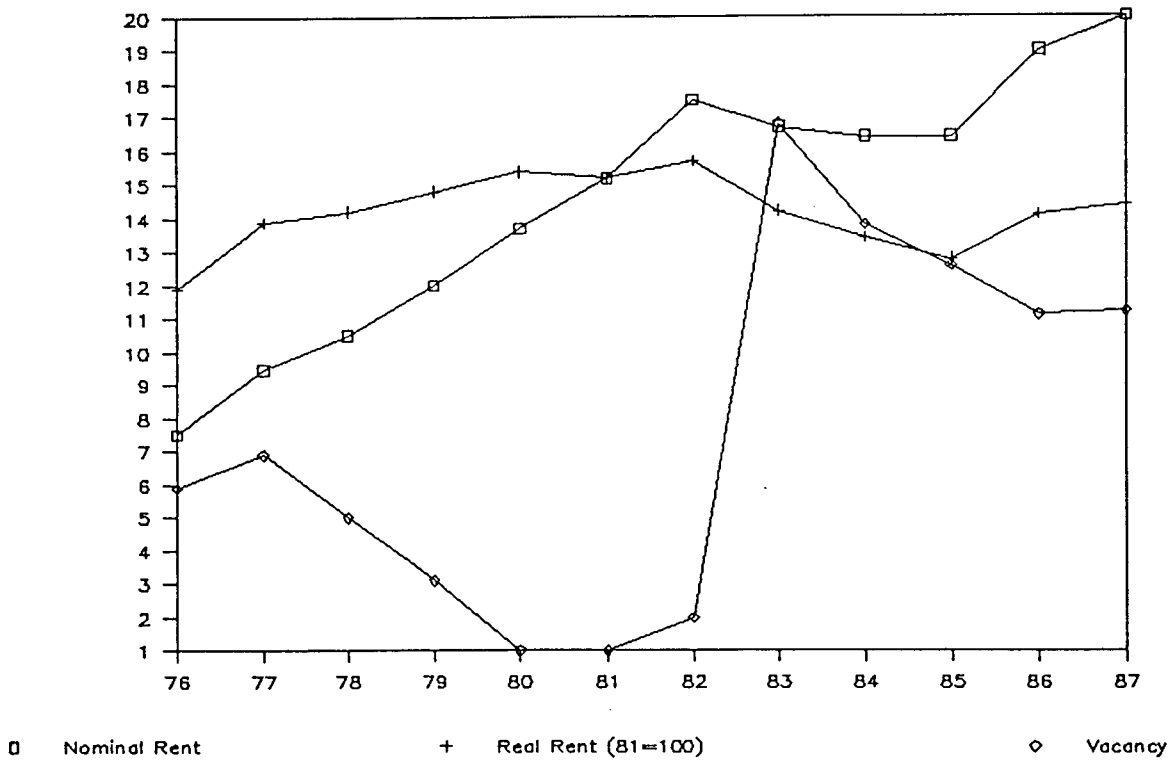
[2]D. Capozza (1980) points out that landlords operating in an inflationary world will respond to real rent levels.

[3]See R.K Semple and W.R. Smith (1981)

FIGURE 3.1.1

Time Series: Rents and Vacancies

MONTREAL




Source: Royal LePage Market Survey

of selected product and service industries.[4] These events had a profound effect on the confidence of businesses operating in Montreal. Crown corporations like CN and Air Canada and national corporations like CP who were all headquartered in Montreal were faced with the potential prospect of having to operate their Canadian operations from a foreign country. In addition to the political situation in the late 1970's, there were other factors at work. Provincial taxes in Quebec were the highest in Canada and there were numerous public and private sector strikes. Overall, the business climate was extremely shaken and it triggered a mass exodus of corporations and professional employees out of Quebec. As an example, in 1977, the Montreal business community was stunned by the decision by Sun Life Assurance Co., an 8 billion dollar company, to move their massive headquarters and operations to Toronto. Their reason was the companies disfavour with the proposed language Bill 101.[5] Overall, between 1971 and 1981, Statistics Canada recorded a shift of over 50,000 finance and service jobs out of Montreal.[6]

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[4]See Vancouver Sun March 12, 1983

[5]See Vancouver Sun March 12, 1983 and R.K. Semple & M.B. Green (1983) for a discussion of corporate relocations in Canada.

[6]See D. Hooper et al. (1983). Most of this employment appears to have moved to Toronto as they showed a net gain of 49,200 jobs in these two sectors in the same period.

The effect on the Montreal office market was significant. As shown in Figure 3.1.3, absorption of space dropped from over 1,500,000 sqft in 1976 to 600,000 sqft in 1977. This trend continued to persist into the mid 1980's. Lease contracts dropped from the normal 7 - 10 year to 3 - 5 terms and many were written with escape clauses allowing tenants to cancel the contract should the province separate.[7] New office construction dropped to a slow trickle between 1976 and 1982. Developers were likely resistant to start speculative projects pending the outcome of the separation referendum in 1980 and the results of the provincial election in 1981. The Royal LePage Market Survey (1976) suggests that this was exacerbated by new zoning bylaws passed in late 1976 that restricted high rise development in the downtown core. Figure 3.1.2 shows that total office space increased only slightly during this period. The sharp dip in vacancy levels was obviously from extremely low levels of new supply and not from overheated demand.

The price adjustment mechanism in Montreal between 1976 and 1982 becomes a little more transparent with this information. The effect of reduced business confidence combined with a decrease in new construction may explain the

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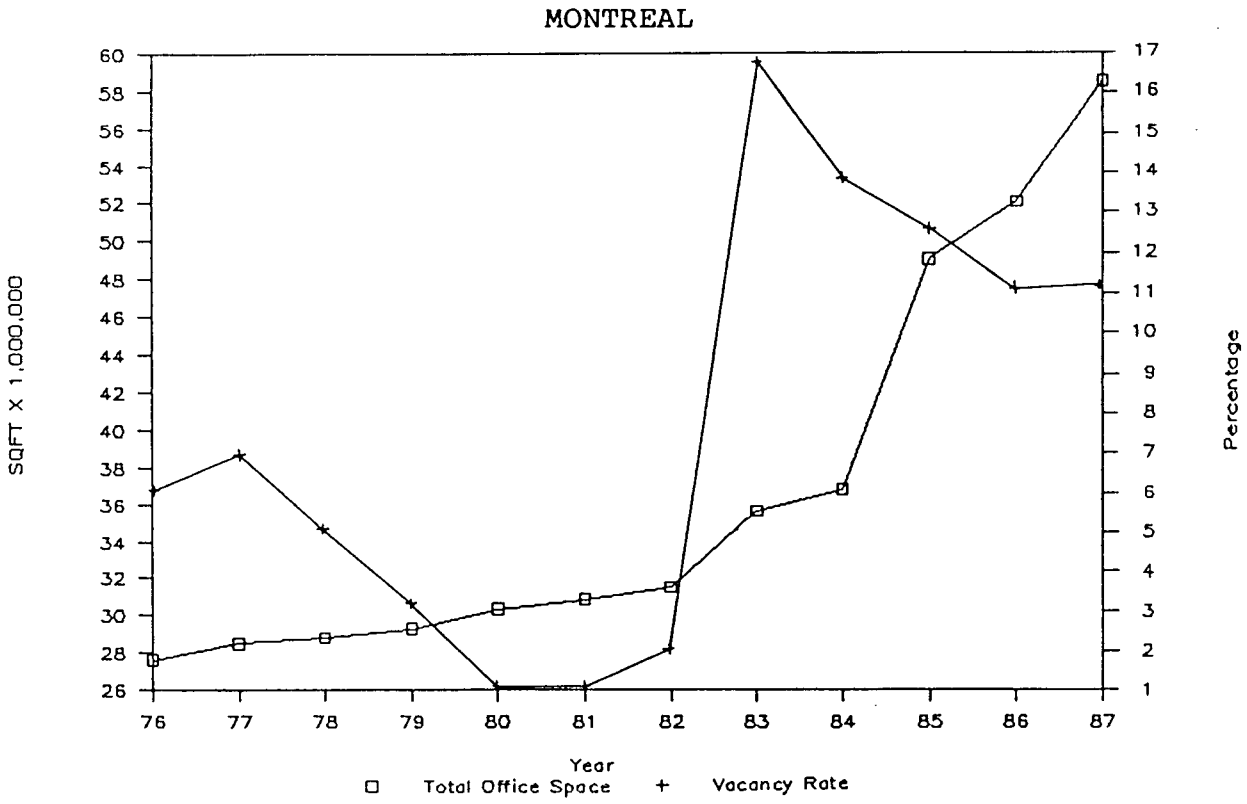
[7]The Royal LePage Market Survey (1978) reports that an informal survey of contracts shows a decrease in the average term of leases and the common inclusion of escape clauses.

FIGURE 3.1.2

Time Series: Total Office Space and Vacancies

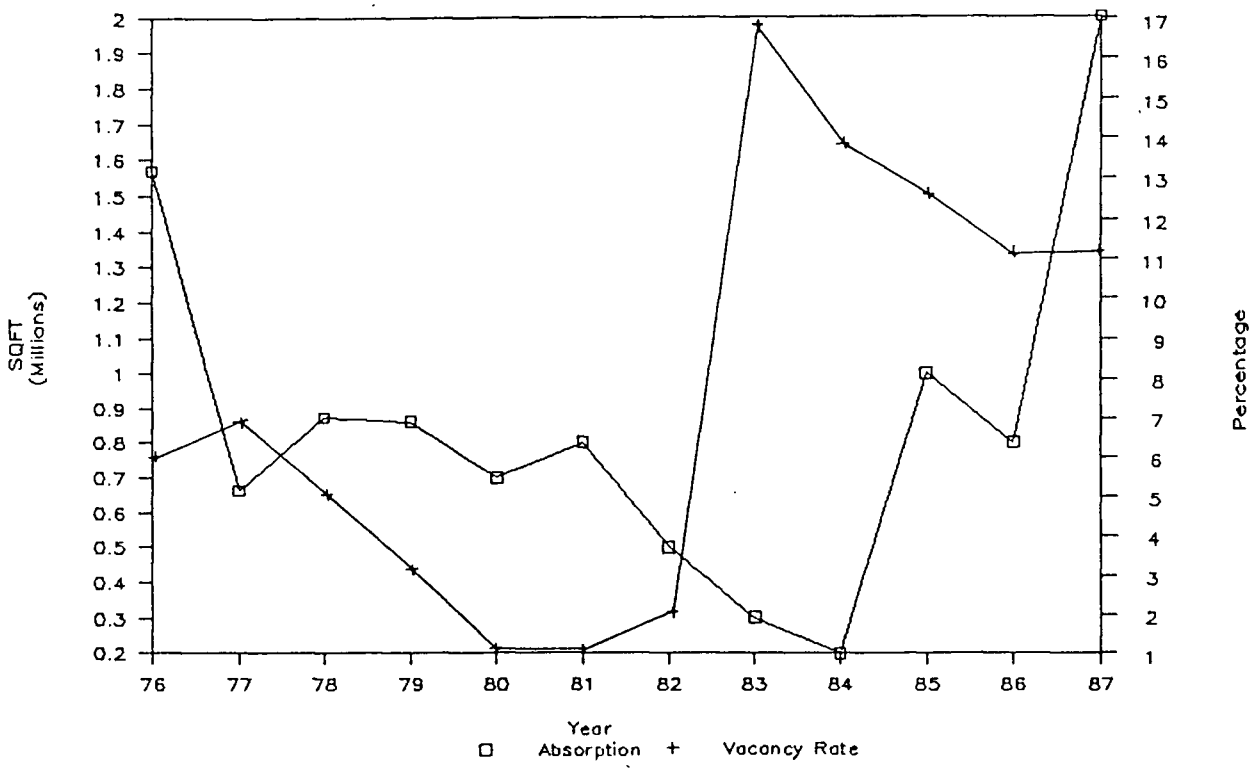



Source: Royal LePage Market Survey

FIGURE 3.1.3

Time Series: Absorption and Vacancies

MONTREAL




Source: Royal LePage Market Survey

low response of real rents in the face of low vacancy levels. The Royal LePage Market Survey (1979) suggests that real rent levels may have fallen even further if not for the extremely low number of available contiguous Class A space over 50,000 sqft. which allowed for some nominal rent escalation during the period.

The doom and gloom in Montreal seemed to recede after the referendum was defeated and the reelection of the PQ in 1981. The business community seemed to gain confidence in what appeared to be a more moderate government. The office market responded with an announcement by both Trizec Corp. and Marathon Realty to build two new major office projects. Unfortunately, the renewed confidence was not immediately felt as Montreal suffered from the national recession between 1982 and 1984. As Figure 3.1.2 and 3.1.3 show, vacancy levels increased dramatically through a combination of rapid drops in absorption and increases in new supply. A lot of existing tenants chose to upgrade to newer energy efficient Class A space and take advantage of depressed rent levels. This left a lot of older substandard space vacant that carried through to 1984 when the economy began to turn again.[8] After 1984, the office market regained some strength. A pro business attitude appears to have risen out of the provincial governments SPECS

[8]For a discussion of this point see the Royal LePage Market Survey (1985)

and QSSP programs and Montreal's renewed strength as a regional centre.[9] This combined with relatively cheap land prices in Montreal dramatically increased the addition of new office space.[10] Figure 3.1.3 shows that absorption also increased in this period.

Both real and nominal rental rates rose after 1985 in spite of the fact that the vacancy level only dropped to 11%. This may be an indication of an increase in the normal vacancy level. It has been suggested that normal vacancy levels have increased in all cities because of a filtering process in the office market. The demand for new energy efficient and modern buildings has created a surplus of older substandard space which is not considered to be suitable any longer. Its addition to the cities vacancy level is not felt to be significant.[11]

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[9] The SPECS program enables private companies to qualify for tax exemptions if they invest in other private Quebec companies who are not going public. The QSSP, the Quebec Stock Savings Program allows tax incentives for investments in new shares of Quebec companies providing they are held for two years (Royal LePage Market Survey 1986).

[10] Royal LePage reports that in 1985 the average land prices in Montreal were $200 per sqft as compared to $750 per sqft in Toronto and $625 per sqft in Vancouver.

[11] The Toronto Planning Department: 1986 Quinquennial Review discusses a rise in the normal vacancy rate from 5% to 10% in the city of Toronto.

## 3.2 Toronto

The time series data for Toronto is shown in Figure 3.2.1. There are two interesting features in this plot. Between 1968 and 1979, there is tremendous stability in the real rent level even though vacancy levels fluctuate between 1% and 10% during the period. Only decreases of the vacancy rate below 5% seem to elicit small sharp increases in real rates. This suggests a normal vacancy level near 5%. The stability of the real rental rate also suggests that landlords were successful in capitalizing inflation into nominal rate increases.

Between 1979 and 1983, the vacancy rate dropped well below the 5% normal vacancy level and as expected there was a corresponding sharp rise in both nominal and real rental rates. After 1983, both nominal and real rates plunged with the national recession.[12] Real rates did not return fully to the previous equilibrium level. This may be evidence of price rigidity and indicate speculative behaviour on the part of landlords. Generally the data for Toronto appears to be reasonably consistent with theoretical expectation.

