The Information Precision of CBD Office Vacancy Rates

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Abstract. **Consistent with the rational expectations information model (REIM), the difference among reported area CBD office vacancy rates is proportional to the level of vacancy, inversely proportional to the size of the inventory, and significantly higher when both a national vendor and a local agent make simultaneous reports. Underlying volatility in the market and the cost and difficulty of acquiring information are the principal causes of the information variance. The difficulties and ambiguities in obtaining information are reviewed and the Diamond REIM model is tested using encountered published vacancy rates for central business districts for the period 1985–1989.**

Introduction

Institutional lenders as well as real estate portfolio managers often cite the "vacancy rate problem"; that is the disparity in the published statistics when performing portfolio analyses of their real estate holdings.[1] The Building Owners and Managers Association (BOMA) report, *Office Market Terms and Definitions, 1990*, questions the accuracy of reported vacancy data in evaluating trends in office space demand and supply.[2] The report and Penz (1990) underscore the need to provide a rationale for the variation among the rates and to develop a uniform methodology in interpreting the data.[3]

This study hypothesizes that the Diamond (1985) Rational Expectations Information Model (REIM) can serve to explain the variance among vacancy rate estimates. The divergence among vacancy rates in previous research is reviewed, and the evolution of the national published office vacancy rate series is discussed. It is suggested that in every market area, the brokers react according to the REIM in evaluating the trade-offs between the cost and value of vacancy information in estimating the returns for office buildings. The difficulties in obtaining such information are reviewed, and finally, a modification of the Diamond REIM using the published vacancy rates for central business districts for 1985–1989 is tested. The results indicate that a divergence in reported vacancy rates in each market can be expected because of the cost of the information search, the volume of the space being traded, and the frequency of the deals. The results further suggest that the analyst can use the model to estimate the mean of the different vacancy rates if the rate variance is equal to that generated by the model.

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Previous Research

A comparison of studies on vacancy rates illustrates the disparities in data collection and analytic techniques. Using the national index developed by CB Commercial (formerly Coldwell Banker), Wheaton and Torto (1988) concluded the natural vacancy rate increased by six percentage points over the period 1968 to 1986. Using a labor market model that relied on data from individual cities, Voith and Crone (1988) concluded the natural vacancy rate increased by seven percentage points for a shorter period, 1979 to 1987. The lack of a vacancy rate information protocol among researchers may explain, in part, why Frew and Jud (1986) found that vacancy was a determinant in setting office rent levels in their one-year latitudinal study of Greensboro, North Carolina, but Glascock, Johanian and Sirmans (1990) could not isolate the effect on an annual basis for vacancies for office rents in Baton Rouge, Louisiana. In earlier studies, Rosen (1984) and Smith (1974) note, vacancy rates are "not known with precision," but these authors do not explore reasons why the reported rates may vary.

Sharkawy (1990) provides evidence of the divergence among vacancy rate statistics by mapping the reported vacancy rates for the Atlanta metropolitan area and its market subareas for a four-year period. Although the metropolitan-wide vacancy rates calculated by three vendors flow in the same direction during the period 1984 through 1988, the vacancy rates reported by the national and local vendors differed considerably: for example, 25%, 21% and 16% vacancy rates in Atlanta were estimated for 1988.

From a contingent claims or portfolio perspective, both Geltner (1990) and Capozza and Schwann (1990) propose that vacancy levels influence the market risk of rent. Geltner specifically identifies that a building's rent has two types of portfolio risks: vacancy rate risk and the effective rental price risk. In a portfolio context, the studies of the impact of vacancy rates in regional markets on the returns on the office property portfolio have been preliminary. The lack of sufficient single-market area data of properties has precluded the use of vacancy data in analyzing the relationship between risk, return and the contribution of vacancy risk. In one study, property returns were aggregated at the regional level; Hartzell, Hekman and Miles (1987) did not test metropolitan market vacancy rates. With a market-specific focus, Grissom, Wang and Webb (1991) observe that the capitalization rates of properties differ among the inner and outer city locations for four Texas cities. (Our data shows that these cities had a wide range in reported vacancy rates.)

While the vacancy rate is not specified as a risk factor, a variable is used to introduce the uncertainty of the property appreciation rate. The vacancy in the inventory will affect the rate of appreciation. The rate of appreciation for a property depends in part on the supply and level of occupied space in a market. Consistent with Geltner's (1990) observation that vacancy contributes to risk, vacancy is a component of this appreciation uncertainty. Not using a vacancy variable in testing the performance of real estate investments whether at the national, regional or local level, raises this question: If one concurs with Geltner (1990) and Capozza and Schwann (1990) that rent and therefore the return on the property is subject to vacancy risk, how can this risk factor be empirically assessed? Any assessment of vacancy risk must address the range and reliability of published vacancy rates.

The difference in vacancy reports between local and national organizations have not been fully analyzed.[4] The organizational advantages of national affiliation for a broker has been explored only to a limited degree. Frew and Jud (1986) conclude that residential franchise agencies benefit from national brand name image. Nelson and Nelson (1988) explore the positive perceptual benefits that a national brand name contributes to the operation of a local agency.

Creation of Vacancy Series

The Building Owners and Managers Association (BOMA) was a pioneer in creating an office building statistics database. Participating owners provided information on the physical and financial attributes of their buildings. The database was and is comprised of a selective sample of buildings in each market surveyed. Year to year, the sample has varied depending on age of properties, new lease terms, and additions and deletions of properties from previous samples. The BOMA data have been used in a macro-perspective analysis of the rent adjustment process (Shilling, Sirmans and Corgel, 1987).

During the 1970s and 1980s, local and regional brokerage houses began to expand their operations to key cities throughout the United States. By the early 1980s, two firms, one on the East Coast and one on the West Coast, could rightfully claim to operate on a national scale with offices in key cities: Coldwell Banker (now CB Commercial Real Estate Group, headquartered in Los Angeles) and New York-based Cushman & Wakefield, Inc.

Responding to the emergence of these two national firms and the growth of Grubb and Ellis through acquisitions, a group of independent local/regional real estate brokerages agreed to participate in an affiliation to share information—the Office Network (now ONCOR International). In 1987, the Society of Industrial and Office Realtors (SIOR), called upon its members to provide information about the local office markets in addition to industrial properties. SIOR, in association with Landauer Associates, has published an annual report on office and industrial market conditions.

In addition, several real estate periodicals—*National Real Estate Investor, Commercial Property News*, and *Real Estate Forum*—regularly report on office space activity in local market areas. The articles generally reference current vacancy rates as provided by real estate brokers, local and/or national. Various consulting groups have also accumulated in-house vacancy rate data from client reports. Emerging are firms who specialize in the monitoring of office transactions, but they have a limited historical base.

Real estate investors, individual or institutional, are reluctant to divulge current occupancy levels for their properties. In an imperfect market, vacancy information about properties in their portfolios could adversely affect lease negotiations or disposition. Private or public offerings for real properties provide current occupancy information to potential investors. However, the limited number and infrequency of these offerings preclude the development of a meaningful database.

