Market Equilibrium Analysis

by Richard L. Parli, MAI, and Norman G. Miller, PhD

Abstract

This article extends the previous work of authors like Mueller, Pyhrr, Smith, Rosen, and others on real estate cycles. The definition of *market equilibrium* is explored, and a new definition is offered identifying stable rental rates as the key indicator. Research on the application of the new definition is presented and a second definition—*equilibrium vacancy*—is proffered. Finally, possible applications for the new approach to market equilibrium analysis are presented.

Introduction

"What's the vacancy rate?"

That is often the first question a market analyst asks about a particular market, because the answer is expected to communicate the health of that market. Whatever the vacancy rate is, it must be put into context, and the context for a market vacancy rate is the equilibrium vacancy rate.

Vacant real estate space has often been viewed as a negative market characteristic. In fact, much of the market operates with the goal of eliminating vacant space, thereby matching demand with supply. From the landlords' perspective, this may be a desirable goal. From the market's (and prospective tenant's) perspective, however, zero vacancy is a highly negative condition that prevents satisfying both tenant relocation and new demand. Given these underlying conditions, the question arises as to how much vacant space is needed in a balanced, efficient market to produce equilibrium?

A market in disequilibrium will have rising or falling rents, and a market in equilibrium will be characterized by stable rents.[1] Since vacancy is recognized as the greatest influence on rental rates, it follows that an equilibrium vacancy rate is that rate that produces no upward or downward pressure on rents. Identifying the actual vacancy rate and the equilibrium vacancy rate can provide insights into the market's current condition as well as future rent movements.

The purpose of this article is to (1) explore the concept of market equilibrium by tracing its evolution, (2) present a new definition for market equilibrium and equilibrium vacancy rate, and (3) offer possible applications of the new approach to market equilibrium.

Defining Market Equilibrium

In the literature, the meaning of market equilibrium is typically presented as self-evident,[2] and the concept of disequilibrium is more often discussed.[3] Market equilibrium usually is broadly defined as the point where demand and supply are equal. For example, the fourteenth edition of *The Appraisal of Real Estate* defines *market equilibrium* as follows:

> The theoretical balance where demand and supply for a property, good, or service are equal. Over the long run, most markets move toward equilibrium, but a balance is seldom achieved for any significant period of time.[4]

This definition of market equilibrium is substantially similar to the definition in the fifth edition

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1. Over a longer term, inflation-adjusted stable real rents. On this basis, most markets in equilibrium will have rather flat real rents over time unless the elasticity of supply is changing, which could soften/tighten the market and cause real rent decreases/increases relative to a change in demand.

2. Daniel A. Hagen and Julia L. Hansen, "Rental Housing and the Natural Vacancy Rate," *Journal of Real Estate Research* 32, no. 4 (2010): 413–433.

3. Richard Voith and Theodore Crone, "National Vacancy Rates and the Persistence of Shocks in the U.S. Office Markets," *AREUEA Journal* 16, no. 4 (1988): 437–458; John M. Clapp, *Dynamics of Office Markets* (Washington, DC: Urban Institute Press, 1993).

4. *The Appraisal of Real Estate*, 14th ed. (Chicago: Appraisal Institute, 2013), 306.

of *The Dictionary of Real Estate Appraisal* referenced by Jorgensen and Fanning.[5] However, if this definition is taken literally, one might conclude that market equilibrium is only achieved at 100% occupancy. This unreasonable implication was tempered with the sixth edition of *The Dictionary of Real Estate Appraisal*, which modified the definition of *market equilibrium* to include vacant space:

> The theoretical balance where demand and supply for a property, good, or service are equal *with the only vacant space being space needed to service the market friction of normal tenant movements and space needed to accommodate new demand coming into the market.* Over the long run, most markets move toward equilibrium, but a balance is seldom achieved for any period of time.[6] (emphasis added)

While continuing to assert that the concept is "theoretical," it is nonetheless encouraging that the new definition includes an allowance for vacant space.[7] According to the definition, the vacant space associated with market equilibrium is allocated between the "space needed to service the market friction of normal tenant movements" and "space needed to accommodate new demand coming into the market." Each of these will be addressed next.