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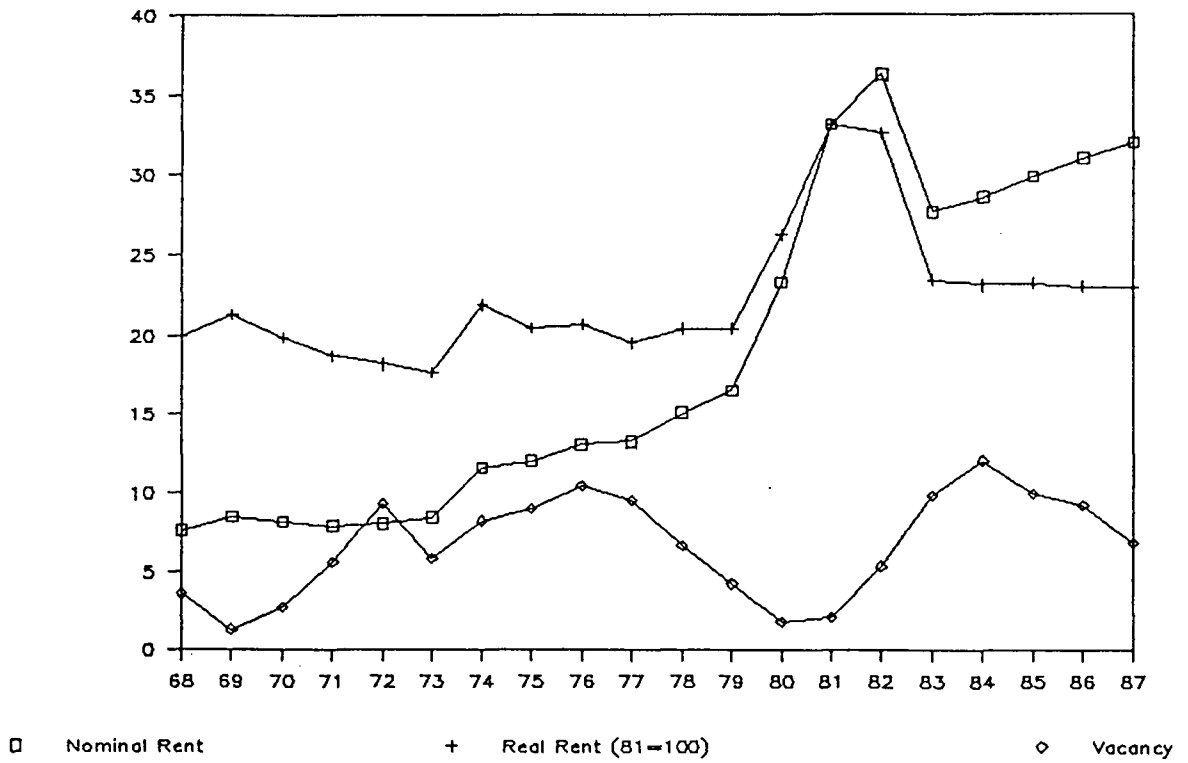
[12] The rental data for the period 1983 to 1987 was adjusted by Royal LePage to account for tenant inducements. A survey of tenant inducements was used as the measure of adjustment. This is a partial explanation for the plunge in both nominal and real rates. (Toronto Planning Department: 1986 Quinquennial Review)

FIGURE 3.2.1

Time Series: Rents and Vacancies

TORONTO




Source: Royal LePage Market Survey

The consistency of the price adjustment mechanism in Toronto is probably due to the size of the city and the relatively stable economic growth resulting from a diversified base. In terms of size, Toronto's inventory of downtown office space ranked third in 1986, exceeded only by New York and Chicago. It is the only Canadian city to achieve any stature in this ranking.[13]

Since 1950, Toronto has experienced rapid growth in both office floor space and office employment. In 1951, office space in Metro Toronto stood at 8,000,000 sqft and has doubled in every decade to over 90,000,000 sqft today. Figure 3.2.2 shows the growth of total office space in Toronto between 1968 and 1987. Office employment in Toronto was between 50,000 and 80,000 in 1951 and has blossomed to close to 500,000 in 1986.[14] This growth has been largely fueled by the ascendancy of Toronto to the role of Canada's most important business centre.[15] This is a trend which began in the late 1930's and sharply accelerated in the 1970's and 1980's when there was a

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[13]See the Toronto Planning Department (1987) for a statistical discussion on the major office centres in North America between 1980 and 1985.

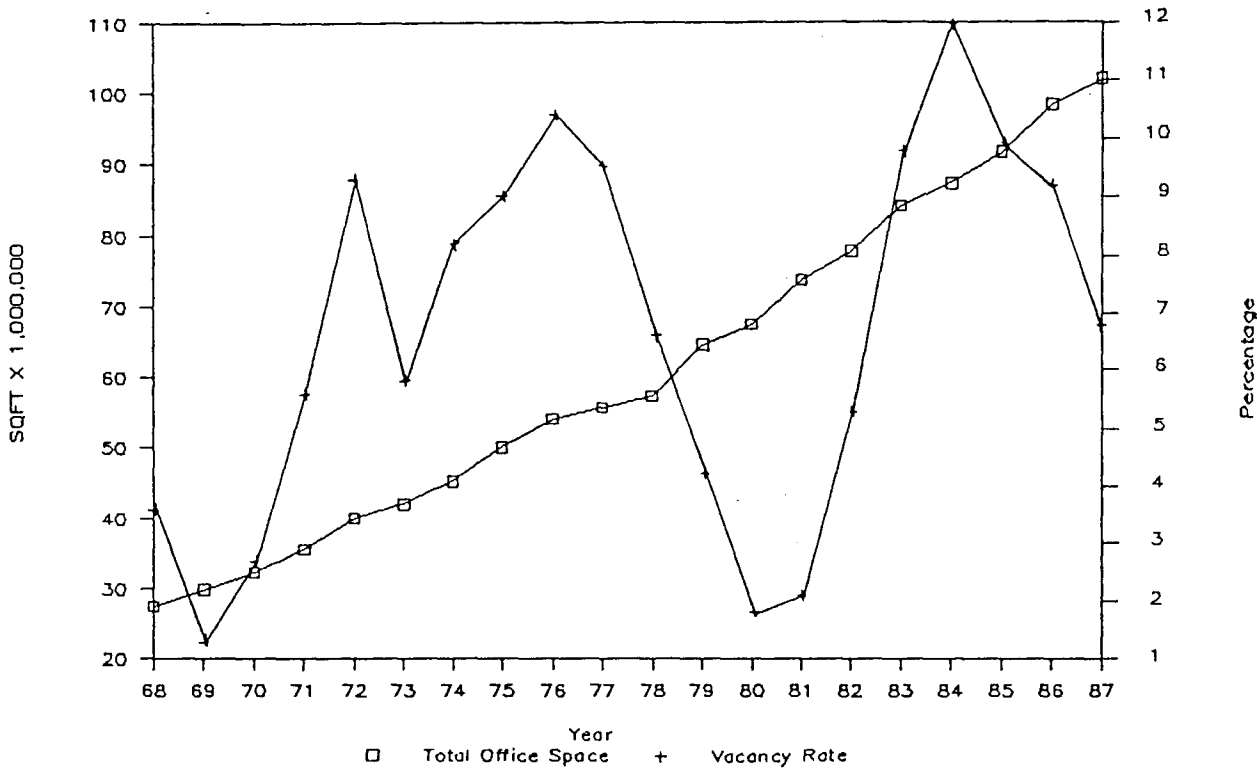
[14]See G. Gad (1976) and Toronto Planning Department: 1986 Quinquennial Review

[15]See D. Kerr (1982), and G. Gad and D. Holdsworth (1984)

FIGURE 3.2.2

Time Series: Total Office Space and Vacancies

TORONTO

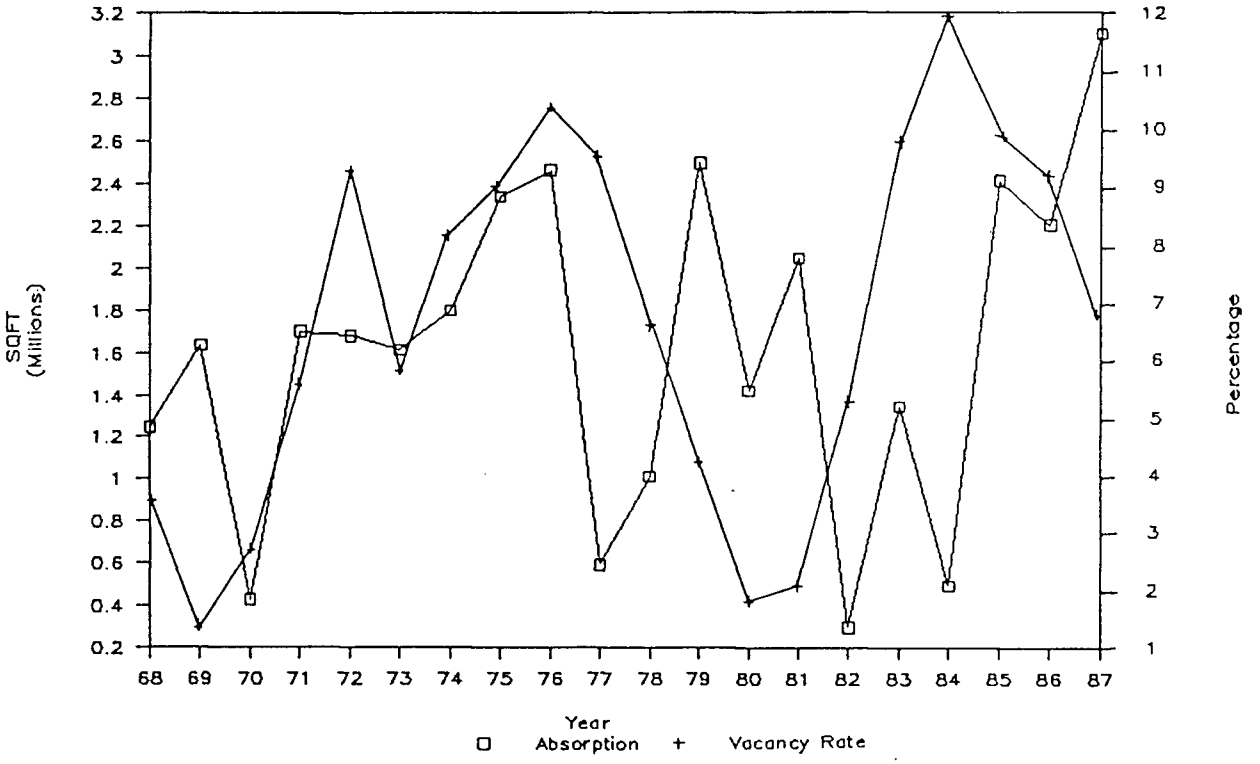



Source: Royal LePage Market Survey

FIGURE 3.2.3

Time Series: Absorption and Vacancies

TORONTO




Source: Royal LePage Market Survey

shift of corporate power from Montreal to Toronto.[16]

There are a couple of other events which should be noted in assessing the price adjustment mechanism between 1976 and 1982; office suburbanization and the decentralization initiative set out on the Toronto Core Area Plan of 1976.

Toronto has exhibited strong growth in suburban office space. In 1970, 82% of the office space in Toronto was in the Central District (CD).[17] Gad (1985) notes that this share decreased to 64% in 1984. The growth of suburban locations has been encouraged by the Core Area Plan adopted by the city of Toronto in 1976.[18] Notwithstanding this proportional shift,

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[16]See R.K. Semple and M.B. Green (1983). The federal government provided 47 charters to foreign financial institutions in February 1982. The majority of headquarters set up by the foreign banks subsequently located in Toronto.

[17]The Central District includes the financial core and several midtown business areas close to the downtown area.

[18]The objective of the Core Area Plan was to divert office activities from the core area to the 3 suburban nodes; Mississauga City Centre, Yonge Sheppard District, and Scarborough Town Centre. The intent was fourfold:

1. To stabilize or reduce downtown land rents.
2. To reduce redevelopment pressure on historic buildings.
3. Save core residential areas from commercial development.
4. To ease the pressure on downtown transportation facilities and increase the utilization of the "backhaul"

The Plan suggested downzoning core areas, providing density transfers in exchange for the preservation of historic downtown buildings and improving the suburban area transportation strategy. (Toronto Planning Dept.: 1986 Quinquennial Review)

there has been continued absolute growth in the CD. The end result has been the creation of two distinct office markets in Toronto. The rent differential between the two markets should effect the price adjustment mechanism by creating some hurdle point where firms are encouraged to shift between the two markets. Both Code (1983) and Gad (1985) have found that the rent differential has to be fairly significant before substantial shifting will take place. The strong information links that exist in the core maintain a strong rationale for firms to continue to locate there.[19]

A more important effect of the Core Area Plan on the price adjustment mechanism may have been the scarcity of buildable office space created through zoning restrictions. Gad (1985) suggests the resulting constriction of new office space combined with the influx of corporations from Montreal and the expansion of foreign banks are the most likely causes of sharp reductions in the vacancy rate and real rent increases in 1979 through 1982.

The Toronto Planning Department: 1986 Quinquennial Review maintains that the normal vacancy rate in Toronto has increased from 5% in 1976 to 10% in 1985. The ever increasing

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[19]W.R. Code (1983) found that a rent differential of $11.00 was required before firms begin to move out of the core.

growth of employment in the professional service sector, a noticeable rise in the Floor Space Ratio for office workers and the filtering of old buildings for new modern buildings has increased the demand for office space in the downtown core.[20] This has inspired confident growth expectations which seem to have increased the accepted normal vacancy rate and the accepted real rent level. This may be a partial explanation for the reluctance of real rents to fall back to the pre 1979 levels.

## 3.3 Edmonton

The time series plot for Edmonton is shown in Figure 3.3.1. In 1976, the 4% vacancy level appears to have prompted a sharp increase in both nominal and real rent levels. Following that year, vacancy levels hovered around 7% to 9% until 1981 and real rents continued to increase albeit at a reduced rate. Between 1981 and 1987 the vacancy rates rose to a level between 19% and 21%. Nominal rents continued to rise

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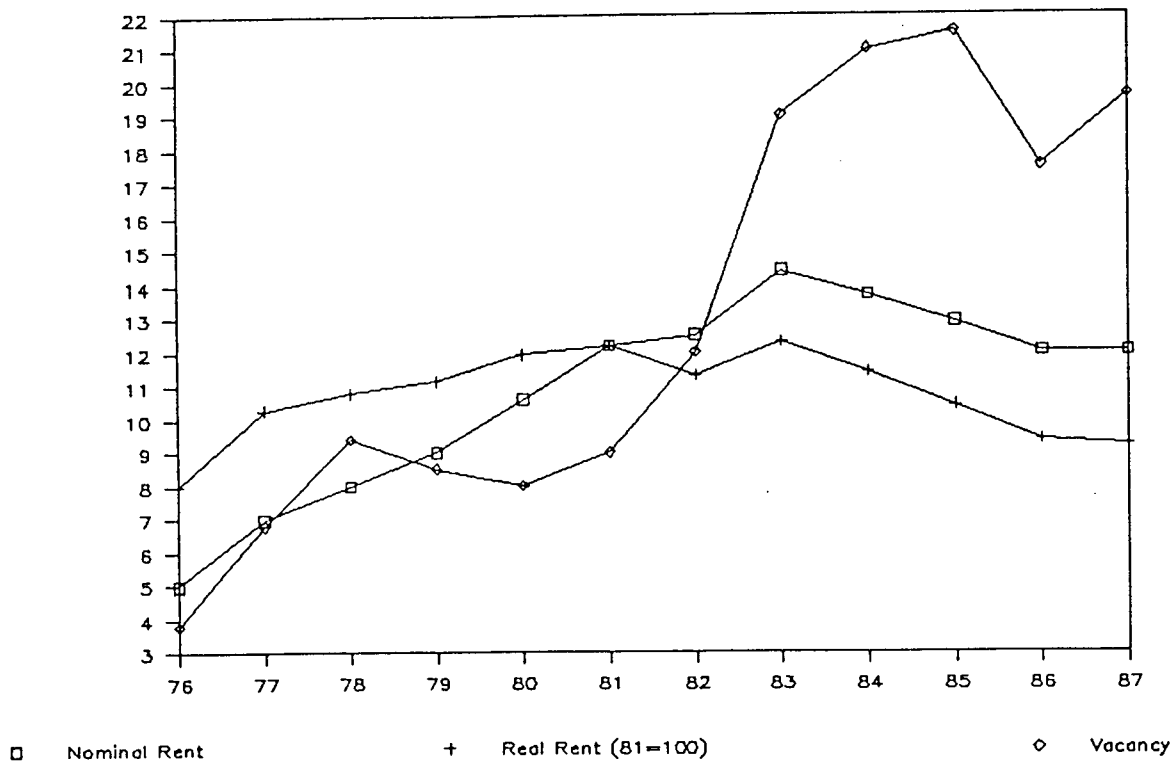
[20]Office employment in Toronto has increased 57% between 1971 and 1985 while manufacturing employment has actually exhibited declining growth.

Between 1975 and 1985, the FSW index increased 14% in Toronto. This implies that increased office space can be accommodated with diminishing impacts on the transportation system.

FIGURE 3.3.1

Time Series: Rents and Vacancies

EDMONTON




Source: Royal LePage Market Survey

until 1983. Real rents fell in 1982, however, they curiously climbed sharply in 1983 despite the steep increase in vacancy. Thereafter, nominal and real rents fell until finally leveling out in 1987. The fact that real rents in 1987 equaled those in 1977 even though the vacancy rate was 18% suggests some price rigidity occurred. Interestingly enough, over the 10 year period, even though vacancy levels fluctuated between 4% and 21% the real rent level has remained within a narrow range. This behaviour would seem to indicate that the normal vacancy level is somewhat higher in Edmonton than that observed Toronto or Montreal over the same period.[21] This seems consistent for high risk cities with single resource based economies. Larger buffer stocks are needed to weather the turbulent boom and bust cycles.