The data varies considerably among organizations publishing vacancy rate statistics. Of the various data series, BOMA has the largest historical database.[5] BOMA has provided an annual survey of occupancy and operating expenses as well as vacancy

rates since the 1960s. By 1986, the BOMA database covered seventy-nine cities and 2,975 buildings. Building information is categorized by city/suburb, size and age. But the BOMA survey has been faulted because the data have not been presented in a consistent format over time: the same buildings are not sampled each year, and the definitions for the statistics have changed.

After nearly a decade of data collection, CB Commercial surveyed 13,000 office buildings nationally in 1986, and the firm published a quarterly vacancy summary for the downtown areas of thirty-seven cities that year. By the early 1980s, CB Commercial began to impose a uniform reporting system on its local offices for their gathering of information (even though published data were available since 1978). Cushman & Wakefield had vacancy rate information for thirty-eight cities in 1986; forty-eight metropolitan areas were covered by 1990. The C & W office market series also began in 1978. Data coverage has been expanded to those key cities where CB Commercial and Cushman & Wakefield have established market research units to collect information on office buildings (and other property types).

Another source of information on a national level are the market reports from the Office Network (ONCOR International), a national brokerage consortium. Each local member broker cooperates with others in the network to produce a national report. In 1986, the Office Network listed twenty-seven American and Canadian cities in its report, growing to thirty-six cities by 1990. Since 1987, the members of the Society of Industrial and Office Realtors (SIOR) have collected comparative statistics on office and industrial property markets in the U.S.; SIOR coverage of metropolitan areas was consistent from 1987 to 1990. The consulting firm of Landauer Associates, New York, has prepared the survey reports for SIOR.

Exhibit 1, *Survey Coverage*, lists the "first tier" metropolitan statistical areas (MSA) and primary metropolitan statistical areas (PMSA) in 1990. The organizations surveying these areas as of 1990 are identified. In addition, each vendor surveys some markets in the second and third tiers.

Responding to a 1986 survey about data availability conducted by Moody's, Cushman & Wakefield, Coldwell Banker, and BOMA noted the difficulties in amassing historical data (Shilling et al., 1987). Office information was generally not available in a readily retrievable form before the early 1980s and no systematic data base development was undertaken until the mid-1980s. Prior to 1980, historical office information may be available, but it would be costly to retrieve. CB Commercial (then Coldwell Banker) generally had more information about Western markets; Cushman & Wakefield, Eastern markets.

This review focuses on three national report series—Coldwell Banker, Cushman & Wakefield, and the Office Network—for central business districts because of their availability, continuity, and visibility during the past decade. Published vacancy information can be compared from Coldwell Banker and Cushman & Wakefield on a quarterly basis from 1985 through 1989. Office Network can be compared annually with the annual data of Coldwell Banker and Cushman & Wakefield from 1987 through 1989.

The Information Model

We propose that a class of risky assets—office buildings—exists in a given real estate market. These assets are traded among investors who rely in part on the level

Exhibit 1
Survey Coverage
First-Tier MSAs and PMSAs, United States

Metropolitan Area	1990 Rank (Est. Pop.)	CB Commercial	Cushman & Wakefield	ONCOR	SIOR
Anaheim-Santa Ana, CA	17	×	×		×
Atlanta GA	9	×	×	×	×
Baltimore, MD	16	×		×	×
Bergen-Passaic, NJ	38	(1)*	(1)		(1)
Boston, MA	8	×	×	×	×
Charlotte-Gastonia, NC	42	×		×	×
Chicago, IL	3	×	×	×	×
Cincinnati, OH	29	×			×
Cleveland, OH	25	×			×
Columbus, OH	34	×			×
Dallas, TX	11	×	×	×	×
Denver, CO	26	×	×	×	×
Detroit, MI	5	×	×		×
Ft. Lauderdale-Hollywood, FL	40	×	×	×	×
Ft. Worth, Arlington, TX	36	×		×	×
Houston, TX	7	×	×	×	×
Indianapolis, IN	39	×		×	×
Kansas City, MO-KS	28	×		×	×
Los Angeles, Long Beach, CA	1	×	×	×	×
Louisville, KY	50		×		×
Memphis, TN	48		×		×
Miami, Hialeah, FL	24	×	×	×	×
Minneapolis, St. Paul, MN	15	×			×
Monmouth, Ocean, NJ	47	(1)*	(1)		(1)
Nashville, TN	45	×	×	×	×
Nassau, Suffolk, NY	10	×*	×		×
New Orleans, LA	37			×	×
New York, NY	2	×	×	×	×
Newark, NJ	23	(1)*	(1)	×	(1)
Norfolk, Virginia Beach, VA	32	×			×
Oakland, CA	20	×	×		×
Orlando, FL	44	×	×		×
Philadelphia, PA	4	×	×	×	×
Phoenix, AZ	18	×	×	×	×
Pittsburgh, PA	21		×	×	×
Portland, OR	41	×	×		×
Riverside, San Bernardino, CA	14		×		×
Rochester, NY	49				×
Sacramento, CA	31	×		×	×
St. Louis, MO.-IL.	13	×		×	×
Salt Lake City, Ogden, UT	43	×			×
San Antonio, TX	35		×		×
San Diego, CA	12	×		×	×
San Francisco, CA	27	×	×	×	×
San Jose, CA	30	×	×		×
Seattle, WA	22	×	×	×	×
Tampa, St. Petersburg, FL	19	×	×	×	×
Washington, DC	6	×	×	×	×

(1) MSA included in Northern New Jersey region
*suburban office market data only

of the specific building occupancy and the level of vacancy in the market area to estimate future returns (Geltner, 1990). The confidentiality of real estate transactions precludes public knowledge of the returns of any one office building (the asset).

Grossman and Stiglitz (1980) propose a noisy rational expectations model that has been modified by the financial community in which the return on a risky asset is:

$$y = \mu + \varepsilon \,, \tag{1}$$

where

y = the observed return on a risky asset,
μ = expected return on the asset for a period, and
ε = the error term, (the noise).

Grossman and Stiglitz suggest that intuitively, the magnitude of the supply of the asset (in our case, the supply of available office space) and the frequency of trading contributes to the size of the error term. If there is a large supply but infrequent trading, the error term will be large. If there is a small supply but frequent trading, the error term will be small.

Let the error term be defined in terms of the vacancy rate and a set of random noise variables. The vacancy rate can now be defined as a function of the expected return and random variables:

$$\upsilon = \mu - y + \eta \,, \tag{2}$$

in which

υ = vacancy rate, and
η = a set of random noise variables.