Market Friction Vacancy
The space needed to service market friction is generally referred to as *frictional vacancy*. Hauser and Jaffe discuss the concept of frictional vacancy in their early article on the post–World War II housing shortage. They observe that the "continuous turnover in housing occupancy necessitates a minimum number of vacant units which may be described as frictionally vacant units."[8] The presence of frictional vacancy has been accepted by analysts as being a necessary ingredient to an efficient market. Aside from this recognition, there is little known about frictional vacancy—it cannot be measured and therefore cannot be proven to exist. It is simply a theoretical construct that justifies a certain level of vacant space as present in every real estate market and implies that an efficient market is always going to have an excess of supply over demand (i.e., a certain degree of inefficiency).

New Demand Vacancy
The space needed to accommodate new demand has been referred to as *lag vacancy*.[9] This relatively recent theory states that the market needs an "inventory reserve for forecasted new growth."[10] This component of equilibrium is based on the demand characteristics of a market—the greater the anticipated demand, the greater the required future supply, and the greater the current equilibrium vacancy rate. Fanning demonstrates that, when all else is equal, a high growth market will have a higher equilibrium vacancy rate (lower equilibrium occupancy rate). Regardless of a market's growth rate, if future supply increases to match demand (after allowing for frictional vacancy), a vacancy rate that considers near-term future demand and supply will represent market equilibrium. Sample calculations are shown in Exhibit 1.[11] Interestingly, this approach rests on the initial theory that a 5% frictional vacancy rate exists in the market, and that this 5% vacancy rate is the true current equilibrium vacancy rate. With no forecasted new demand, the market equilibrium vacancy rate would be 5%. This is shown in Exhibit 2. The formula used in Exhibits 1 and 2 correctly relates future demand to future supply. However, the theory that frictional vacancy is the basis for calculating equilibrium vacancy is a misconception.

In order to move the concept of market equilibrium from a theoretical condition to one

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5. Kerry M. Jorgensen and Stephen F. Fanning, "One Step Further—Implementing the Recommendations of Guide Note 12," *The Appraisal Journal* (Summer 2013): 215.

6. *The Dictionary of Real Estate Appraisal*, 6th ed. (Chicago: Appraisal Institute, 2015), s.v. "market equilibrium."

7. We find it troublesome that the definition also relates a "good, or service" as needing vacant space.

8. P. M. Hauser and A. J. Jaffe, "The Extent of the Housing Shortage," *Law & Contemporary Problems* 12, no. 1 (Winter 1947): 3. Hauser and Jaffe in their research were building upon Homer Hoyt's work on market cycles; see Homer Hoyt, *100 Years of Land Values in Chicago: The Relationship of the Growth of Chicago to the Rise in Its Land Values, 1830–1933* (Chicago, IL: University of Chicago Press, 1933).

9. Stephen F. Fanning, *Market Analysis for Real Estate*, 2nd ed. (Chicago: Appraisal Institute, 2014).

10. Fanning, *Market Analysis for Real Estate*, 2nd ed., 198.

11. These calculations are similar to those by Fanning in *Market Analysis for Real Estate*, 2nd ed., 199.

Exhibit 1 High Growth/Low Growth Market Sample Calculations

	High Growth Market							
	Current Year		Year 1		Year 2			
Demand (sf)	1,400,000		1,480,000		1,560,000			
Forecasted Increase per Year in Demand (sf)			80,000		80,000			
Frictional Vacancy @ 5%	73,684	+	4,211	+	4,211	=	82,105	
Lag Vacancy (sf) Needed for New Demand			80,000	+	80,000	=	160,000	
Total Needed Current Vacant Space (sf)	242,105						242,105	
Total 3-Year Supply	1,642,105							
Market in Equilibrium Vacancy Rate	15%							

	Low Growth Market							
	Current Year		Year 1		Year 2			
Demand (sf)	1,400,000		1,410,000		1,420,000			
Forecasted Increase per Year in Demand (sf)			10,000		10,000			
Frictional Vacancy @ 5%	73,684	+	526	+	526	=	74,737	
Lag Vacancy (sf) Needed for New Demand			10,000	+	10,000	=	20,000	
Total Needed Current Vacant Space (sf)	94,737						94,737	
Total 3-Year Supply	1,494,737							
Market in Equilibrium Vacancy Rate	6%							

Exhibit 2 No Growth Market Calculations

	No Growth Market							
	Current Year		Year 1		Year 2			
Demand (sf)	1,400,000		1,400,000		1,400,000			
Forecasted Increase per Year in Demand (sf)			0		0			
Frictional Vacancy @ 5%	73,684	+	0	+	0	=	73,684	
Lag Vacancy (sf) Needed for New Demand			0	+	0	=	0	
Total Needed Current Vacant Space (sf)	73,684						73,684	
Total 3-Year Supply	1,473,684							
Market in Equilibrium Vacancy Rate	5%							

with practical applications, consider the following alternative definitions of *real estate market equilibrium*:

> The balance of space where supply of a property type exceeds demand by an amount of space that produces stable rents.

or simply:

> The relationship of demand and supply that results in real rent stability.[12]

These alternative definitions link vacancy to equilibrium and equilibrium to rents.