Edmonton is one of two Alberta cities who depend on the health of the petroleum industry. However, Edmonton is different than Calgary. Edmonton is the capital of Alberta so unlike Calgary, it enjoys some stability from the provincial government bureaucracy. In addition, Calgary is the head office and financial centre of the petroleum industry. Edmonton, on the other hand is located closer to the oil rich north and therefore provides broader support services for the

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[21] 5% appears to be the normal rate in Toronto in the period prior to 1981. Speculation now suggests this rate may have moved closer to 10%.(See Toronto Planning Department: 1986 Quinquennial Review)

petroleum industry. Many of the exploration and geophysical operations are based in Edmonton and most of the major assembly, installation and servicing of oil field equipment takes place in the city. Therefore, the Edmonton office market services two major tenant markets; the stable provincial government and the fluctuating petroleum industry.

The Royal LePage Market Survey provides a good review of the events that have affected the Edmonton office market over the last 10 years. In 1976, over 50% of the Class A space was being utilized by the Alberta government. However, this pattern was being tempered by the emergence of the petroleum industry as a significant economic force in the 1970's. Syncrude, a new multi billion dollar heavy oil plant located in Fort McMurray was initiated in 1974. The head office for the consortium was set up in Edmonton bringing many new professional employees into town. The Alaska - Mackenzie pipeline was announced and all through the late 1970's, extensive engineering and construction preparations were being made. The North East region of B.C. opened up for further natural resource exploration which added to exploration activity in the oil and gas sector which was already reaching all time highs. In 1978, the frenzy of petroleum activity stimulated a response by the development community to increase the office space in Edmonton by 2,300,000 sqft by 1980. Total building permits in 1978 exceeded $1,000,000,000 for the first

time. In 1979, Edmonton prospered from two major discoveries; the Elmworth gas field and the West Pembina Oil field. The latter was one of the most significant developments within the previous 10 years. In that same year, 5 multi billion dollar heavy oil megaprojects and two major petrochemical plants were in late stages of design. A survey conducted by Alberta Business Development and Tourism showed that there were 311 projects planned or underway totalling more than $22,000,000,000 in capital expenditures. The employment impact of this activity was more than 13,000 permanent jobs. Adding to the already stimulated office market was an announcement in 1979 by several major banks to split Alberta into northern and southern regions. Edmonton was finally going to gain a toehold in the financial sector, the jewel of the downtown office tenants.

By 1981, the Edmonton economy was at its height. Immigration to Edmonton exceeded 2,000 people per month and the city had recorded building permits in excess of $1,000,000,000 per year for the last four years. An additional 5,000,000 sqft of office space were scheduled for completion over the next 5 years. Together government and oil industry functions were absorbing office space at the rate of 1,000,000 sqft a year. This was remarkable for a prairie city which had less than 6,000,000 sqft of office space 5 years earlier. Total employment growth in the city since 1971 was up a

whopping 68%, second only to Calgary out of all other Canadian cities during the same period.[22]

The overall effect on the Edmonton office market between 1976 and 1981 is best illustrated in Figure 3.3.2 and Figure 3.3.3. The demand and supply of new space were both increasing at a rapid rate in the late 1970's. Unfortunately for the city, so much of the heated activity was to be very short lived. In 1982, after the collapse of the petroleum industry, all megaprojects were put on hold and the office market in Edmonton plunged into depression. In 1983, the vacancy rate rose from 12% to near 20% with the completion of lagged boomtime construction. Rental rates increased with one last surge in that year as absorption rose slightly one last time. By 1985 core vacancies were still at 19%, however, the overall city vacancy was only being held down by the government district whose vacancy stood at 12.3%. Rental inducements were being offered that reduced the quoted face rental rate from $12 to $14 per sqft to $2 to $3 per sqft.[23] New construction was still coming on the market yet no new major lease commitments were being made. The average deal was only 2,000 to 3,000 sqft. The cancellation of the Petroleum

---

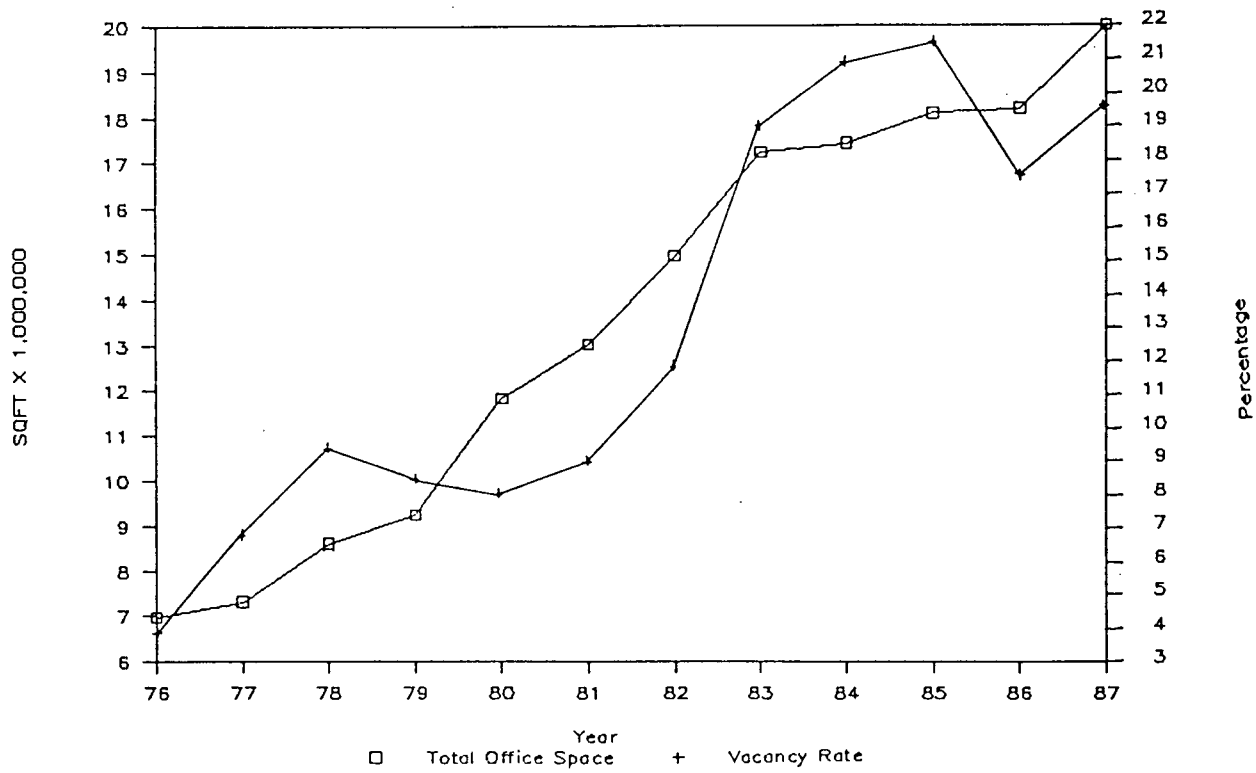
[22]The largest gains were made in the Finance, Insurance, Real Estate and professional services sectors. (D. Hooper et al. 1983)

[23]This may partially explain the reluctance of nominal and real rents to fall significantly in this period.

FIGURE 3.3.2

Time Series: Total Office Space and Vacancies

EDMONTON

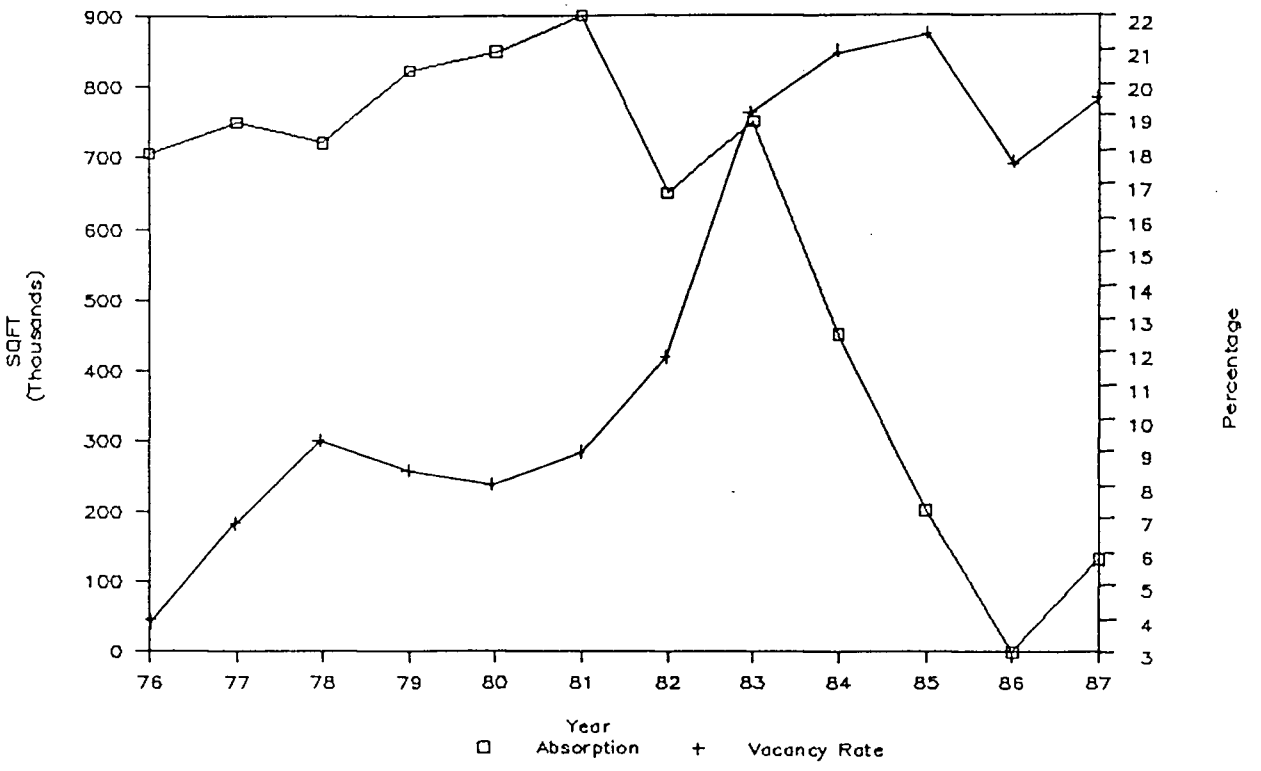



Source: Royal LePage Market Survey

FIGURE 3.3.3

Time Series: Absorption and Vacancies

EDMONTON




Source: Royal LePage Market Survey

Gas Revenue Tax (PGRT) and $700,000,000 in government aid in 1986 had little direct benefit on the office market. The only real activity seemed to be tenants upgrading from inferior space or moving to downsize their operations. In 1987, 10 year leases were common with inducement packages totalling $40 to $50 per sqft. Only the provincial government provided any spark to the market by preleasing 400,000 sqft of space in a building to be completed in 1990.

## 3.4 Calgary

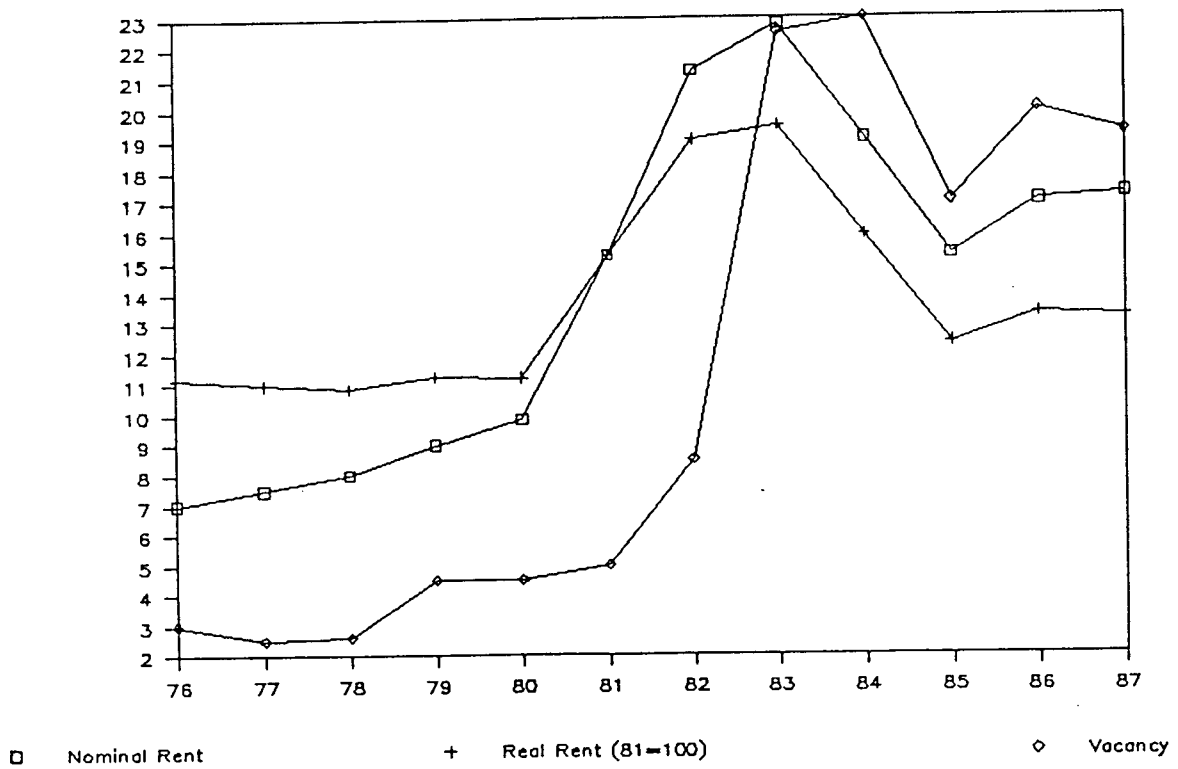
The time series plot for Calgary is shown in Figure 3.4.1. Calgary is an interesting case. Between 1976 and 1980 the vacancy level was below 5%. Throughout this whole period, the real rent level was rigidly stable at $11.00 per sqft. It seems to indicate an incredibly low normal vacancy level. This is even more incredible considering Calgary's dependence on one resource. One would expect the normal vacancy rate to be somewhat higher. The explanation may be in looking at the years prior to 1976. The Larken Office Space Review (1985) shows that overall vacancy levels in Calgary had been low since 1965.[24] Absorption was relatively consistent over the

[24]Calgary enjoyed two decades of steady economic and demographic growth. The major recession that hit North America in 1974 and 1975 had little effect on the city. (J. Whitehead 1987)

FIGURE 3.4.1

Time Series: Rents and Vacancies

CALGARY




Source: Royal LePage Market Survey

same period. The stability of the market obviously entrenched a low vacancy level into expectations and therefore stable rent levels were allowed to exist. Given the frenzy in the petroleum market in the late 1970's it is still strange that expectations took so long to change. Figure 3.4.2 and 3.4.3 show both total office and absorption increasing at significant rates after 1978.

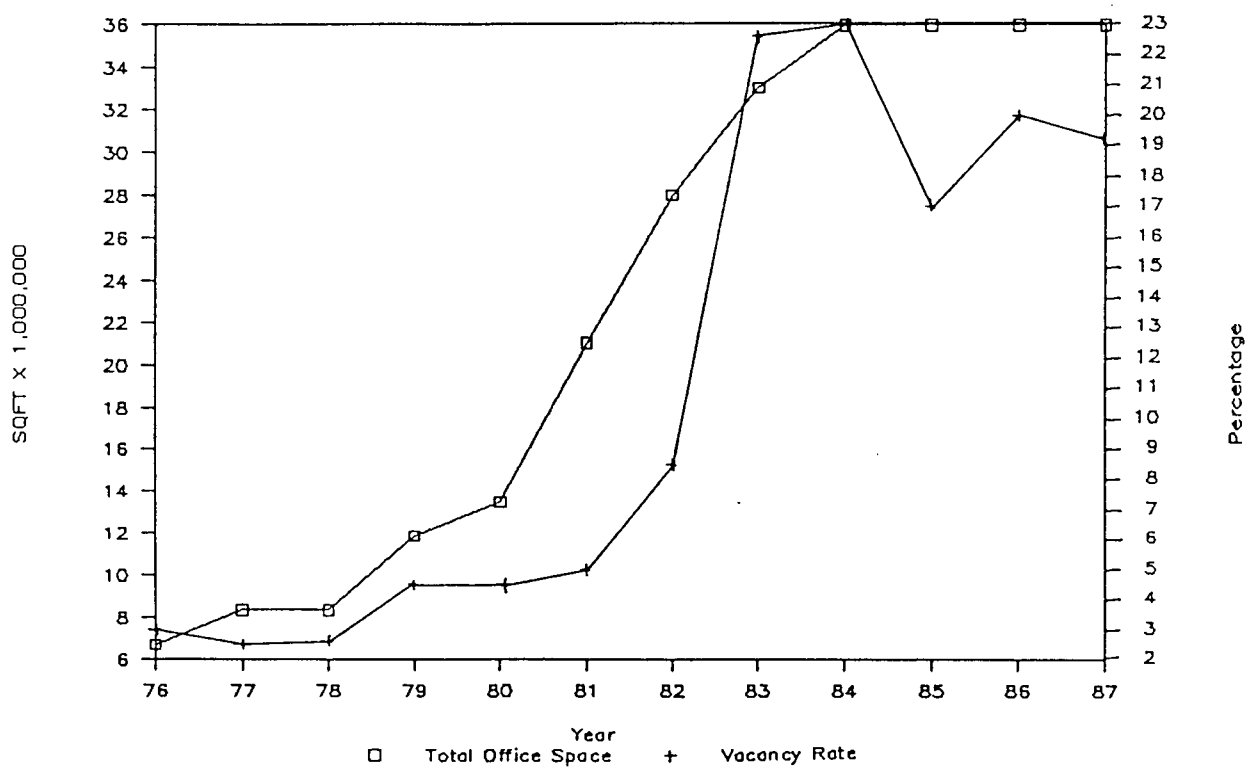
The change in the market seems to occur in 1981 when both nominal and real rents skyrocketed. The catalyst for this reaction appears to be the huge leap in absorption in 1981; over 5,000,000 sqft of space in one year. The boom was short lived as vacancy rates began to climb in 1982 and shot up to 22% in 1983. There was an immediate sobering effect on rents as they plummeted until 1985 where they finally appeared to level off. Some form of price rigidity seems to be in effect between 1984 and 1987 as real rent levels still exceeded the pre 1981 level while the vacancy rate remained over 16%. This must be tempered by the tenant inducement activity which has existed in the market ever since 1982.