Diamond (1985) proposes that the difference between the observed return and the expected return is due to errors in information, the variance in the assets (the volume of trading in the asset class), the wealth per trader, the risk-aversion level of the traders, the supply of the asset being traded, and the observation that only a certain percentage of traders choose to pay the cost of being informed. The price of an asset will vary per period and transaction because of the difference between each trader observed and expected returns. Diamond reviews that the price, P, of a risky asset is defined (Diamond, 1985, Lemma 1, p. 1976) as:

$$P = \alpha Y + \beta u - \gamma X \,, \tag{3}$$

in which

Y = the sum of the random information variables,
ρ = the value of the asset,
X = the supply of the risky asset,

where

$$\alpha = \frac{rvh}{rvh + r\lambda sv + r^3(\lambda s)^2} \,, \tag{4}$$

$$\beta = \frac{r\lambda sv + r^3(\lambda s)^2}{rvh + r\lambda sv + r^3(\lambda s)^2}, \tag{5}$$

$$\gamma = \frac{v + r^2\lambda s}{rvh + r\lambda sv + r^3(\lambda s)^2}, \tag{6}$$

in which

λ = the percentage of informed traders, and

v = variance of assets. (In the specific case of office space, the inventory of the asset is nonoccupied space or the product of the vacancy level times the inventory.)

h = precision of the realized returns. The greater the volatility in returns, the more difficult the information gathering process, and less the precision. The greater the precision the less the error term. The precision of the realized returns is h, and

r = the absolute risk-aversion preference, the exponential utility function, at a given risk level. The common assumption is that agents are constantly risk adverse, and

s = the precision of the information. The degree of the random noise term η is a function of the accuracy of the information. Greater precision information reduces the error term. Part of the precision of the information is the frequency of the trading. The precision of the information cannot be observed, but an estimate of the precision of information, s, can be made.

For the class of risky assets, office buildings, a major contribution to the estimate of returns, the vacancy rates, indicate the available supply of space. The real estate brokers wish to secure information about these rates. The brokers have spent time and borne costs to acquire the information. Some broker agents are independent and local. Other agents are part of a national organization.

The agent observes ex-post the series of returns y. For a cost, c, the agent can improve his estimate of y in the future. In the case of office buildings, we propose that information that may be available at cost about the anticipated return, μ, is the vacancy rate. The agents may choose to pay for the information and become informed participants or take their chances and remain uninformed. The availability of information determines the magnitude of the error term.

Grossman and Stiglitz (1980) and Diamond (1985) conclude that agents will pursue three alternatives. The first condition is when all agents choose to become informed because the error in the information is less than the volatility of the returns so that the cost of the information leads to a better estimate of the returns. The second condition, which may seem paradoxical, is that all agents choose not to purchase information and remain "noninformed." The volatility of the returns is smaller than the error in the information so that there is no benefit in obtaining additional information. A high degree of trading is occurring. In the convention of financial information theory, the precision of the returns is greater than the precision of the information. The precision of return or information is the inverse of the variance of the returns or information. Semantically, the phrase "noninformed" can be mis-

leading. The observed returns are providing sufficient information so that the agent chooses to be noninformed because he has obtained sufficient information to choose to trade or not. The third condition applies when some percentage of traders decide to purchase the information to become informed. These agents believe that they benefit by obtaining additional information to estimate the trade return about the asset.

Diamond's model first can be used to address the percentage of informed traders. Once that solution is found, the form for the precision of the information, s, can be derived. Since office space is not that frequently traded, we suspect that there will be a certain percentage of informed traders. Given the expected price, and the set of traders with a given risk-aversion level, Diamond (1985) derives the percentage of informed traders as:

$$\lambda = \frac{v}{rs}\sqrt{\frac{s}{e^{2/cr}-1}} - h \,. \tag{7}$$

Since a major (albeit not complete) factor that determines the returns on the asset class known as office buildings is their vacancy, we note that from equation 2 the vacancy rate is defined in terms of the estimate of returns. We argue that the vacancy factor is predominant in the information about returns and influences the precision of the information s. While s is not observable, an estimate of s can be made by observing the variance among the series of vacancy rates.

Exhibit 2 depicts a model based on equation 7 in graph form. The central vertical axis from 0 to 1 depicts the percentage of informed traders. The left axis depicts the increasing degree of the precision of the information and the right axis depicts the increasing cost of the search. Note that when the precision of information is low and the costs of the search are low, the number of traders who expend funds to gain additional information increases.

When the percentage of informed traders is between zero and one, the following relationship of s, the degree of information precision is observed (Diamond, 1985)

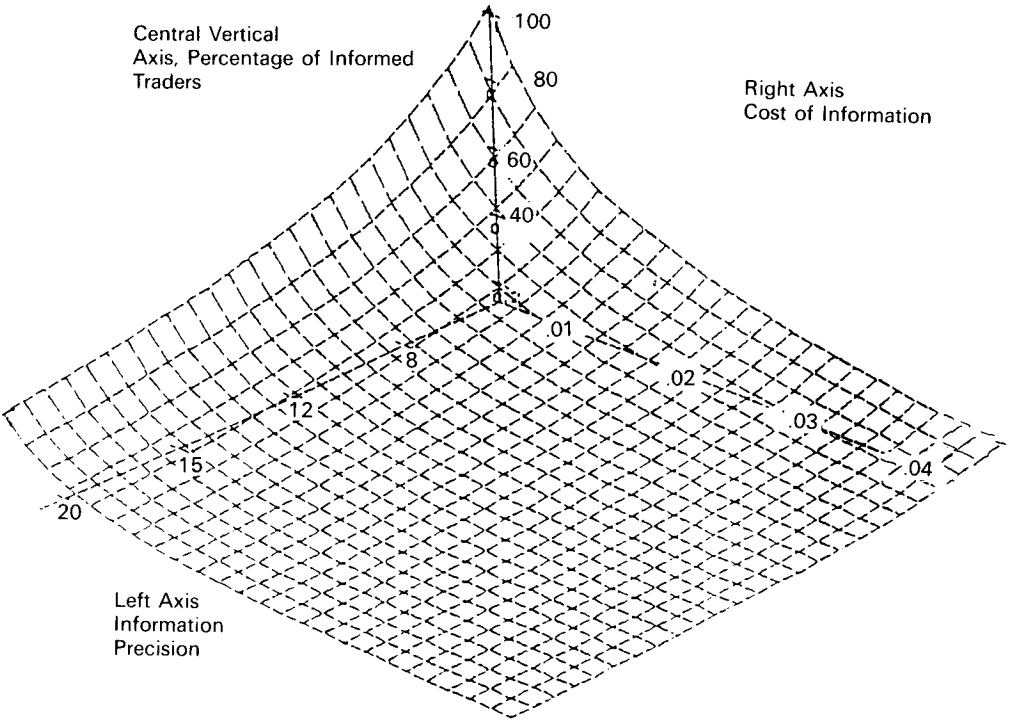
$$\exp\,(2c/r) - 1 = \frac{s}{h + (r\lambda s)^2/v} \,. \tag{8}$$

Therefore when the percentage of informed traders is between zero and one, we solve for the value of s from equation 9 as:

$$s = \frac{v \pm \sqrt{-v^2 + r^2\lambda^2 hv\,\exp^{(4c2/r2)} + 2\,\exp^{(2c/r)}}}{r^2 l^2\,\exp^{(2c/r)} - 1} \,. \tag{9}$$

The impact of the supply of assets and the cost of information upon the precision of the information is illustrated in Exhibit 3. If the risk level and percentage of informed traders are held constant, as the cost increases (left axis) the precision decreases (vertical axis). As the volatility (variance) of the asset increases (right axis) the precision increases. The asset to be traded, the office space, is a function of the overall inventory and the amount of vacant space.