Events in the 1970's lead to the boom years that existed in Calgary's office market. In 1970, all resource industries in Western Canada were acting at or near capacity and all over Canada buoyant commodity prices began to force wages and inflation up. When OPEC acted unilaterally in 1973 to raise

FIGURE 3.4.2

Time Series: Total Office Space and Vacancies

CALGARY

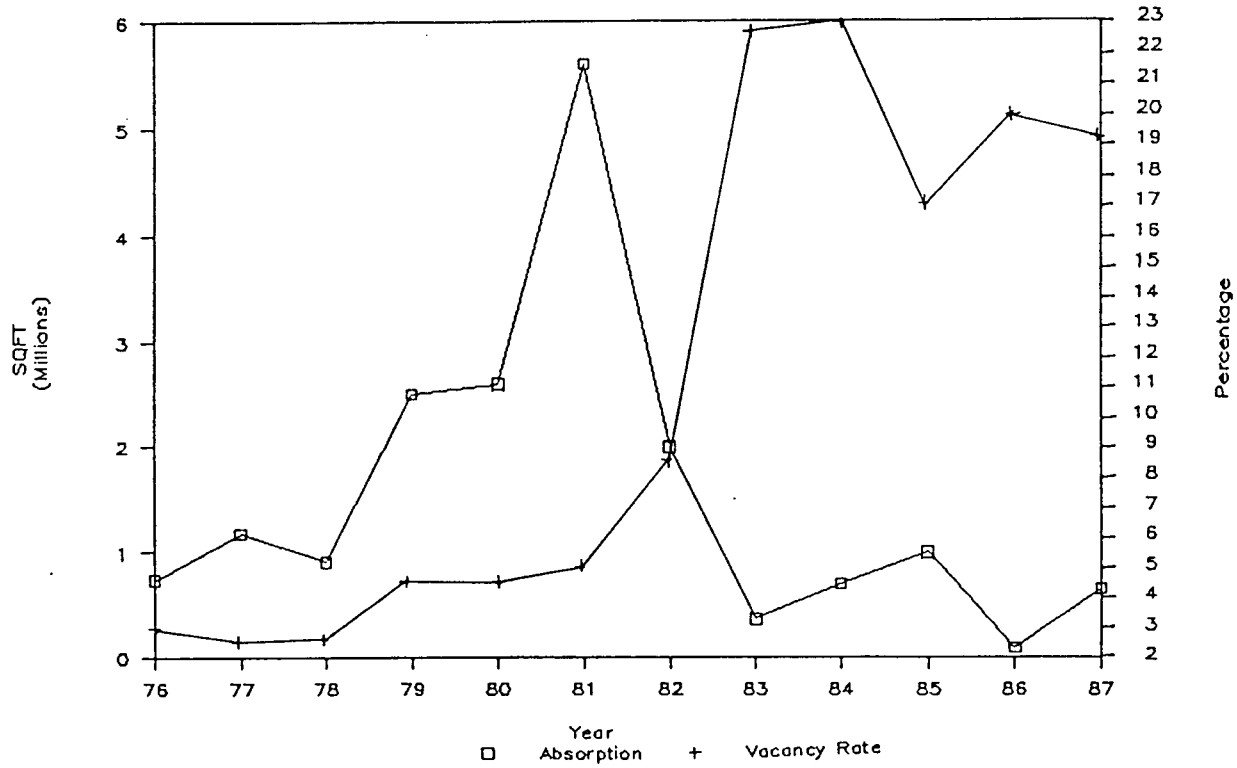



Source: Royal LePage Market Survey

FIGURE 3.4.3

Time Series: Absorption and Vacancies

CALGARY




Source: Royal LePage Market Survey

oil prices it hit most of the Canadian economy quite hard as energy conservation programs were put into effect. A tightening of the monetary system brought high interest rates which brought most of the country to a standstill in 1974 (Whitehead 1987). Calgary and Edmonton were the only exception to the rule. The effect of increased oil prices provided an electrifying jolt to the petroleum industry in both cities. The Provincial Government under Peter Lougheed saw the opportunity to create great wealth in the province. They immediately launched initiatives to rally the business community and promoted billions of dollars worth of megaprojects. The enthusiasm had a tremendous impact on the confidence level of investors and businessmen. Everyone seemed to become myopic in their vision of the future and there was a belief that no external event could stop the momentum (Whitehead 1987).

The boom in the petroleum industry filtered through to both residential and commercial property markets. Like Edmonton, Calgary experienced 4 years where annual building permits exceeded $1,000,000,000. In fact, the peak was close to $3,000,000,000 in 1981 (City of Calgary Building Permits Statistical Summaries 1979-84). Many of the new jobs created in Calgary during the boom period were service oriented

positions which were drawn to downtown locations.[25] This had a profound effect on the office market. As Figure 3.4.2 and Figure 3.4.3 show, both supply and demand spiraled up after 1977. Over 21,000,000 sqft of office space were added to existing inventory between 1976 and 1985 (Larken Office Space Review 1985). This was the largest relative surge in office construction ever experienced in North America (Whitehead 1987).

Much of the surge in office space was due to speculative development. Developers were convinced that new office construction, regardless of the location and type, was a sound investment. For a while this may have been true, however too many developers thought the same way and acted accordingly. The frenzy in the market was exacerbated by actions at the local government level. The City of Calgary had no master plan and little or no zoning bylaws for the downtown core and over reactions by all participants allowed indiscriminant use and density in many instances (Whitehead 1987).

The boom ended in the early 1980's as the petroleum industry began to shrink. Adding to the demise was the

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[25]Between 1971 and 1981 Calgary lead the country in employment growth with a 92% increase. Finance, Insurance and Real Estate sectors grew 115.6%, Service employment grew 99% and Construction employment grew by 138%. (Statistics Canada Cat. 72-002)

introduction of the National Energy Policy (N.E.P.) and the introduction of restrictive monetary policy. In the oil and gas industry, the collapse of investor confidence, high debt loads, shrinking markets, higher taxes and reduced cash flows brought the proverbial "house of cards" crashing down (Hayes and Jenish 1983). Some sectors of the oil industry experienced 50% reductions in employment. From 1982 through 1983, 44,000 jobs were lost in the city (City of Calgary InfoPak 1985). Migrations into Calgary flipped from a net positive inflow of 23,783 in 1981 to a net negative outflow of 12,730 in 1982 (City of Calgary InfoPak 1985). The reverberations were felt immediately in the office market as absorption in 1982 dropped to 200,000 sqft in 1982 from over 5,000,000 sqft in 1981. With all the speculative boomtime construction coming on stream, there was 8,500,000 sqft of vacant space in 1982. With more space to come in following years it is little wonder that rental inducements became commonplace throughout the city and tenants were able to upgrade substantially at little additional cost. Since 1981 there has been little new growth in the office market. However, four new office towers have recently started in the downtown core. It appears developers are playing the expensive game of "musical buildings" as most tenants are coming from older existing space in the city (Canadian Building February 1988).

## 3.5 Vancouver

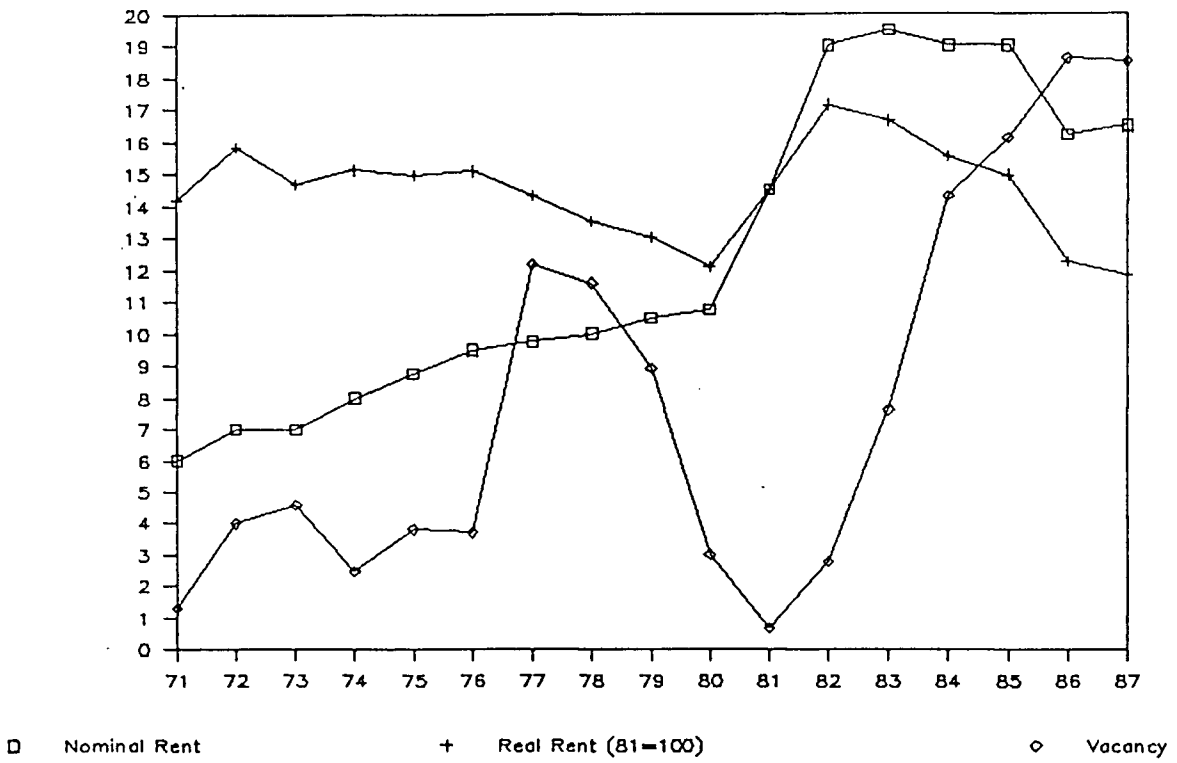
The time series plot for Vancouver is shown in Figure 3.5.1. Vancouver is a resource city like Calgary and Edmonton and the vacancy level seems to exhibit the same wide variation. What is different in this case is the fluctuation in the real rent level. Between 1971 and 1976 the vacancy rate fluctuates well below 5% and real rents respond with fair stability throughout the period. However, when the vacancy rate soared in 1977, the real rent level immediately began to sink. There appears to be no evidence of any price rigidity. In fact, the real rent level kept dropping even while the vacancy fell. Finally, when the vacancy level bottomed out in 1981 at 1%, real rents began to climb again. The optimism was short lived. In 1983, when vacancy rates climbed back to 8% the real rent level again dropped and continued to fall back to the 1980 level as vacancies topped out at 19%. Again, there is no evidence of any price rigidity. It appears that Vancouver landlords use guerrilla tactics in their approach to the market. They attack quickly and abruptly with large rent increases in very low vacancy periods yet retreat swiftly when the vacancies climb again. Speculation does not seem to be part of their behaviour.

B.C.'s economy has grown and prospered on the strength of its natural resource base. Industries such as forestry,

FIGURE 3.5.1

Time Series: Rents and Vacancies

VANCOUVER




Source: Real Estate Board of Greater Vancouver

mining, agriculture and fishing have historically provided the driving force (B.C. Central Credit Union:Economic Analysis of British Columbia 1988). Generally, Vancouver enjoyed reasonably stable employment growth in the 1960's and 1970's. In 1961 the private sector employment in Greater Vancouver was 206,000. This increased to 490,000 by 1981 (GVRD 1986). The most pronounced employment growth in the Vancouver CMA was in the Finance, Real Estate, Insurance and personal business service sectors which all contribute heavily to office space demand. These sectors more than tripled in the period (GVRD 1986).[26] The City of Vancouver issued licenses to 1,800 firms with downtown addresses engaged in business and professional services in 1971 and to 3,500 firms in 1980 (Vancouver Planning Department 1981b).

Despite the overall growth in the 1970's there were some further economic and political events which affected the office market. After the tremendous surge in office space experienced in 1973 there was a concern that the downtown core was becoming too large. A strategy for growth management, The Liveable Region 1976 - 1986, was prepared by the Greater Vancouver Regional District in 1975 (GVRD 1975). Its intent

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[26]In the Vancouver Metropolitan area, there was 150% absolute growth in managerial positions and between 30% and 130% growth in various professional categories. Clerical positions grew by 60% ( D. Ley 1985 ).

was to control growth in the downtown by "taking more jobs out to where people live". Similar to Toronto this was to be accomplished through decentralization strategies. One of the City's actions was to lower allowable density in certain zones in the core (Metrotrends 1975). This combined with rising land costs, and decreased access to the core helped trigger increased growth in the suburban office market. The time series plot in Figure 3.5.1 does not indicate any substantial effect on the price adjustment mechanism.

The continued drop in real rents in the later 1970's despite falling vacancies may be due to decreasing investor confidence spurred on by the left wing political situation and the ever increasing labour problems in the province.[27] The record of labour productivity in B.C. was one of the worst in Canada. Foreign investment in the resource industry dropped significantly as a result of the uncertain economic environment (Royal LePage Market Report 1979).

The boom hit Vancouver in 1980 and 1981. The Socred provincial government restored the confidence of both the local and international business community. The forestry

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[27]There appeared to be growing trend towards British Columbia becoming a "class adversary" Province. This resulted from the increasing number of situations where, for example, it was labour versus management and municipal politicians against developers. (Royal LePage Market Survey 1979)

industry was performing well with a strong housing market in the U.S. and with the declining Canadian dollar. Mining and coal products were in strong demand from the Pacific Rim. As Figure 3.5.1 and Figure 3.5.3 show, the office market responded with peak absorption rates of 1,900,000 sqft and sharp increases in real rents.

The recession started in 1982 with a slump in housing starts in both B.C. and the U.S.. The reduced demand for forestry products combined with a major labour dispute in 1981 seemed to curtail the economic expansion and investor confidence. In 1983, the recession had really hit. Employment in Vancouver dropped to 423,000 from a high of 490,000 in 1981 (GVRD 1986). The office market experienced drastic dips in demand and had to shoulder massive additions of new space.[28] Although by 1984, the economy was showing signs of recovering, the massive glut of space in the office market pushed vacancy levels up close to 20%. Nominal rent levels began to fall and as in the other cities, tenant inducements became commonplace.