Exhibit 2
Percentage of Informed Traders, Information Costs and Information Precision

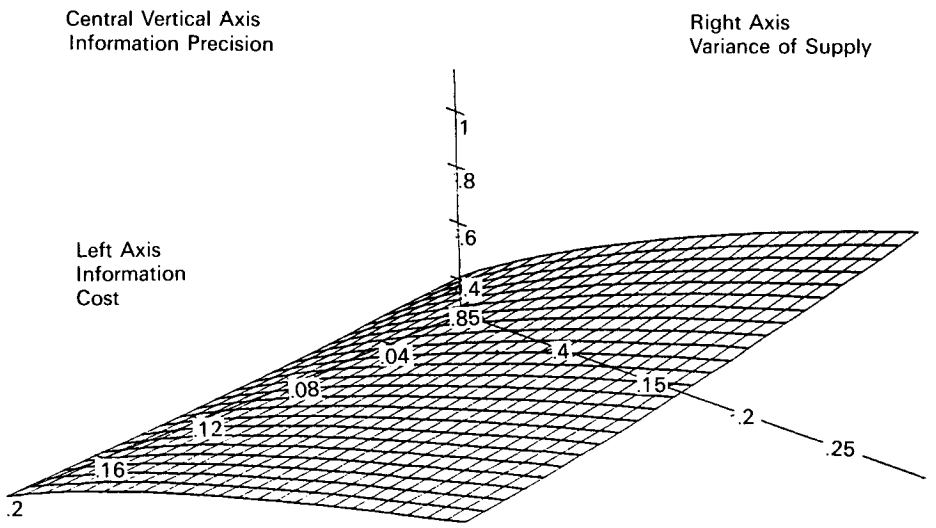


When equation 9 is sequentially simulated with parameters held constant for risk levels, percentage of informed traders, precision of returns, we note that the results for the range of values for s, c, and v follow the patterns exhibited in Exhibit 3. The resulting three-variable model for s, c, and v is exponential. Based on these observations and those of Diamond, we summarize that given a level of absolute risk aversion, the variance in the reported rates increases as the variance in the tradable asset, the supply of space, increases, the cost of information increases, the error in the information increases, and the percentage of informed traders decreases.

The Information Base

According to the BOMA report (1990) three major factors determine the variance in reported vacancy rates: the office space inventory (the model's tradable asset), the reporting process (which is the cost in the model), and the timing of the information. The model does not explicitly treat the timing issue. The brokers proceed to expend time, money, and networking to assess the inventory of the asset to be traded.

Exhibit 3
Information Precision, Costs, and Variance of Supply



Inventory

Whether a building is included in an inventory sample depends on its quality rating, location within the downtown area as defined, and the ownership/occupancy of the building. (While the empirical tests focus on Cushman & Wakefield, Coldwell Banker and the Office Network because of the breadth of their information, we will include commentary about the other vendors in this section.) SIOR and Cushman & Wakefield report Class A space. Office Network and Coldwell Banker report on an aggregated sample of Class A, B and C buildings. Further, SIOR additionally reports Class B space separately. The reporting on the separate classes of space directly responds to the agents' perception of the risk level of their clients. Institutional investors who seek to minimize their risk will seek assets perceived as less risky, Class A. Speculative investors with lower absolute risk aversion will screen the entire asset class. Furthermore, the inclusion of a property in the inventory has the effect of abetting the perception that the property is of a given quality. Brokers might be persuaded to tilt the ranking to aid their clients.

How are the quality ratings determined? The appraiser (*Appraisal of Real Estate*, 1987) would answer that the building's architectural style and functional utility are interrelated in determining what rent it can command on the market. On the other hand, brokers generate a large quantity of the vacancy information from their daily operations. To the broker, the difference in the quality of office space can be distinguished by:

- the size of the building;
- the asking and actual rents;
- age and physical characteristics;
- the location within the central business district;
- ownership and major tenants; and
- its classification as either on-the-market or off-the-market office space.

While attempts to distinguish office space by perceived quality levels have been made, vendors do not agree on the cutoff point between a Class A building and a Class B building. None of the vacancy series studied defines, qualitatively, the absolute characteristics of the A buildings surveyed.

If the inventory classification is not universal among vendors, each survey will assign a different weight for quality of space. One inventory sample (A) may be heavily weighted with Class A space. The emphasis on this one type of space might signal some long-term absorption problems, a condition that may not exist depending on the availability of other classes of space. Another inventory sample (B) may be weighted with A, B and C quality space. As the city evolves through the business cycle and its own economic base life cycle, businesses will shift their demand for space among the different classes of space. A survey focusing solely on Class A buildings ignores the vacancy dynamics of the other classes.

As an alternative to the preceding description of buildings by classes, the BOMA guide suggests two new definitions: a "metropolitan" class (derived from physical attributes and tenant functions) and an "international" class (buildings classified as investment and institutional grade properties). However, the metropolitan base definition and the international base definition are not mutually exclusive.

Buildings are also classified by the rents that they command. Higher rent buildings suggest high class buildings. However, the actual rental rates usually vary from contract rents. Classification by rents may be erroneous. First, asking rents generally are the figures released to the public. Because of confidentiality, data on actual rents paid are not widely available.

Secondly, effective market rents are a function of the negotiating strategies employed by the landlord in his quest for a diversified mix of tenant leases. Often, a prestigious tenant may garner concessions, resulting in rents below the current market for a particular building in a particular location. Lead tenants in a large multitenant office building often command very attractive below-market rents to "anchor" a building ("naming rights" in the United Kingdom). Because the reported vacancy series do not provide detailed building-by-building lease analyses, it is virtually impossible to obtain an accurate profile of the actual rents collected from the occupied space. The broker will speak of asking rent, but the resulting rent collected after a discount to a large tenant or a generous work letter is difficult to determine. If a building defined as Class A is garnering Class B rents in its recent leases, a distortion at the Class A vacancy level may occur.

Geographic boundaries of the downtown office market area constitute another factor causing differences in the office space inventory classification. The published reports may define the areas of inclusion quite differently. Comparison of the boundaries used would be a costly exercise at this stage of the research. Brokers also tend to specialize in submarkets and they may tend to focus their resources and information gathering on areas having an expected high degree of leasing turnover.

Finally, cities do not march in tandem in their usage of office space. Hekman (1985) observed that local business and economic conditions can override national conditions. There will be timing differences in how businesses decided to lease additional space or let leases terminate and relocate. In some cities, the building permit approval process may be tedious, impeding the pace of new development. As a result cities will vary in the rate of adjustment of rents to the vacancy rate.

Exhibit 4
Inventory Definitions

	CB Commercial (Coldwell Banker)	Cushman & Wakefield	SIOR Class A	ONCOR—(Office Network)
Inventory Includes				
Government buildings	No	No	No	No
Government leases[a]	Not known	Not known	Not known	Not known
Owner-occupied	No	No	No	No
New space (6 mon.–1 yr)[b]	No	No	Yes, Rehab.	Yes
Class A, B and C	All three	Class A only	Class A[d]	All three
Medical office space	No	No	Not known	No
Core CBD only	No	No	Historic Core	No

[a]The SIOR study asks, "Does the vendor include space in privately owned buildings that is leased to government agencies?" The answer cannot be determined from the responses. The answer is probably yes for all four when the property is a multitenant building with private-sector tenants.

[b]Does the vendor include in the inventory space that is coming on line in six months whether leased or not? CB Commercial and Cushman & Wakefield add new buildings upon issuance of a certificate of occupancy. Office Network (ONCOR) includes *under construction* but does not distinguish pipeline timing. SIOR separately lists *under construction* after the vacancy for current inventory.

[c]Does the vendor distinguish between core Central Business District and Downtown office space? Three use definitions that extend beyond core area. CB Commercial provides boundaries in their report, see *Office Vacancy Index of the Untied States, December 31, 1990,* issued February 1991. Cushman & Wakefield uses boundaries as defined by the local office; see, *Focus on Market Trends 1991* (February 1991). For the Office Network, see *1991 Commercial Property Trends* (April 1991).

[d]SIOR defines the CBD as "space located near the historical urban core commonly associated with traditional government and financial districts," see *1990 Guide to Industrial and Office Real Estate Markets, S.I.O.R.* Additionally, it breaks out substantial rehabilitation as a distinct category above the existing inventory.

The Reporting Process

The aggressiveness of the reporting process is determined by the costs that the agent will bear. Among the many factors that must be searched to determine the reported occupancy in a building are:

Exhibit 5
Vacancy Definitions

	CB International (Coldwell Banker)	Cushman & Wakefield	SIOR	ONCOR—(Office Network)
Summary[a]				
Physically available	Yes	Yes	Yes	Yes
Vacancy includes				
Sub-lease	Yes	Yes	Yes	Yes
Proposed space[b]	No	No	No	No
Announced space[c]	No	No	No	No
Space under construction available				
(6 months to year)[d]	No	No	No	Yes
Off-market[e]	Not known	Not known	No	Not known
Non-competitive	No	No	No	No

[a]The attempt here is to conceptualize the thrust of the vendor's attitude toward Vacancy. Is the thrust to determine all space that is physically available for new tenants? A yes here indicates the thrust is to monitor space physically available. *All three surveys include physically available space.*

[b]Does the vacancy rate include space that is proposed? An announcement has been made and permits have been issued. *All four do not count proposed space.*

[c]Does the vacancy rate include space that is announced? Plans are public but permits have not been issued. *All four do not count announced space.*

[d]Under construction and available within six months? Under construction and available within one year? *Office Network (now ONCOR) includes building under construction; the others do not. No distinction is made between six months and one year.*

[e]Does the vacancy include space, physically available but considered part of an owner-occupied building? SIOR specifically instructs that owner-occupied space should not be included. *For the other three unable to determine answer from source materials.*

- Determination of the actual gross and net square footage of the building, and the definition of the square footage of space leased. Even the several common definitions of what gross and net leases (and what should be followed in signing a lease), are not ironclad and vary from lease to lease and city to city.
- Effective date of the occupancy. Is it the signing of the lease, the start date of the lease, or the actual occupancy? The real estate broker representing the lessor usually has an early lead on this information. Generally, one would expect the new lease to be announced, but there could be reasons for not disclosing the lease terms.

- Leased space *not* occupied by the lessee and up for sublet. Space may be leased to a major tenant who bears the responsibility for rent payment, but the tenant could be actively engaged in subletting this space.

The BOMA guide suggests a chart of accounts for detailing these variations of occupied space, but it appears that vendors do not consistently follow the format or use a different method of accounting.

Exhibits 4 and 5 present the differences among the vendors studied in this research.

Timing of Information

Legal requirements for recording a lease vary by purpose of lease and market area. Owners, managers, brokers, and professional consultants are motivated, to some degree, to avoid full disclosure of office leasing information to the public. In a tight market, the landlord will keep the details of the lease as private as possible. He does not want to invite assessment reviews to risk bickering among existing tenants if there are differences in terms, nor tip off competitive brokers who are trying to lure tenants away as leases roll over. In contrast, in a soft market, the landlord may want to boast of new tenants, but he may not want to disclose his concessions to the competitors. Accordingly, the public announcement of vacancy levels for a market area, especially because of major lease expirations, affects the bargaining position of landlord and tenant.

For brokerage houses, market surveillance is a costly form of business espionage. The inside broker has the critical information about the deal; the outside broker observes the activity and through formal and informal information gathering tries to ascertain what has transpired. However, the inside broker always has the timing advantage. Depending upon broker activity and knowledge, vendors will differ in their assessment of vacancy levels. Because some agents do not search as aggressively or expend the funds necessary for timely reporting, lags may occur in the reporting.

The broker is faced with a series of choices in assessing the vacancy information. Two major factors are identified in the REIM model: what shall the broker define as the inventory (or subset of inventory) of available space and what shall the broker spend for the cost of information, the cost of the search. The third factor is what will be the timing of the release of the information. Many seemingly independent individuals are participating in what appears as a chaotic information process. Can the REIM model describe the aggregation of individual actions?

The Tests

If all brokers have access to the same information at the same time and are willing to bear the cost, no difference in the reported rates is expected. If because of the reporting process, brokers receive the same information but at different times (or choose not to spend the money to obtain it as quickly as everyone else), then a lag is expected in the reported rates. If the variation in activity turnover and the size and complexity of the inventory complicates the search for information, then a variance in

the reported rates is expected. The variance of reported rates may be due either to a lag in reporting, or to the combination of the available supply, search cost and trading activity.

An OLS regression is used to test the degree of lagging. Suppose that there is an office inventory in central business district, I, with a given vacancy, at time period V_t. The vacancy for this city will vary over time, $t_1, t_2, \ldots t_n$.

If the observers, $a, b, c. \ldots$ record the same vacancies over the same period of time, then we can conclude that there is a level of common information is present and readily available in published form. The equation to be tested is

$$V_{a,t} = V_{b,t} = V_{c,t} \ldots . \tag{10}$$

If there is no agreement, several forms of differences may arise. Let $V_{a,t}, V_{b,t}, \ldots$ be the different observations of vacancy among observers.

Same Inventory, Different Time

If the observers were using the same inventory base, but delays occur in the data collection, then the timing difference between vacancy series would be represented by

$$V_{a,t} = \beta V_{b,t-1} + e \ , \tag{11}$$

in which e is the difference between the reported vacancy rate of B in the former period and the current vacancy rate reported by A. The residual error term would be serially correlated. Because we are using yearly periods, we do not expect that the lag of the term e will be greater than one. A lag in reporting among vacancy series is revealed by the autocorrelation of the residual, i.e., the Durbin-Watson statistic. To test for autocorrelation the following identity is established:

$$\mathrm{E}(\varepsilon_{x+1} - \varepsilon_x)^2 = \mathrm{E}\varepsilon^2{}_{x+1} + \mathrm{E}\varepsilon^2{}_x - 2\mathrm{E}(\varepsilon_x \varepsilon_{x+1}) \ , \tag{12}$$

in which

$$\varepsilon_x = \textit{disturbance term.} \tag{13}$$

If the successive disturbances are positively correlated, the left-hand expectation will be smaller than when they are uncorrelated. There is a series of tests for auto-correlation. With the assumption that the Least Squares (LS) residuals $e_1 \ldots, e_n$ are satisfactory approximations for the corresponding disturbances, the more common test uses the Durbin-Watson statistic (Theil, 1971):

$$d = \frac{\sum_{x-1}^{n-1} (e_{x+1} - e_x)^2}{\sum_{x=1}^{n} e_x^2} \ . \tag{14}$$

When d takes a sufficiently different value from 2, this suggests that autocorrelation exists. Because the limited sample of observations does not approach 100, the Durbin-Watson statistic is used instead of the Box-Pierce statistic (Kennedy, 1989).