The behaviour of the market in 1987 seems to indicate some stabilization. The last of the boomtime office space came on stream in 1985 so absorption was able to finally slow the

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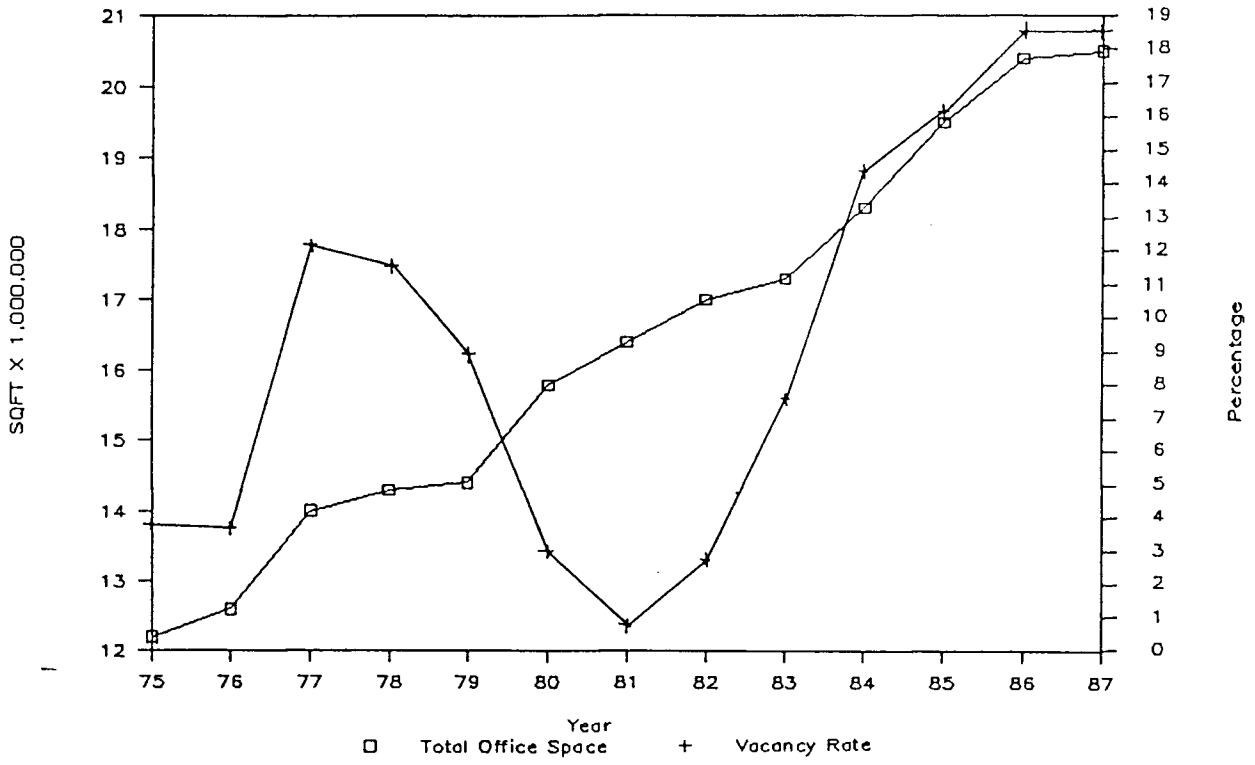
[28] In 1984, 1,300,000 sqft of space came on stream. This was the largest completion since 1973. (City of Vancouver Planning Department: Quarterly Review 1984)

FIGURE 3.5.2

Time Series: Total Office Space and Vacancies

VANCOUVER

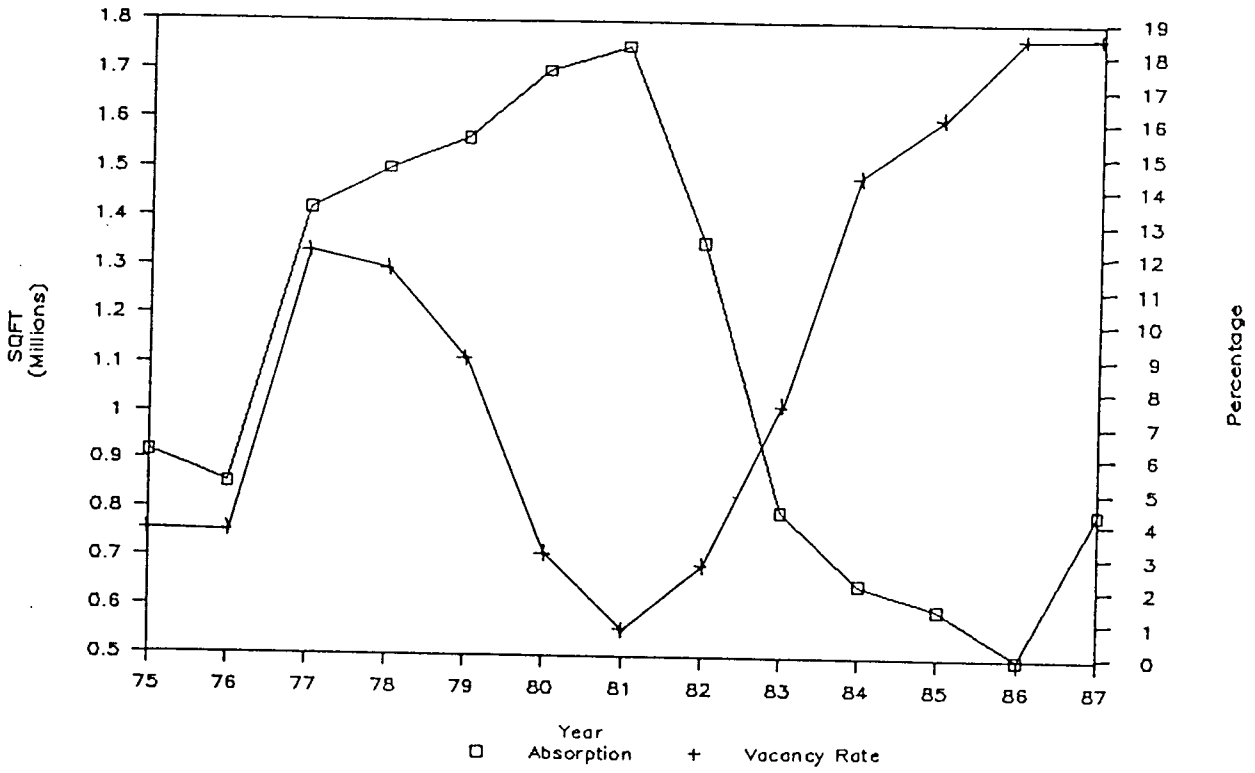



Source: Royal LePage Market Survey

FIGURE 3.5.3

Time Series: Absorption and Vacancies

VANCOUVER




Source: Royal LePage Market Survey

rise in vacancy. A lot of the activity in the office market seemed to be tenants moving to new cheaper space or downsizing. In 1987, the forestry and mining industries both picked up and the confidence has shown through increased absorption and some stabilization of real rents (Royal LePage Market Report 1988).

## 4.0 DATA ANALYSIS

This chapter is divided into 3 sections. The first develops the empirical model that will be used to test the data on the Canadian office market. The second section describes the sources for the data and any of the transformations that were necessary to make the data suitable for the empirical model. Finally, the last section discusses the results obtained from the empirical analysis. An attempt has been made to relate the results to previous work that has been done and to the characteristics of the office market in each city under study.

### 4.1 The Price Adjustment Model

Following the arguments raised in the Literature Review the empirical model should consider the following factors:

1. In the short run the supply of new office space is relatively fixed. Any price adjustments will be due to changes in demand.

2. For the reasons given by Capozza (1980) and those briefly suggested by Shilling et al. (1987), we should observe asymmetric price behaviour. Large price increases should be observed in response to large

positive demand shocks. Negative demand shocks should result in relative price rigidity. None of the authors who have done empirical work in the office market have adequately investigated this behaviour. The vacancy variable should be transformed to account for the non linearity. Capozza (1980) suggests the kinked response around the normal vacancy rate indicates a function of the form, 1/Vacancy.

3. The period under study from 1968 to 1987 was an inflationary environment. Landlords most likely attempted to pass through inflationary increases to tenants through nominal rent increases. As suggested by Capozza (1980) and Rosen (1985) the model should include a proxy variable for inflation expectations.

4. All the literature suggests that marginal operating costs should affect price response if they have a significant impact on the marginal cost of holding inventory. Shilling et al. (1987) have included the change in total operating costs as an independent variable.

5. Price asymmetry suggests the existence of an optimum or normal vacancy level. Although previous authors recognise a normal vacancy level they have either

ignored it or assumed that it is constant over the period. However, the factors which determine the normal vacancy rate are unlikely to remain constant over a long period. Office demand expectations and uncertainty, interest rates, and marginal operating costs will vary over time. This suggests that the model may be improved by introducing them as independent variables.

6. From the discussion by Hekman (1985) the local factors in each city suggests the need for a pooled cross sectional time series analysis. Dummy variables should be used for each city.

The base model used in this empirical analysis will be that suggested by Rosen and Smith (1983) and later used by Shilling et al. (1987) for the office market;

$$dR = f( V^n - V, dE )$$

The model should incorporate additional independent variables as suggested by the points mentioned above. Therefore the model which will be empirically tested will be;

$$dLnRENT = Constant + \sum \alpha_i x_i + b_1 INVAC + b_2 E(dLnINF) + b_3 E(dLnEMP) + b_4 dLnOP + b_5 I + \in \quad \text{where,}$$

dLnRENT: the %change in average gross nominal or real rents[1]

$x_i$: a dummy variable for each city

INVAC: the inverse of vacancy to account for the asymmetric price response

E(dLnINF): a proxy for inflation expectations

E(dLnEMP): a proxy for the demand expectations in the office market

dLnOP: the %change in average nominal or real operating costs

I: the level of nominal or real interest rates.

## 4.2 Data

Empirical testing of the price adjustment model is performed using data from Toronto, Montreal, Calgary, Edmonton, and Vancouver. These cities provide a fairly complete cross section of the Canadian office market.

With the exception of Vancouver, the data for each city has come from Royal LePage's annual office market survey and the Experience Exchange Report prepared by the Building Owners and Managers Association (BOMA). These two sources represent

[1]To remove collinearity that exists between variables moving with inflation it may be more appropriate to specify the model in real rather than nominal terms.

the most comprehensive sources of time series data covering a meaningful analysis period. Unfortunately, there are some limitations to each of the sources. Both sources record aggregated average figures which often does not adequately represent the diversity that can exist within each office market. Eger and Smith (1987) have pointed out the potential pitfalls of unqualified aggregated data from secondary sources. In addition, the Royal LePage survey is prepared by a real estate company involved in the office market. They use the information primarily for marketing purposes. Since Royal LePage is not an independent source and the survey methodology is not stated, it is difficult to assess the quality of the data.

The data collected in the Experience Exchange Report comes from a formal survey conducted each year by BOMA. Although BOMA is an independent industry association, the limitation to this source is the small sample of office buildings used in the survey in Canada.

Notwithstanding the limitations mentioned above, the data is the best available at this time. My perception is that these secondary sources are becoming more rigorous in their collection methodology and they should become more valuable in time for future empirical work.

For their survey, Royal LePage tracks the supply of net rentable office space greater than 10,000 sqft in the downtown and suburban areas of major Canadian cities. From this database they record total supply, average asking gross or net rental rates, average annual vacancy, operating costs, completions and absorption. BOMA records slightly different information. Pursuant to the interest of their members, they survey detailed operation and maintenance data. This provides a fairly accurate record of operating costs in each city broken out by different building classification.

As a data source for Vancouver, I have used Metrotrends, a publication prepared each year by the Real Estate Board of Vancouver. The data provided is more comprehensive than the Royal LePage data and should yield better results.

Supplementary economic and demographic information has been obtained from Statistics Canada and the planning departments of each metropolitan area.

For Toronto, the time series spans 1968 to 1987. For Vancouver the time series spans 1971 to 1987. For Montreal, Edmonton and Calgary the time series spans 1975 to 1987. The aggregate data base has approximately 70 points.

The following provides a description of each variable and the transformations necessary to prepare the data for the empirical analysis:

Rent: Gross rental data has been used to maintain consistency in the analysis. Gross rents require the landlord to collect for both the rental of space and for operating costs. The rents from Royal LePage are the average annual nominal full floor asking rates for the top ten downtown core buildings. The rents from Metrotrends are weighted average nominal asking rates for all office buildings in the downtown core built since 1960. Real rent rates are found by adjusting the nominal rate by the CPI. The rental data was transformed by taking the natural log of each rental rate and then differencing to create the %change in rents in each year.

Vacancy: Vacancies are the average annual percentages of vacant existing space and space to be completed for occupancy in that year. In the case of Calgary, Edmonton and Montreal the figures include all office space in the city. For Toronto and Vancouver the figures are exclusive to the downtown core area.

Operating Costs: The figures include average annual variable and fixed operating costs for downtown office buildings between 50,000 and 600,000 square feet. Real operating costs are found by adjusting the nominal figures by the CPI. The data was transformed by taking the natural log of each operating cost value and then differencing to create the %change in operating costs in each year.

Inflation Proxy: I have used 3 sources as proxies for inflation expectations; the average 3 month T bill yield, the average 10 year Government of Canada bond yield, and a moving average of the Consumer Price Index estimated with an ARIMA (0,1,1) model. All of this data has been compiled from Statistics Canada sources.[2]

Office Demand: As a proxy for demand expectations I have used office employment data compiled for each metropolitan area in the Labour Force Survey

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[2]The nomenclature used in the empirical model for the 3 inflation proxies is as follows,
TBILL: nominal 3 month Treasury bill rate
BOND: nominal 10 year Government Bond rate
FITCPI: moving average of the CPI rate
RTBILL: real 3 month Treasury bill rate

conducted by Statistics Canada. Office employment was assumed to be the total employment in the Professional Services, Public Administration and Finance, Insurance and Real Estate sectors. The data was transformed by taking the natural log of each employment figure and then differencing to create the %change in employment in each year.[3]

Interest: The average 3 month T Bill rate and the average 10 year Government of Canada Bond rate have been used as variables for the interest rate. The real rate of interest has been calculated by subtracting the inflation rate in each year.

## 4.3 Empirical Results

To provide a preliminary inspection of the data, the % change in real and nominal rents have been plotted against corresponding vacancy levels in Figures 4.1 through 4.7. Both cross sectional data and each individual city have been plotted for analysis.

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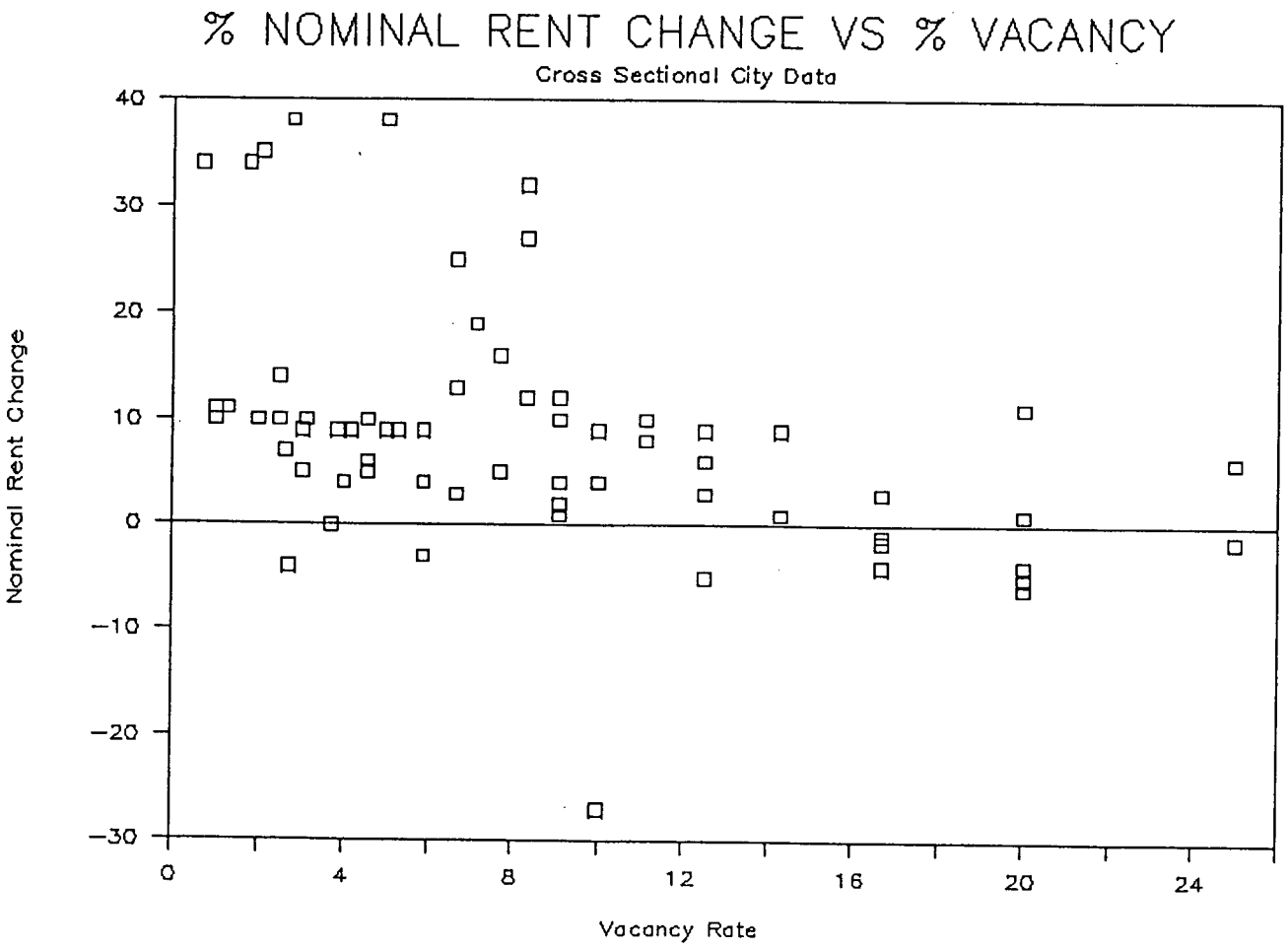
[3]An ARIMA (0,1,1) estimate was conducted using the employment data for each city to try and generate a moving average expectational variable. Unfortunately the time series was too small to yield meaningful results for the empirical model being tested. Instead, the % change in employment each year was used as the proxy for expected office space demand growth.