The data sets for office vacancies in the central business districts were available in both annual and quarterly reports. On an annual basis, a four-year history, 1986–1989 for fourteen cities was composed from CB Commercial, Cushman & Wakefield, and Office Network (ONCOR). A regression for both non-lagged and lagged data was performed on this data. The form of the non-lagged regression is:

$$R_t = \alpha + \beta x_t + \varepsilon \,, \tag{15}$$

in which

R_t = the reported vacancy rate per time period, t, for vendor A,
x_t = the reported vacancy rate for the same time period, t, for vendor B.

Similarly the lag regression followed the same ordinary linear regression except that:

x_{t-1} = the reported vacancy rate of the previous quarter. (Beyond a lag of one quarter, the regression results were not statistically significant.)

Cushman & Wakefield (CW), CB Commercial (CB), and ONCOR International (identified as net in the exhibits) provide reports listing annual vacancy rates for the central business district for many of the cities in the first tier (Exhibit 1). A major difference between the vendors is that Cushman & Wakefield surveyed on only Class A space (according to its reports). CB Commercial and ONCOR surveyed all office space. The data from 1986 through 1989 were used for the testing. The three vendors reported data in each of fourteen cities. In thirteen other cities, two of the three vendors reported data for the period. The data was tested in lag and non-lag form.

Our purpose is to test the relative impact of each of the variables. To discretely solve the model requires the actual cost of information and the input of the risk levels of the participants, an effort that is beyond the scope of this research. While complex, the solution to solve for the estimate of information precision, s (equation 9) is exponential in form.

From the Diamond model we expect the following:

- the higher the mean reported vacancy rate, the higher the variance;
- the larger the inventory, the lower the variance, simply because there is more trading in a large class of assets (Grossman and Stiglitz, 1980);
- if one of the vendors is local, there may be greater variance because the local vendor has a cost advantage;
- if one of the vendors entered after 1980, there may be a greater variance if the vendor did not sufficiently cover the cost of the search;
- if one of the vendors is Class A, then there may be a greater variance if the samples are independent (DeGroot, 1975);
- the more vendors reporting the lower the variance because there are more traders (Grossman and Stiglitz, 1980).

The test for the level of information precision is:

$$\sigma^2 = m + size + local + post80 + classa + vendors \ , \tag{16}$$

where

σ^2 = variance of annual vendor reported vacancy rates for each city,
m = mean of reported annual vacancy rates for each city,
size = the square footage of the inventory for the central business district as reported by SIOR, 1989,
local = a dummy variable in which 1 indicates that a vendor was local and affiliated with the Office Network; and zero indicates vendors reporting were CB and/or C&W,
*post*80 = dummy variable of 1 indicates one of the vendors began reporting after 1980,
classa = dummy variable of 1 indicates that one of the vendors was CW, who reports only Class A space,
vendors = the number of vendors reporting for a city.

We did not test for all the variables in the model. Because the solution for s is exponential and we sought the *relative* changes (the variable elasticities; see Theil, 1971) between variance and the mean and inventory size, the logs of the variance, σ^2; the mean, m; and the *size* were used in the regression.

The Results

Vendors did not agree about rates for the same period in the fourteen cities with data from three sources. The three vendors did not agree in any of these cities which include the largest central business districts. In only six cases did two of the three vendors agree about their rates in the same period. (See Exhibit 6; the t-statistic for the variable was significant at the 95% confidence level in nine cases.) In only two of the thirteen cities with two sources of data did the vendors agree (see Exhibit 7).

When the data of one vendor was compared to the lagged data of another vendor, the relationship improved in all but two of the fourteen cities with three sources. (See Exhibit 5; lag between vendors is noted with the prefix "l" and the t-statistic for relationship is noted for the variable.) However, the relationship improved by lagging in only five of the cities with two sources. It appears that vendors agreed only on a random basis.

The period-by-period comparisons or lagged comparisons confirm what the industry sensed—a wide divergence in the reported rates. This divergence ranged from a low variance of .1 for Seattle rates for a four-year period to a high variance of 4.1 for Austin rates. (The total number of cases for the regression were twenty-eight; Orlando was added to the regression data set.)

The results of applying the modified Diamond REIM suggest that this range in variance is to be expected. Exhibit 8 attributes higher variance to a higher mean vacancy rate and lower turnover characteristic of smaller markets. With a high

Exhibit 6
Annual Vacancy Reporting Relationships, CB Commercial, Cushman & Wakefield, and Office Network (ONCOR)

City	Vendors	*t*-Stat. Variable	*t*-Stat. Constant	Variable Coeffic.	Constant Coeffic.	Durbin-Watson Statistic
Atlanta	cbcw	.63	2.08	.26	12.21	2.29
	cbnet	1.07	.21	.96	−3.31	2.02***
	cwnet	1.32	2.69	.85	31.20	1.95***
	lcbcw	.40	1.29	−.40	20.26	2.47
	lcwcb	1.12	1.69	.45	9.44	1.99***†
	lcbnet	.16	.76	−.20	17.66	2.46
	lnetcb	11.07**	39.02**	−.52	25.30	2.10***†
	lcwnet	1.17	.08	.81	1.00	1.63
	lnetcw	.36	2.66	−.18	20.98	3.35
Boston	cbcw	1.84	1.26	.57	4.14	1.29
	cbnet	3.76*	5.94**	.43	6.74	2.25
	cwnet	1.26	2.80	.36	7.83	1.96***
	lcbcw	1.45	4.31**	.47	15.45	1.99***
	lcwcb	1.36	.22	.88	1.46	2.01***
	lcbnet	.23	3.66	.06	9.78	1.24
	lnetcb					
	lcwnet	1.66	3.18	.39	7.13	2.53
	lnetcw	3.11*	5.62**	−.87	17.51	2.09***†
Charlotte	cbcw	.23	3.13	.06	8.51	2.64
	cbnet	.10	3.19	−.02	9.42	2.86
	cwnet	5.12**	.11	.98	−.23	.93
	lcbcw	4.85**	12.91**	−.51	14.61	1.08†
	lcwcb	.49	.61	.53	6.02	1.47
	lcbnet	2.17	6.42**	−.42	13.80	1.62†
	lnetcb	.47	1.04	.39	7.78	1.87
	lcwnet	.98	3.03	−.46	15.82	1.55
	lnetcw	.00	2.30	.00	11.27	1.35
Chicago	cbcw	1.07	1.35	.39	6.20	1.44
	cbnet	1.82	6.18**	−.33	15.74	1.44
	cwnet	3.52*	9.21**	−.55	20.45	2.10***
	lcbcw	5.39**	10.73**	−.87	22.27	1.45
	lcwcb	1.57	.60	1.79	−7.69	1.71
	lcbnet	7.37**	.38	.77	.54	2.64†
	lnetcb	.88	1.38	−2.22	39.18	1.46
	lcwnet	.99	.62	.56	4.86	1.88
	lnetcw	1.28	.21	1.31	−2.70	3.33
Dallas	cbcw	4.20**	.05	.89	.24	2.00***
	cbnet	2.12	.27	.75	3.89	1.65
	cwnet	2.13	.58	.79	5.01	2.96
	lcbcw	8.13**	3.13	1.45	−14.54	2.16†
	lcwcb	1.10	.13	.93	2.40	1.12
	lcbnet	2.30	.18	.82	1.53	2.07**:†
	lnetcb	.07	.83	.08	21.13	1.59
	lcwnet	1.85	.64	.72	5.94	1.49
	lnetcw	1.16	.00	.94	.08	2.36
Denver	cbcw	.90	1.03	.52	14.67	1.41
	cbnet	2.63	2.41	.53	13.16	1.05
	cwnet	2.81	2.52	.49	11.70	1.67
	lcbcw	7.01**	1.24	1.34	−5.97	2.93†
	lcwcb	1.63	3.21	−.90	49.81	1.31
	lcbnet	1.51	.76	.66	9.35	.93
	lnetcb	.70	1.41	−.93	53.01	1.27
	lcwnet	.05	1.44	−.03	25.36	.61
	lnetcw	2.52	1.23	2.07	−25.48	1.24
Hartford	cbcw	.20	.73	.13	5.97	1.01
	cbnet	1.18	.06	.65	−.41	1.15
	cwnet	3.00*	.35	.94	1.34	2.10***
	lcbcw	1.20	.22	.44	.98	2.07**:†
	lcwcb	.03	1.79	−.02	11.99	1.88
	lcbnet	.65	.69	.25	3.20	1.78
	lnetcb	.17	3.38	−.06	11.40	1.60
	lcwnet	.04	1.55	−.02	12.07	1.89
	lnetcw	.65	3.32	−.22	13.40	1.91***

City	Vendors	*t*-Stat. Variable	*t*-Stat. Constant	Variable Coeffic.	Constant Coeffic.	Durbin-Watson Statistic
Houston	cbcw	.35	2.38	.12	17.44	2.20
	cbnet	.34	3.88	.90	18.21	2.17
	cwnet	8.34**	4.95**	.68	8.20	2.26
	lcbcw	2.54	.91	.66	5.39	2.78†
	lcwcb	.35	1.29	−.39	29.61	.87
	lcbnet	2.27	3.67	.37	12.59	2.92†
	lnetcb	.68	1.33	−1.04	40.76	.86
	lcwnet	.92	1.10	.47	11.84	1.73
	lnetcw	.65	−.02	.90	−.55	1.41
Los Angeles	cbcw	1.50	.05	.88	.48	2.68
	cbnet	.07	4.85**	.02	14.13	1.58
	cwnet	1.21	10.44**	−.17	18.88	2.01***
	lcbcw	.90	.31	.65	3.78	3.03
	lcwcb	.60	8.55	.08	16.09	1.86
	lcbnet	8.33**	27.11**	−.47	20.93	2.26†
	lnetcb	1.06	1.74	−1.23	29.15	3.32
	lcwnet	2.82	39.26**	−.10	18.53	1.35†
	lnetcw	.82	1.21	−1.41	34.96	3.16
Miami	cbcw	.15	1.20	.09	19.46	2.38
	cbnet	1.01	5.34**	−.20	26.87	2.56
	cwnet	.88	4.56	.16	21.01	1.33
	lcbcw	.44	.97	.26	14.75	3.05
	lcwcb	2.91	8.09**	−.65	39.79	1.42†
	lcbnet	2.00	3.64	.29	13.87	3.18†
	lnetcb	1.02	1.92	−1.32	55.91	1.57
	lcwnet	6.85**	15.64**	.30	17.77	1.16†
	lnetcw	1.38	2.23	−1.70	69.04	2.46
Philadelphia	cbcw	2.04	.22	1.27	−1.25	2.22
	cbnet	2.56	1.34	.63	3.55	3.51
	cwnet	2.57	3.18	.38	5.00	2.28
	lcbcw	.09	.90	−.12	11.19	1.38
	lcwcb	1.21	.76	.52	3.49	1.87
	lcbnet	1.13	.41	.66	2.70	2.57
	lnetcb	1.39	.17	1.10	−1.38	1.90***
	lcwnet	1.87	.99	.54	3.07	1.75
	lnetcw	.60	.12	.93	1.68	.86
San Francisco	cbcw	1.28	.59	.74	4.51	2.39
	cbnet	2.77	.37	.90	1.68	2.90
	cwnet	2.10	.89	.65	3.87	2.13
	lcbcw	2.16	1.00	1.89	−12.14	3.15†
	lcwcb	1.50	2.30	−1.54	36.34	2.03***
	lcbnet	1.27	.44	1.44	−7.39	1.52
	lnetcb	3.64*	5.00**	*2.35	49.46	2.78***†
	lcwnet	.12	.59	.14	10.59	.59
	lnetcw	9.91**	5.25**	2.11	−15.42	1.58†
Tampa	cbcw	1.45	4.04**	−.46	24.34	3.05
	cbnet	.22	4.48**	.04	14.96	3.10
	cwnet	.78	5.13**	−.18	22.24	1.69
	lcbcw	.18	1.52	−.11	17.91	3.26
	lcwcb	2.14	.04	1.20	−.33	1.55**:†
	lcbnet	.26	2.22	.08	14.22	3.00
	lnetcb	2.29	4.32**	−1.83	44.89	2.56†
	lcwnet	.66	1.63	.27	13.45	2.52
	lnetcw	1.31	.40	1.24	−4.92	2.20***†
Washington	cbcw	.13	3.17	−.04	10.46	1.19
	cbnet	.99	7.35**	.12	8.87	.74
	cwnet	.38	4.57**	−.09	10.33	2.51
	lcbcw	2.22	11.09**	−.26	12.81	2.73
	lcwcb	3.72*	1.43	1.53	−5.88	1.80**:†
	lcbnet	.03	9.99**	.00	10.24	2.71
	lnetcb	.50	.85	*1.37	23.47	2.33***
	lcwnet	2.51	3.07	.37	5.59	1.15†
	lnetcw	2.04	3.36	−2.18	30.73	2.68

*significant at 90% confidence level **significant at 95% confidence level
***Durbin-Watson statistic within 1.90 and 2.10 †lag relationship improves *t*-statistic for variable