Looking first at the pooled cross sectional data there are some definite patterns which provide evidence for the propositions about the office market. Figure 4.1 shows the nominal rent changes while Figure 4.2 shows the real rent changes for the cross sectional data set. At lower vacancy levels there is a marked increase in dispersion showing evidence of price asymmetry. The normal vacancy level appears to be in the range of 7% to 10%. In addition, all the rental changes below this region are generally positive indicating that landlords increase rents at low vacancy levels to choke of the demand and preserve some inventory of space for buffering future demand shocks. Above the 10% vacancy level there is a fairly tight dispersion of rental changes. This may corroborate the existence of price rigidity at high vacancy levels. However, tenant inducements are most likely clouding the true behaviour. Any nominal price changes that do occur appear to be positive which indicates an attempt to keep pace with the inflationary environment of the 1970's and 1980's. An inspection of real price changes show a greater tendency for negative price movements at high vacancy levels. Either landlords were not able to fully pass through inflationary rises or long term market conditions and expectations changed enough to force rents to fall.

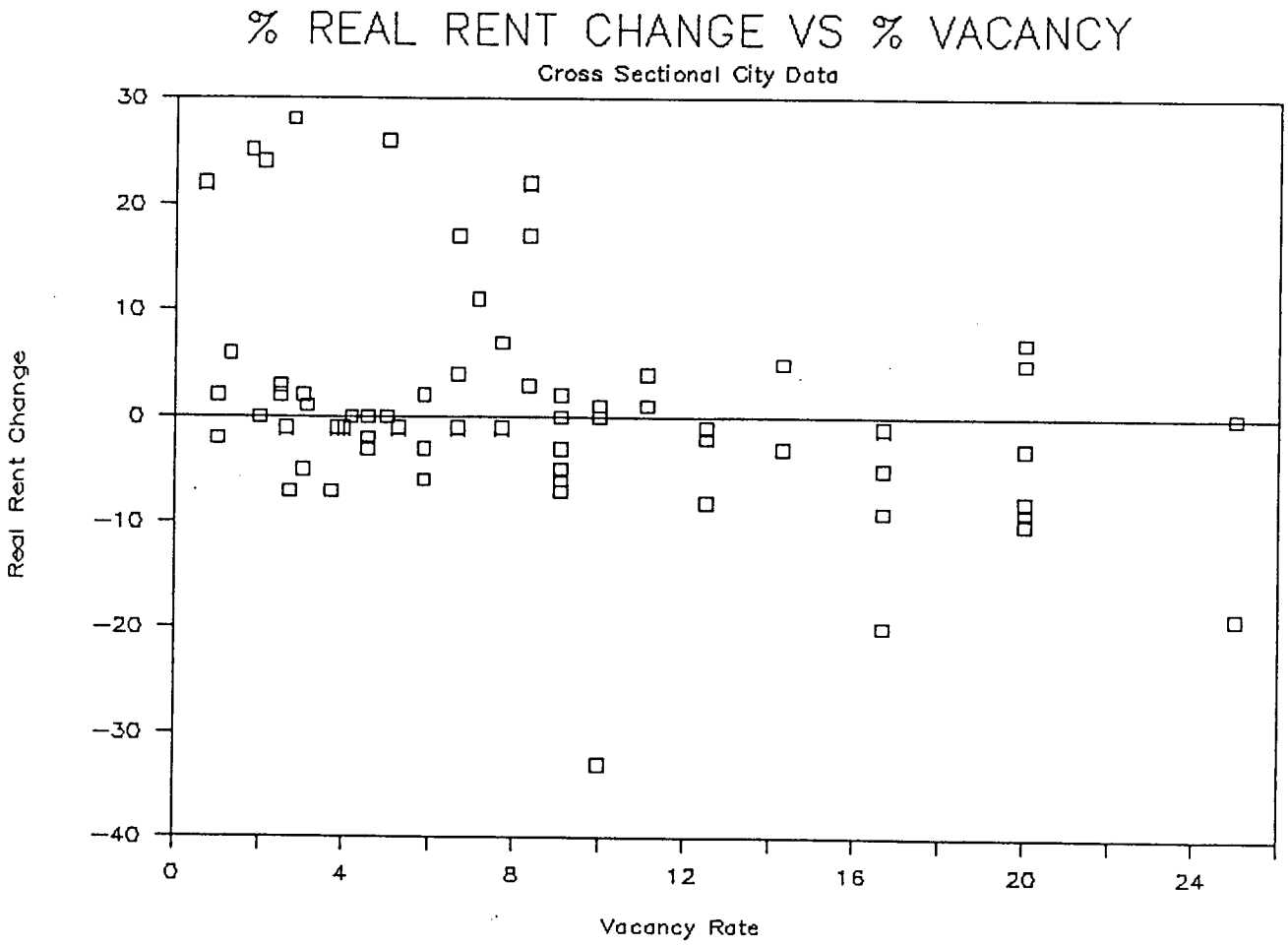
The plots for Montreal are shown in Figure 4.3. The price behaviour is a bit curious. Nominal rent changes are

FIGURE 4.1




Source: Royal LePage Market Survey and the Real Estate Board of Greater Vancouver

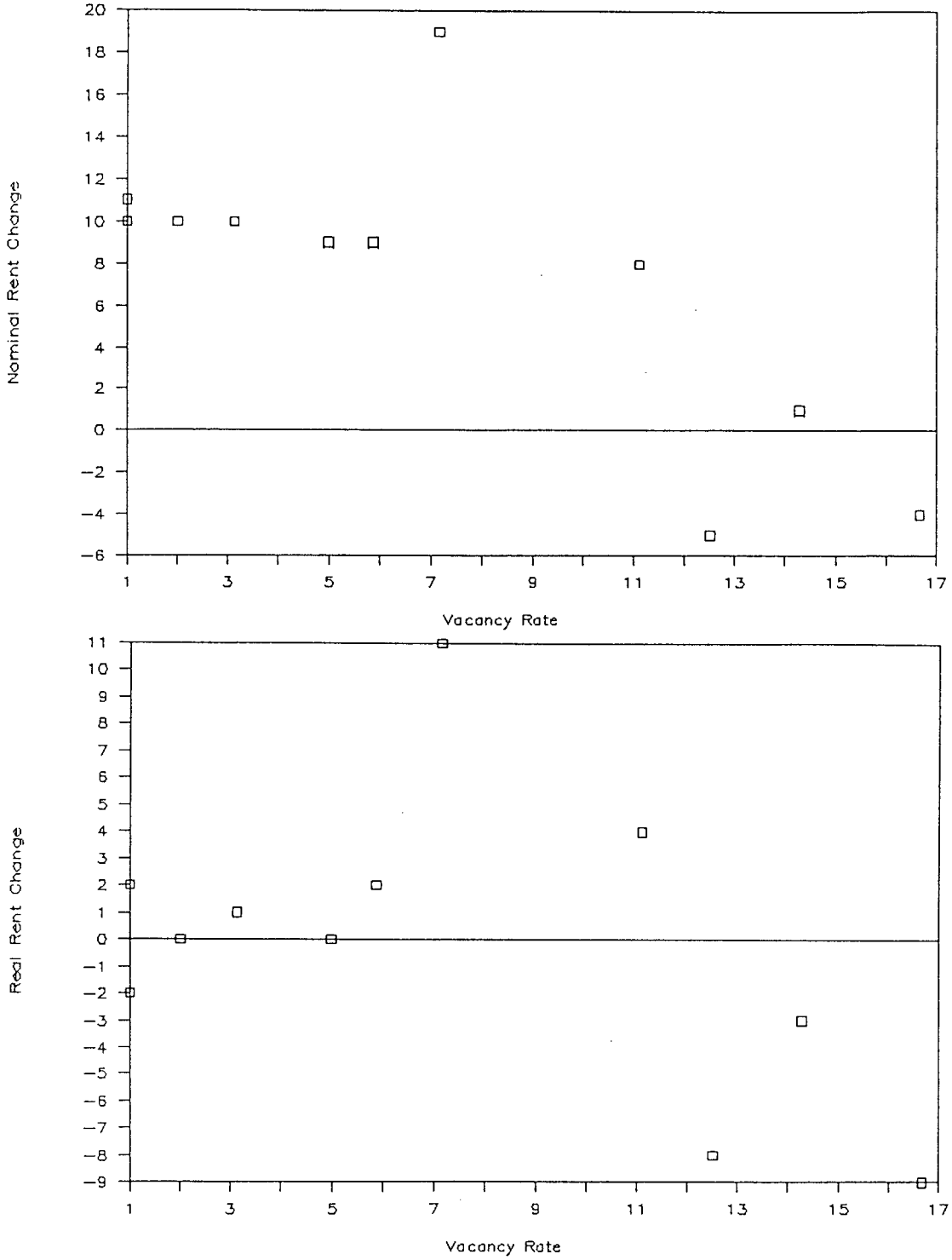
FIGURE 4.2




Source: Royal LePage Market Survey and the Real Estate Board of Greater Vancouver

FIGURE 4.3

% Nominal and Real Rent Change vs % Vacancy: MONTREAL




Source: Royal LePage Market Survey

large and positive for vacancy levels below 12% and primarily large and negative above 12%. The real plot shows that nominal price changes at best only kept real rent levels in pace with inflation even at low vacancy levels. Real rent changes above a 12% vacancy level actually dropped. Political unrest in Quebec and the corporate exodus during the late 1970's may have lowered demand expectations and forced rents to dip. Landlords faced with a shrinking market may have been less willing to hold vacancies and refrained from sharp price increases fearing further reductions in demand.

The plots for Toronto are shown in Figure 4.4. Both the nominal and real plot show the expected price asymmetry at low vacancy levels and price rigidity at high levels. The normal vacancy would appear to be around 3% to 4%. Toronto has a fairly diversified economic base which reduces the uncertainty of demand. It is reasonable to expect a lower normal vacancy rate.[4]

There are two outliers in the Toronto data. The first occurs in 1974 when real rents jumped up by 28% at a fairly high vacancy level of 8%. The response may have been a jerk reaction to a sudden decrease in vacancy after 4 years of a increase in the vacancy rate. The record absorption rate in 1973 caused the sudden drop in vacancies. The second outlier

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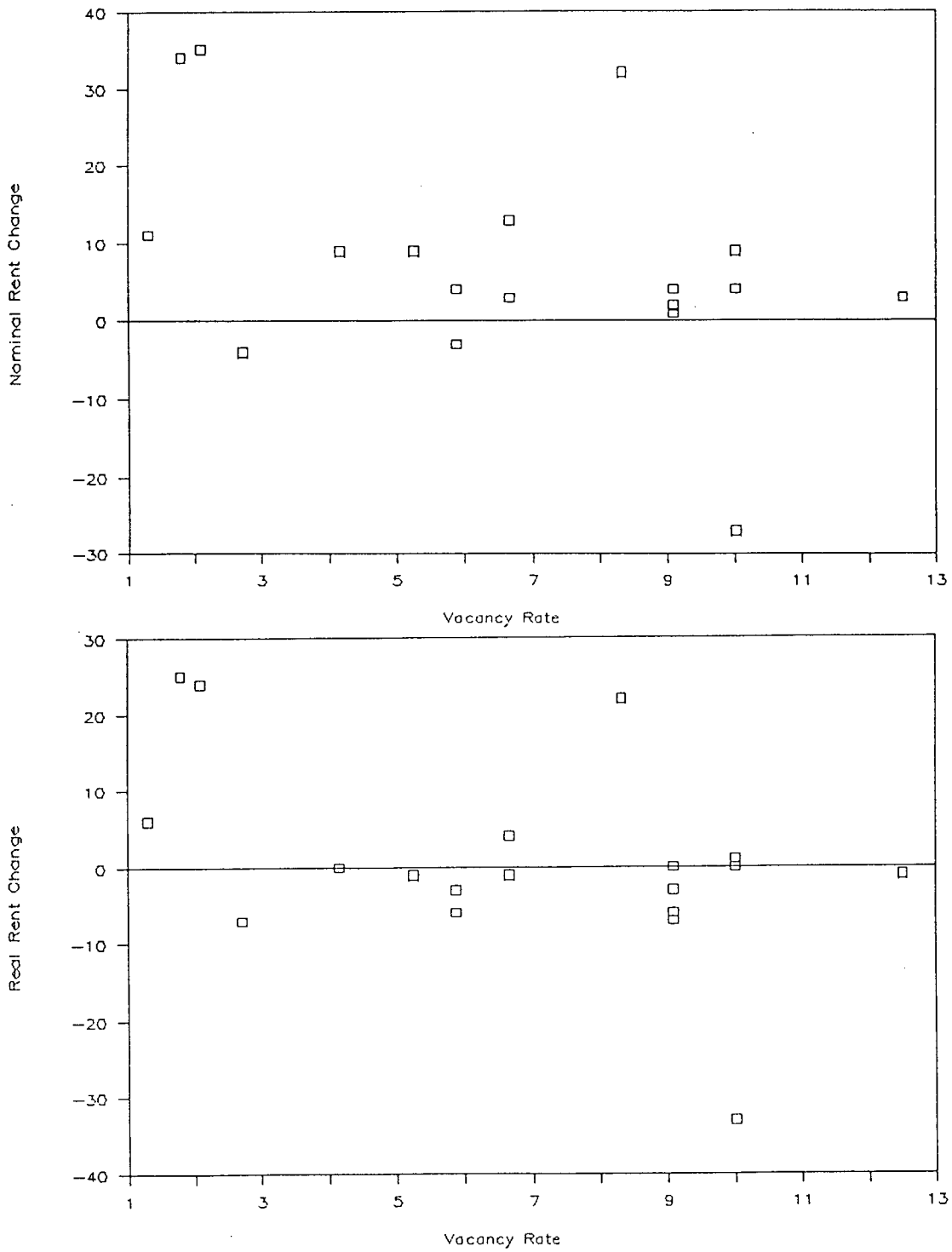
[4]See J.D. Shilling et al (1987)

FIGURE 4.4

% Nominal and Real Rent Change vs % Vacancy: TORONTO




Source: Royal LePage Market Survey

occurred in 1983. Real rents dropped by 33% at a vacancy of 10%. As I mentioned in the previous chapter, the rental data for Toronto after 1983 was corrected for tenant inducements. This may have caused the abrupt drop not normally shown by uncorrected rental data.

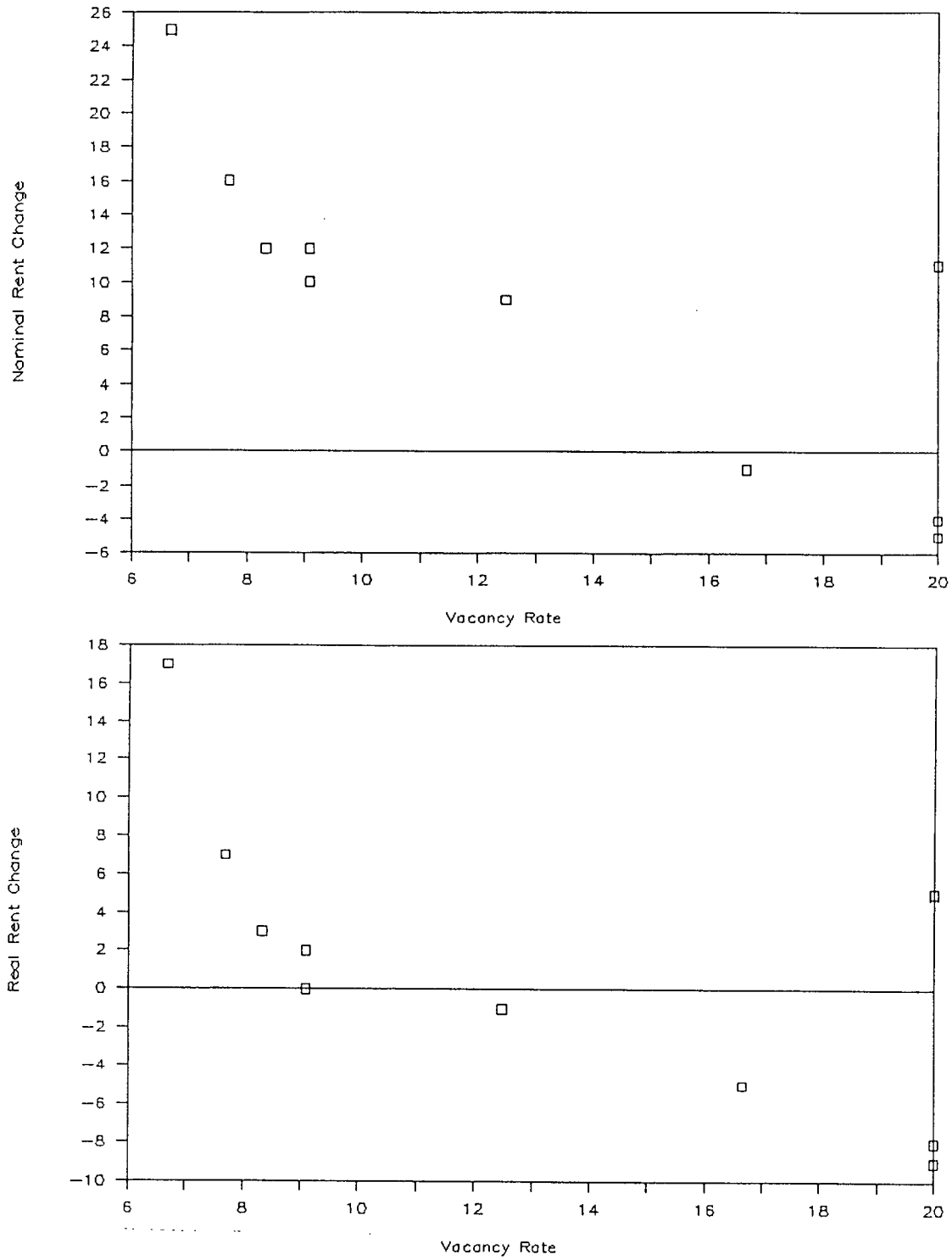
The plots for Edmonton are shown in Figure 4.5. Both the nominal and real plot show price asymmetry below a normal vacancy level of 9% to 13%. The higher normal rate is indicative of a city with resource based economy. The lack of price rigidity at high vacancy levels is probably due to the substantial change in market conditions and demand expectations following the 1981 recession. The real plot shows a nice hyperbolic curve.

The one outlier for Edmonton is the 6% increase in real rents in the face of a 19% vacancy rate that occurred in 1983. The response is most likely due to the sudden surge in absorption that occurred that year. It is also possible that a portion of the space that came on stream that year was preleased at pre recession rates. The preleased rates would be reflected in the average rate.

The plots for Calgary shown in Figure 4.6 are somewhat inconclusive. There is some price dispersion below a 10% vacancy level, however, the majority of the real rent

FIGURE 4.5

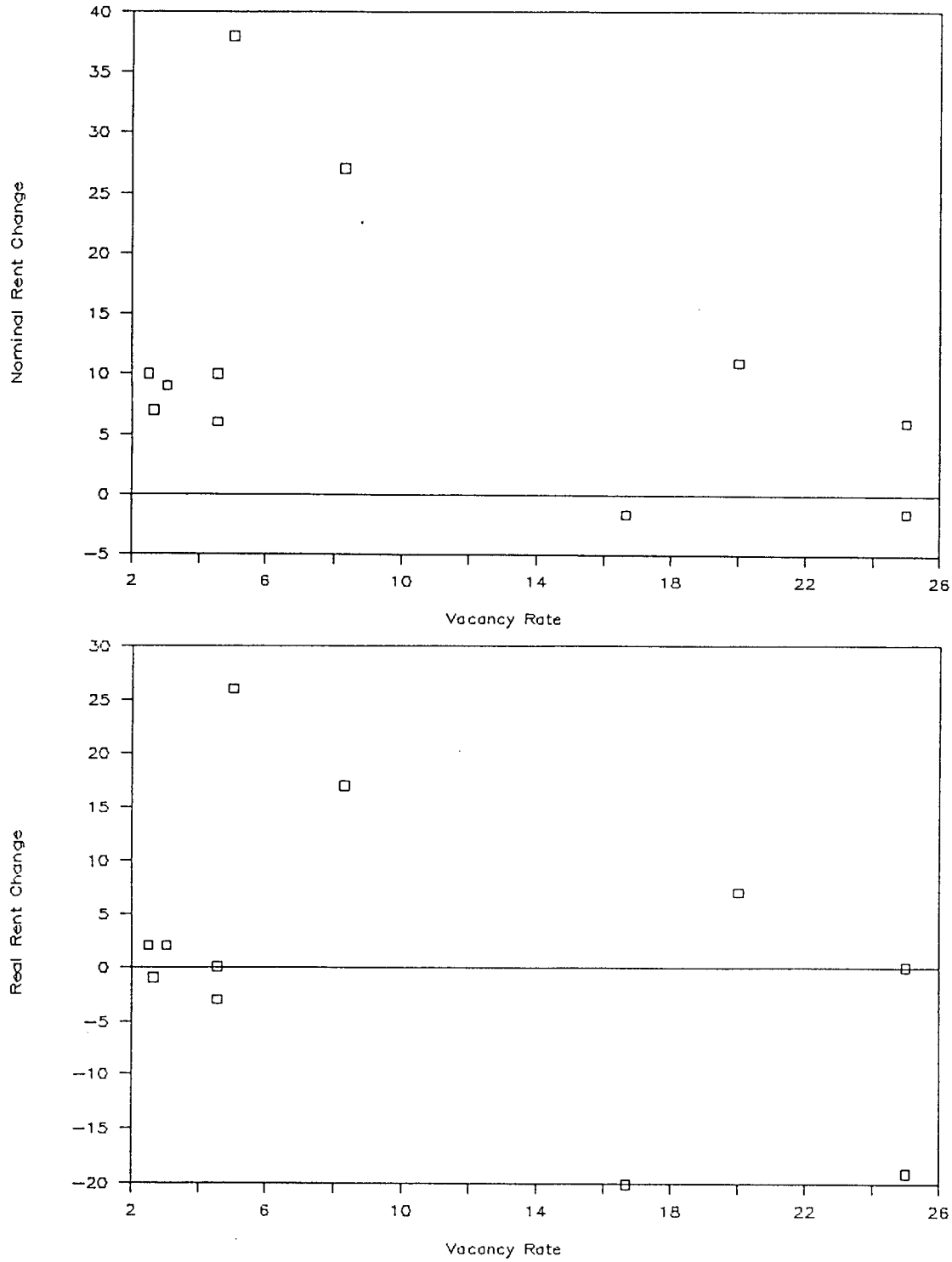
% Nominal and Real Rent Change vs % Vacancy: EDMONTON




Source: Royal LePage Market Survey

FIGURE 4.6

% Nominal and Real Rent Change vs % Vacancy: CALGARY




Source: Royal LePage Market Survey

changes are close to zero even at low vacancy levels. This is a curious result given the boom experienced in the Calgary office market in the late 70's and early 80's. The explanation may be that there were two price adjustment regimes operating in the period. Prior to the boom, vacancy levels were consistently low in Calgary, less than 5%.[5] This would indicate a normal vacancy level in this range and we would not expect to see any substantial real rent changes until demand expectations changed. This would explain the low price response during that period. After 1980, landlords appear to have reacted strongly to the boomtime environment which set off a new regime.

There is one outlier point in the Calgary data which requires some explanation. In 1986, real rates rose despite the fact that the overall vacancy increased to 20%. This discrepancy most likely resulted from dramatic fluctuations in oil prices that occurred through 1985 and early into 1986. Oil prices were rising steadily through 1985 to the highest level since 1981, $38.41 (Cdn) per barrel. Confidence was increasing in the petroleum industry and it seemed to spark a surge of absorption in the early portion of 1986. In February 1986, Saudi Arabia announced its displeasure with some of the OPEC countries who were not abiding by their quotas. They

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[5]Larken Real Estate Review (1985) shows that vacancy levels were historically low in Calgary prior to 1981.

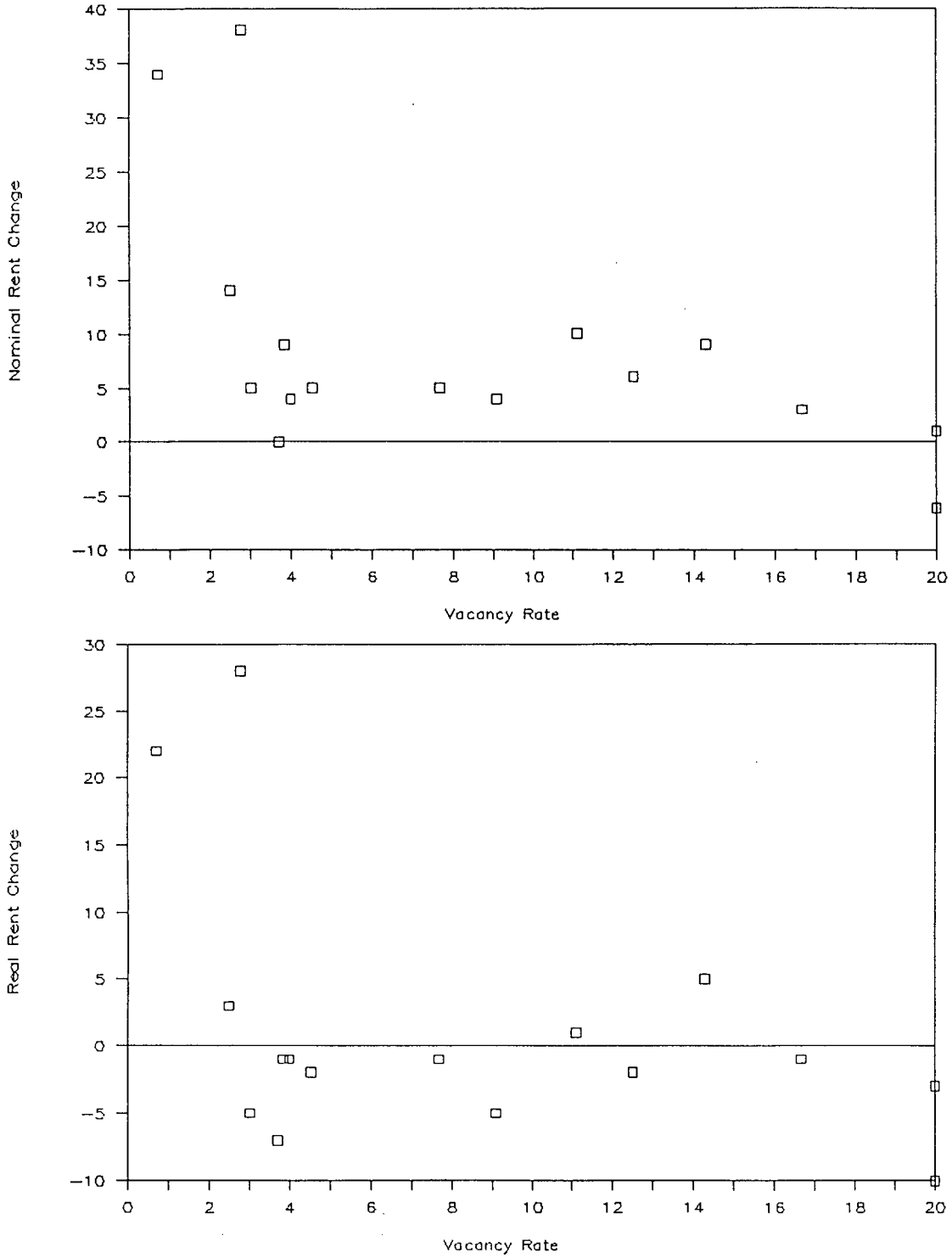
subsequently flooded the market and drove down prices to $17.40 (Cdn) a barrel. Business confidence was immediately lost again and vacancy levels rose again through the rest of 1986. This was exacerbated by a significant amount of tenant downsizing in that year. The sudden twist in the market may explain the curious result.

The plots for Vancouver are shown in Figure 4.7. Asymmetric price response is evident, however, there are peculiar dips in the change in rents at low vacancy levels. As mentioned in the city analysis, Vancouver landlords seem reluctant to speculate and drop real rents the instant they begin to move upwards. The behaviour seems to indicate a very low normal vacancy level of 4% to 5%, very similar to Toronto. This is uncharacteristic of a city which is resource dependent. One possible explanation may be the lack of large corporate offices in the city who are relatively resistant to economic swings. A large proportion of office space is occupied by small legal, accounting and financial tenants who are very susceptible to the whims of the economy and the level of office rents.

Table 4.1 shows the ordinary least squares regression equations estimated with the pooled cross sectional time series data. In equation 1 the CPI moving average, FITCPI is used to proxy inflation expectations and the T Bill rate,

FIGURE 4.7

% Nominal and Real Rent Change vs % Vacancy:VANCOUVER




Source: Real Estate Board of Greater Vancouver

TABLE 4.1

Price Adjustment Model for the Canadian Office Market 1968 -1987

| DEPENDENT VARIABLE | CONSTANT | TBILL | BOND | FITCPI | TORONTO | EDMONTON | CALGARY | VANCOUVER | INVAC | dLnEMP | dLnOP | RTBILL | dLnROP | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. dLn(Nom Rent) | -0.13 | 0.01 | | 1.18 | 0.04 | 0.03 | 0.02 | 0.02 | 0.13 | 0.03 | 0.16 | | | R^2 = 0.24 |
| | -2.1 | 1.0 | | 2.1 | 0.8 | 0.7 | 0.4 | 0.5 | 1.9 | 0.1 | 1.0 | | | SSE = 0.11 |
| | * | | | * | | | | | * | | | | | F = 3.22 |
| 2. dLn(Nom Rent) | -0.09 | 0.01 | | | 0.04 | 0.03 | 0.02 | 0.02 | 0.16 | -0.01 | 0.25 | | | R^2 = 0.19 |
| | -1.6 | 1.9 | | | 0.8 | 0.6 | 0.4 | 0.5 | 2.3 | -0.0 | 1.5 | | | SSE = 0.11 |
| | | * | | | | | | | * | | | | | F = 2.86 |
| 3. dLn(Nom Rent) | -0.10 | | 0.00 | 1.38 | 0.03 | 0.04 | 0.02 | 0.02 | 0.16 | 0.04 | 0.17 | | | R^2 = 0.23 |
| | -1.3 | | 0.2 | 2.5 | 0.7 | 0.8 | 0.5 | 0.4 | 2.4 | 0.1 | 1.0 | | | SSE = 0.11 |
| | | | | * | | | | | * | | | | | F = 3.05 |
| 4. dLn(Nom Rent) | -0.08 | | 0.01 | | 0.04 | 0.04 | 0.02 | 0.02 | 0.20 | 0.02 | 0.27 | | | R^2 = 0.15 |
| | -0.9 | | 1.0 | | 0.8 | 0.7 | 0.5 | 0.4 | 3.0 | 0.1 | 1.6 | | | SSE = 0.11 |
| | | | | | | | | | * | | | | | F = 2.38 |
| 5. dLn(Nom Rent) | -0.13 | 0.01 | | 1.18 | 0.04 | 0.03 | 0.02 | 0.02 | 0.13 | | 0.16 | | | R^2 = 0.26 |
| | -2.1 | 1.0 | | 2.2 | 0.8 | 0.7 | 0.5 | 0.6 | 2.0 | | 1.0 | | | SSE = 0.11 |
| | * | | | * | | | | | * | | | | | F = 3.69 |
| | | Diagnostic Checks: | | p = .01 for F = 3.69 | | | Skewness = -.15 | | | Kurtosis = .53 | | | | |
| 6. dLn(Real Rent) | -0.10 | | | 0.81 | 0.03 | 0.04 | 0.03 | 0.02 | 0.13 | -0.10 | | -0.00 | 0.09 | R^2 = 0.07 |
| | -1.7 | | | 1.6 | 0.7 | 0.9 | 0.6 | 0.5 | 2.2 | -0.3 | | -0.4 | 0.6 | SSE = 0.10 |
| | | | | | | | | | * | | | | | F = 1.54 |
| 7. dLn(Real Rent) | -0.11 | | | 0.87 | 0.03 | 0.04 | 0.03 | 0.02 | 0.13 | | | | 0.09 | R^2 = 0.10 |
| | -2.3 | | | 1.9 | 0.8 | 0.8 | 0.6 | 0.5 | 2.2 | | | | 0.6 | SSE = 0.10 |
| | * | | | * | | | | | * | | | | | F = 2.02 |
| | | Diagnostic Checks: | | p = .06 for F = 2.02 | | | Skewness = -.04 | | | Kurtosis = .60 | | | | |

Notes: 1. t statistics are shown below each coefficient. A * indicates significance.