Exhibit 7
Vacancy Reporting Relationships, Cities with Two Vendors

City	Vendors	*t*-Stat. Variable	*t*-Stat. Constant	Variable Coeffic.	Constant Coeffic.	Durbin-Watson Statistic
Austin	cbcw	2.44	1.42	2.23	−32.56	2.42
	laga	8.88*	8.73**	42.77	−1199.12	3.39†
	lagb	1.23	.33	1.05	−8.42	1.37
Baltimore	cbnet	1.94	1.16	.56	4.75	1.78
	laga	.57	.16	.55	4.09	1.97***
	lagb	1.11	.50	1.71	−10.22	1.54
Fort Worth	cbnet	.73	.92	−2.23	64.81	.46
	laga	1.56	1.37	4.61	−92.04	1.97***
	lagb	1.16	8.00**	−.22	26.49	2.02***
Kansas City	cbnet	9.84*	2.99	1.66	−8.97	1.86
	laga	.81	.07	1.22	−1.98	.97
	lagb	.29	.90	.20	13.26	.67
Nashville	cbcw	.42	13.55**	−.03	19.70	1.33
	laga	3.23*	22.04**	−.17	22.23	2.03***†
	lagb	2.20	1.91	6.76	−111.57	1.63
New Orleans	cbnet	1.96	.62	.82	6.07	1.47
	laga	.97	.85	.56	11.50	2.13
	lagb	.05	1.33	−.04	23.51	2.52
Oakland	cbcw	2.88	1.23	1.61	−13.70	1.66
	laga	2.80	2.45	7.92	−134.19	2.10***
	lagb	2.11	1.59	.64	8.58	2.00***
Pittsburgh	cwnet	.06	1.04	.06	15.10	.67
	laga	1.71	2.51	1.35	−2.68	1.44
	lagb	4.05*	15.89**	.44	12.01	2.47†
Portland	cbcw	2.24	.46	.87	3.23	2.36
	laga	.88	1.36	.54	8.47	2.90
	lagb	5.68*	4.69**	.15	18.62	2.63*
San Antonio	cbcw	2.23	4.30**	.31	15.18	1.94***
	laga	.60	2.88	.15	18.62	2.06***
	lagb	4.83*	2.15	1.84	−18.89	3.05†
San Diego	cbnet	5.29*	3.57	.80	8.84	3.01
	laga	1.48	.32	1.05	−4.65	1.23
	lagb	1.97	.76	1.13	6.25	1.78
San Jose	cbcw	.02	2.00	.01	20.75	1.50
	laga	.59	1.89	−.39	30.94	1.58
	lagb	.40	2.10	−.29	32.05	1.03
Seattle	cbcw	.66	1.29	−1.09	28.36	1.90***
	laga	4.64	6.11	−3.22	57.10	3.33†
	lagb	.22	9.09	−.02	13.49	.95

*significant at 90% confidence level
**significant at 95% confidence level
***Durbin-Watson statistic within 1.90 and 2.10
†lag relationship improves *t*-statistic of variable

vacancy rate it is more difficult to keep track of all the deals. In a smaller market, there is the possibility of fewer participants. The fewer the participants, the more likely the potential for greater control of information. The presence of both a local and national vendor increases the variance. This increase in variance suggests that

Exhibit 8
Model Regression Results

Equation 1. All variables entered

Multiple-*R*	.61479	Dependent
R-Square	.37797	Variable, Log of Variance
Adjusted *R*-Square	.20024	
Standard Error	.78702	
	F=2.12670	Significance of *F*=.0930***

Variable	Coefficient	SE	*t*	Significance of *t*
Local Agent	1.163090	.694177	1.675	.1087
Class A Only	.309667	.739205	.419	.6795
Post 1980 entry	.203044	.405758	.500	.6220
Log of Vacancy Mean	1.298210	.580201	2.238	.0362**
Log of Size of Inventory	−.350481	.299259	−1.171	.2547
Two Vendors	.514356	.596514	.862	.3983
(Constant)	−2.289808	2.695870	−.849	.4053

Durbin-Watson Statistic: 2.08830**

Equation 2: Significant variables entered

Multiple-*R*	.58509	Dependent
R-Square	.34233	Variable, Log of Variance
Adjusted *R*-Square	.26012	
Standard Error	.75699	
	F=4.16418	Significance of *F*=.0165*

Variable	Coefficient	SE	*t*	Significance of *t*
Local Agent	.781962	.394319	1.983	.0589***
Log of Vacancy Mean	1.261525	.512545	2.461	.0214**
Log of Size of Inventory	−.433687	.238153	−1.821	.0811***
(Constant)	−1.097884	1.739775	−.631	.5340

Durbin-Watson Test=2.11382**

*significant at 98% confidence level
**significant at 95% confidence level
***significant at 90% confidence level

there may be a cost difference between the two vendors. At this point we cannot conclude what constitutes the difference between the rates of either vendor.

Because the time of entry by a broker into a market, and number of vendors are possibly related, these variables are not significant and may be multicollinear. The lack of significance of whether or not a vendor covered Class A space substantiates

the BOMA view about the lack of standardization in reporting space. (A possible exception is that volatility of space among different classes was the same.)

All residuals were within the 95% confidence level. The standardized residuals exceeded a standard deviation of one in only six of the cases and the maximum residual was 2.67, for Austin. The acceptable range of the residuals and the statistical significance of the regression and the selected variables suggest that the regression equation can be used to determine a normal range of variance of reported rates. The analyst can test for whether the different data series are within an acceptable variance.

Conclusions

This research supports the unique application of information theory to the divergence among reported office vacancy rates. Divergence among rates is to be expected. Users of vacancy rates information should expect greater variance of reported rates in smaller CBD office areas with a higher reported level of office vacancies. Less divergence should be expected in larger market areas with lower vacancy rates. The problem of increased variance because a national vendor and a local agent with national affiliations publish their observations for the same market area needs further research.

The results suggest that both in theory and in practice the creation of a single office vacancy index is not feasible. However, the model suggests that when a greater number of informed participants are in the market, the precision of the information and therefore the precision of the estimates of returns increases. Rather than going for the single shot of an index, the industry should be trying to build as broad a base of information as feasible, in this case vacancy information.

These results, and the descriptive review of what inventory each vendor attempts to monitor, raises the possibility that vendors compile their office market information for transactions with clients having different risk-aversion levels. For examples, one vendor will maintain a low-risk profile and compile only information for what is perceived as low-risk inventory. Another vendor may assemble vacancy rate information for a greater range of properties for more speculative investors. While risk level was treated as a constant, the REIM results suggest that the real estate information is not as disparate as it might be, given the range of clients' risk profiles.

A common public body of historical and current information about office markets to provide at least the minimal form of information precision still does not exist. Further investigation would explore the determinants for a body of information on office markets by surveying the providers and different risk-adverse users of market research reports and validating their information through selective intensive sampling.

Notes

[1]Robert Houser of the Urban Land Institute in the autumn of 1992 was polling members of the Institute to confirm the degree of concern specifically about this problem. At the annual meeting of the Real Estate Center Directors, Mystic, Connecticut, September 1991, Walter Barnes, Travelers Insurance Co., cited the array of vacancy rates available for many of the major cities as a primary source of confusion for the underwriters at his firm.

[2]The BOMA report did not comment on the emerging firms in a limited number of markets, such as Chicago, Washington, D.C. and Houston, which only *monitor* office space availability, leasing and sales transactions. Their historical horizon varies. One monitoring service was attempted in Manhattan, New York in 1983–84. After an initial period of cooperation, the big brokerage firms forced the firm out of business by withholding transaction information.

[3]The Homer Hoyt Institute is currently revisiting the problem in another attempt to establish uniform standards.

[4]The limited number of emerging monitoring firms do not have a sufficient historical base for comparison.

[5]The initial observations about the various vendors are from a survey conducted for Moody's Investor Services, Spring 1986. Subsequently the authors have obtained the various reports that detail coverage.

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