2. See next page for variable definitions

TABLE 4.1 (continued)
Price Adjustment Model for the Canadian Office Market 1968 -1987

| DEPENDENT VARIABLE | CONSTANT | TBILL | FITCPI | TORONTO | EDMONTON | CALGARY | VANCOUVER | INVAC | VAC | LOGVAC | dLnEMP | dLnOP | RTBILL | dLnROP | MONTDUMY | CALDUMY | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8. dLn(Nom Rent) | -0.10 | 0.00 | 1.29 | 0.02 | 0.02 | 0.02 | 0.00 | 0.16 | | | 0.07 | 0.18 | | | -0.03 | -0.05 | R^2 = 0.22 |
| | -1.4 | 0.6 | 2.2 | 0.2 | 0.3 | 0.3 | 0.0 | 2.0 | | | 0.2 | 1.0 | | | -0.4 | -0.7 | SSE = 0.11 |
| | | | * | | | | | * | | | | | | | | | F = 2.61 |
| 9. dLn(Real Rent) | -0.06 | | 0.81 | -0.01 | 0.01 | 0.03 | -0.02 | 0.17 | | | -0.07 | | -0.01 | 0.11 | -0.06 | -0.08 | R^2 = 0.07 |
| | -0.8 | | 1.6 | -0.1 | 0.2 | 0.4 | -0.3 | 2.5 | | | -0.2 | | -0.8 | 0.7 | -0.8 | -1.2 | SSE = 0.10 |
| | | | | | | | | * | | | | | | | | | F = 1.42 |
| 10. dLn(Nom Rent) | 0.09 | 0.01 | 0.30 | -0.00 | 0.05 | 0.08 | 0.00 | | -0.01 | | -0.16 | 0.08 | | | -0.05 | -0.14 | R^2 = 0.34 |
| | 0.9 | 1.6 | 0.5 | -0.0 | 0.8 | 1.1 | 0.1 | | -3.6 | | -0.5 | 0.5 | | | -0.7 | -1.9 | SSE = 0.10 |
| | | | | | | | | | * | | | | | | | * | F = 3.74 |
| 11. dLn(Real Rent) | 0.10 | | 0.23 | -0.01 | 0.05 | 0.08 | -0.01 | | -0.01 | | -0.21 | | 0.00 | 0.04 | -0.06 | -0.15 | R^2 = 0.14 |
| | 1.2 | | 0.4 | -0.2 | 0.7 | 1.2 | -0.1 | | -3.4 | | -0.7 | | 0.5 | 0.3 | -0.9 | -2.1 | SSE = 0.10 |
| | | | | | | | | | * | | | | | | | * | F = 1.94 |
| 12. dLn(Nom Rent) | 0.15 | 0.00 | 0.71 | -0.01 | 0.03 | 0.04 | -0.02 | | | -0.08 | -0.08 | 0.15 | | | -0.07 | -0.12 | R^2 = 0.30 |
| | 1.3 | 0.8 | 1.2 | -0.1 | 0.5 | 0.6 | -0.3 | | | -3.2 | -0.2 | 0.9 | | | -1.0 | -1.6 | SSE = 0.10 |
| | | | | | | | | | | * | | | | | | | F = 3.44 |
| 13. dLn(Real Rent) | 0.17 | | 0.35 | -0.02 | 0.02 | 0.05 | -0.03 | | | -0.08 | -0.18 | | -0.00 | 0.01 | -0.09 | -0.13 | R^2 = 0.14 |
| | 1.6 | | 0.7 | -0.3 | 0.4 | 0.7 | -0.5 | | | -3.3 | -0.6 | | -0.4 | 0.6 | -1.2 | -1.9 | SSE = 0.10 |
| | | | | | | | | | | * | | | | | | * | F = 1.94 |

Notes: 1. t statistics are shown below each coefficient. A * indicates significance.

2. Variable definitions:

| | | | |
|---|---|---|---|
| dLn(Nom Rent): | the %change in nominal rents | INVAC: | the inverse of the vacancy rate |
| dLn(Real Rent): | the %change in real rents | VAC: | the vacancy rate |
| TBILL: | the nominal 3 month Treasury Bill rate | LOGVAC: | the logarithim of the vacancy rate |
| BOND: | the nominal 10 year Government of Canada Bond rate | dLnEMP: | the %change in office employment |
| FITCPI: | a moving average of the Consumer price index | dLnOP: | the %change in nominal operating costs |
| TORONTO: | a dummy variable for Toronto | RTBILL | the real 3 month Treasury Bill rate |
| EDMONTON: | a dummy variable for Edmonton | dLnROP: | the %change in real operating costs |
| CALGARY: | a dummy variable for Calgary | MONYDUMY: | a dummy variable for 1976 - 1982 in Montreal |
| VANCOUVER: | a dummy variable for Vancouver | CALDUMY: | a dummy variable for 1976 - 1980 in Calgary |

TBILL is used as the interest rate variable. The coefficient on the vacancy variable, INVAC shows the expected positive sign and is significant. This supports the proposition that there is asymmetric rental price response in the office market and provides further evidence that there is some optimum or normal vacancy level to which landlords respond. The inflation expectation variable, FITCPI has the correct sign and is also significant. The coefficient is larger than 1 which indicates that landlords are able to pass rent changes off to tenants which exceed the expected inflation for the coming year. This is the same peculiar result found by Rosen (1985). The explanation may be in the long term nature of the leases and the attempt to provide an inflation hedge for the landlord through the full life of the rental contract. The variable for operating cost changes, dlnOP and the interest rate variable, TBILL show the correct sign, however neither are significant. This suggests that in the short term, operating costs do not substantially affect the cost of holding inventory. Therefore, landlords are likely to use vacancy rather than price adjustment to buffer demand shocks. The disturbing result is the insignificance of the variable used to proxy growth expectations in the office market, dlnEMP. Although it has the expected sign, it has very little explanatory power in this rental price adjustment model. This is most likely a case of model misspecification. Growth expectation and uncertainty are fundamental components of price adjustment models with

inventory.[6] The 4 categorical dummy variables used for each city are all insignificant indicating a lack of substantial difference between Toronto, Edmonton, Calgary and Vancouver. The constant in the equation partially accounts for any differences in local factors in Montreal. This value is significant. This may reflect the unique political environment and the corporate shift that occurred in that city during the analysis period. Further refinement of the model specification should bring local factors in each city more to bear. The adjusted $R^2$ of the equation .24 indicates a low degree of explanatory power.[7]

Equations 2 to 4 estimate the model using different combinations of inflation expectation and interest rate proxies. No substantial improvement is observed.

To provide a bit of further refinement to the model the insignificant office demand variable, dlnEMP was swept out in equation 5. The effect on the other variables was not substantial. A diagnostics check was done on this equation. The F statistic of 3.69 shows the model is significant at the 1% level. The normal probability plot of the residuals shows a

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[6]No current literature has shown how to correctly specify the growth expectation variable in the price adjustment model.

[7]K.T. Rosen (1984) had an $R^2$ of .55 for San Francisco and J. Hekman (1985) had an $R^2$ of .37 for his cross sectional data set.

slight left skewness and some positive kurtosis. Neither is too serious. The correlation matrix for the coefficients indicates little collinearity other than for the city dummy variables.

Equations 6 and 7 test the price adjustment model using variables specified in real terms. The intent here is to eliminate any collinearity that may exist between variables moving with inflation. The only marked improvement occurs in the significance of the vacancy variable INVAC. The real interest variable RTBILL drops out of the model as it loses both the proper sign and its significance. The office demand variable, dLnEMP is again insignificant. The inflation proxy, FITCPI is significant to a lesser degree and the coefficient is now between .8 and .9. This shows that landlords capture in excess of 80% of the inflationary rises each year. The real operating cost variable has the correct sign but is even more insignificant. The city dummy variables are all insignificant. Overall the significance of the model has decreased. The explanatory power has decreased to an $R^2$ between .07 to .1 and the F statistic of 2.02 is only significant at the 6% level.

Some further adjustments were made to the model to test and expand the empirical results obtained.

The analysis of the data for Montreal and Calgary indicates events that produced low price response at very low vacancy levels. To account for this behaviour two dummy variables were added to the model. **MONTDUMY**, accounts for the period between 1976 and 1982 in Montreal and **CALDUMY**, accounts for the period 1976 and 1980 in Calgary. The results are shown in equations 8 and 9. Both variables provide the correct sign in both the nominal and inflation adjusted equations, however, the significance is quite low. It seems the observed deviations are not strong enough to account for any significant variation in the model.

Price asymmetry is one of the central theoretical propositions. The significance of the vacancy term specified in nonlinear terms seems to support this behaviour. However, in order to test the robustness of this proposition, another regression was performed using a linear specification of the vacancy variable, **VAC**. The results are shown in equations 10 and 11. The results seem to contradict the arguments raised in this thesis. The linear vacancy variable, **VAC provides the correct negative sign and is more significant than the non linear variable,** INVAC. The explanatory power of the model also improved with an $R^2$ of.34 in the nominal model, (.14 in the inflation adjusted model). The inflation proxy ,FITCPI also drops in value and significance. The interest variable, **TBILL** seems to improve but still remains insignificant. It may

be capturing some of the inflation effect lost by the proxy, FITCPI. Both the employment growth proxy, dlnEMP and the operating cost variable, dlnOP remain insignificant. The two additional dummy variables, MONTDUMY and CALDUMY improve substantially. CALDUMY becomes significant in the inflation adjusted model. Overall, the results provide an interesting rebuttal to those found for the proposed model.

The visual inspection of the pooled cross sectional time series data clearly shows some form of asymmetric price behaviour. To further support this proposition, an alternate non linear specification of the vacancy variable, LOGVAC was used. The results are provided in equations 12 and 13. The vacancy variable has the correct negative sign and is equally significant to the linear term in the previous specification. The inflation proxy, FITCPI is larger and more significant than in equations 10 and 11. However, it still does not carry the same weight as it does in the proposed model and does not indicate that landlords overcapitalize inflation in rent changes. All the other variables generally perform in a similar fashion as those in the previous equations. Both MONTDUMY and CALDUMY show some improvement in equations 12 and 13.

In summary, the empirical analysis seems to show the following results:

1. Vacancies are important in the short run price adjustment process.

2. There is evidence of price asymmetry as shown by the significance of the vacancy variable specified in nonlinear terms. The evidence is clear from the visual inspection, however, the empirical analysis does not produce conclusive results. Both linear and nonlinear specifications of the vacancy variable provide similar results.

3. Inflation expectations seem to be important in determining the price adjustment mechanism.

4. Total operating costs and interest rates do not appear to be significant determinants in the price adjustment mechanism. This leads to the conclusion that neither is a significant factor in the cost of holding inventory in the short run. This provides theoretical support for observing vacancy adjustment rather than price adjustment when landlords are faced with negative demand shocks.

5. Expected office demand is not significant in this specification of this model. Future work needs to be

done to properly specify this variable in the model. It is plausible that expected supply needs to be integrated into the model to offset the expected demand.

6. In Canada, the individual nature of each city office market does not appear to be significant in determining the price adjustment mechanism. As the model is further refined, locational factors should become more important.

## 5.0 CONCLUSIONS

In the coming years office buildings will continue to have a significant impact on the large cities in Canada. The rapid growth of service oriented employment will continually feed the demand for office space. Developers and city planners will have to hone their skills in order to anticipate this demand and provide a built form which satisfies both the needs and constraints of the urban environment. The rental price adjustment mechanism is an integral component of the model for anticipating the future requirements for office space. At this point very little academic work has been done in this area. This has been due primarily to a lack of adequate testable data. This should change over the coming years. The current growth of the office market combined with improved data sources should stimulate future academic study and shed some badly needed light on a challenging area.

The current school of thought on rental price adjustment models is that there is a strong relationship between rents and vacancies. Much of this work has been tested in the housing market. There are features of the office market which provide a strong rational for a observing similar behaviour. A review of the relevant literature leads to certain propositions about the rental price mechanism in the office market.

1. In the short run office supply is fixed creating the requirement for inventory or vacancy levels.

2. We should observe asymmetric price movements. Large price increases should be observed in response to positive demand shocks to chock off demand. Negative demand shocks should result in downward price rigidity as landlord participate in speculative behaviour. Rents may eventually fall if expectations change. A non linear specification is required for the vacancy variable in the price adjustment model

3. Landlords will likely attempt to pass inflationary increases through to the tenant.

4. Operating costs and interest rates will be important in the price adjustment mechanism if they have a significant impact on the cost of holding inventory.

5. There exists an optimum or normal vacancy rate to which landlords will respond and attempt to maintain. The normal vacancy rate is determined through demand expectations, uncertainty, and the cost of holding inventory.

A price adjustment model was developed from these propositions and tested using data from the Canadian office market. The data source was the Royal LePage Market Survey. Five cities were chosen to provide an adequate cross section of the Canadian market; Montreal, Toronto, Edmonton, Calgary, and Vancouver. There are certain limitations to the data set which the author recognizes. These include excessive aggregation, inconsistent survey methodology and failure to control for market imperfections such as tenant inducements. Notwithstanding these limitations, the Royal LePage Market Survey is the most comprehensive source at this time.

A visual inspection of the pooled cross sectional time series data confirms many of the propositions. Price asymmetry seems to be evident. Rent changes are most dispersed at low vacancies while the dispersion is tighter at higher vacancy levels. Rent dispersion begins to increase again as vacancy moves to extremely high levels. Demand expectations probably change significantly at high vacancy levels causing price speculation to cease and rents to drop. A normal vacancy for the cross sectional data during the analysis period seems to be in the order of 7% to 10%.

Each city seems to exhibit unique behaviour through the analysis period. Montreal was plagued with political unrest and a corporate exodus. This seemed to rattle investor

confidence and lowered growth expectations. This prevented real rents from increasing even at extremely low vacancy levels. Toronto exhibited more consistent behaviour. This is largely due to its stable growth and diversified corporate strength. Edmonton had wild fluctuations in vacancy levels due to the boom and bust effect of the petroleum industry. Rents rose in low vacancy periods, however, little downward price rigidity was evident due to the tremendous jump in the vacancy level. Growth expectations obviously changed substantially after the fall in the market. Calgary exhibits curious behaviour. There appears to be two price adjustment regimes in the data set. The first is active through the steady growth period prior to 1979. The other occurs during the boom and bust cycle from 1980 through 1987. As a result, the combined affect of the two regimes obscures any uniform price adjustment mechanism. Vancouver is reasonably consistent with the theory, however there appears to be peculiar behaviour on the part of landlords who lower real rents at the slightest increase in the vacancy rate. This occurs even at low vacancy levels which leads to the conclusion that Vancouver has a very low normal vacancy rate. No price speculation seems to occur. The result may be explained by the uneasy political and labour situation in B.C. and the sensitivity of the local market to demand fluctuations. Overall, the visual examination of the data for each city clearly points to the importance of growth expectations in the price adjustment mechanism.

A regression was performed on the pooled cross sectional time series data set. The results seem to generally concur with the results found in the U.S.. Vacancies are an important variable in the price adjustment mechanism. However, the extension in this thesis was the specification of the vacancy variable in nonlinear terms. The intent was to illustrate the existence of price asymmetry in the office market model. Unfortunately, the model is not conclusive in its support for this proposition. Both linear and nonlinear specifications are significant. Inflation expectations appear to have some significant in the model. Landlords attempt to pass off inflationary increases to tenants. Operating costs and interest rates did not prove to be significant in the model. This argues that neither of these two variables are important to the cost of holding inventory in the short run. This lends theoretical support for vacancy adjustment rather than price adjustment as a response to short run negative demand shocks. The most disturbing result of the regression was the insignificance of the proxy for demand or growth expectations in the office market. Given the analysis of the data and the relevant events in each city, there is substantial rationale for the inclusion of this variable. It would appear that the variable is misspecified in this model.

As a suggestion for future research, there are two fundamental concerns which seem to fall out of this thesis.

First, the data has to be improved substantially before any conclusive results can be found. Uniform collection methodology needs to be employed and attempts should be made to disaggregate the data by city and each sub market in order to capture the true price adjustment mechanism. In addition, tenant inducements are prevalent in current office markets. This distorts the rent data at high vacancy levels and prevents an accurate assessment of speculation behaviour and downward price rigidity. Some method for controlling this behaviour needs to be employed.

The second concern is the specification of the proxy variable for growth or demand expectations in the price adjustment model. This seems to be a fundamental component and models will continue to have low explanatory and predictive capability until this variable is properly integrated.

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