Linking Equilibrium to Rents

There is an abundance of published research linking vacancy to equilibrium and equilibrium to rents. Possibly the first article to connect the three was by Smith, who concludes that there is some level of vacancy that is associated with market equilibrium, "at which rents are in equilibrium."[13]

Smith's later collaboration with Rosen postulated that a real estate market in equilibrium means a vacancy rate at which rent changes equal zero.[14] Numerous subsequent studies express the same conclusion but in different ways, describing equilibrium as that rate of vacancy that provides landlords with no incentive to adjust rents,[15] as the vacancy rate where effective demand is equal to effective supply,[16] and as a market where there is no tendency toward changes in prices or quantities.[17]

Classical economic theory supports the premise that if there is market disequilibrium due to excess supply, there will be downward pressure on rental rates, which produces new effective demand for the vacant space.[18] If the disequilibrium is due to excess demand, there will be upward pressure on rental rates until the relative demand is diminished (via higher rents or additional delivered space). Consistent with this theory, there must be some level of vacancy—equilibrium vacancy—that is associated with no upward or downward pressure on real rents.

The equilibrium vacancy rate hypothesis is, therefore, that there must be a market vacancy rate where demand and supply are *effectively* equalized. As a corollary, the movement of rents in a market is inversely related to the vacancy rate of that market and movement away from equilibrium can produce either upward or downward pressure on rental rates.

Identification of the Equilibrium Vacancy Rate

There is no known way to forecast an equilibrium vacancy rate; it must be inferred or extracted from the historical record. Over the years, research has produced at least sixteen published studies that estimate the equilibrium vacancy rate for different property types in many different communities and for many different time periods. The published research has emphasized two main methods: (1) regression analysis, using rent as a dependent variable; and (2) the average vacancy rate over an extended period. The reported research results range from 4.4% to 22.3%. All have relied upon historical vacancy rates linked to published rental rates.

A study by Parli and Miller tests and compares the results of these methods in nine markets, including three cities on the West Coast, three

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12. Real rents would be stable even though they move nominally with inflation. In a market with 1.5% inflation per year the rents would rise by approximately 1.5% per year.

13. Lawrence B. Smith, "A Note on the Price Adjustment Mechanism for Rental Housing," *The American Economic Review* 64, no. 3 (June 1974): 481.

14. Kenneth T. Rosen and Lawrence B. Smith, "The Price-Adjustment Process for Rental Housing and the Natural Vacancy Rate," *The American Economic Review* 73, no. 4 (September 1983): 779–786.

15. See G. Donald Jud and James Frew, "Atypicality and the Natural Vacancy Rate Hypothesis," *AREUEA Journal* 18, no. 3 (1990): 294–301; Glenn R. Mueller, "Real Estate Rental Growth Rates at Different Points in the Physical Market Cycle," *Journal of Real Estate Research* 18, no. 1 (1999): 131–150; and others.

16. John M. Clapp, *Dynamics of Office Markets*.

17. John F. McDonald and Daniel P. McMillen, *Urban Economics and Real Estate—Theory and Policy*, 2nd ed. (Hoboken, NJ: John Wiley & Sons, 2011).

18. Demand consists of not only desire but also affordability—the ability to act on the desire.

cities on the East Coast, and three cities in the central United States. In all cases, the equilibrium vacancy rate of the city's Class A office space was the focus of analysis.[19] Their conclusion is that consistent reliance on the mean vacancy rate would produce a reliable indication of a market's equilibrium vacancy rate. In addition, the equilibrium vacancy rate indicators for each city demonstrate enough difference to confirm variation and to show that localized analysis is essential. Geltner et al. conclude that the regression process may not produce reliable results unless net effective rent is used, stating that "real [net effective] rents reflect the actual physical balance between supply and demand in the space market."[20] By using the mean vacancy rate, this problem is eliminated.

A major value of relying on the long run mean vacancy rate is that it implicitly recognizes the cyclical nature of any real estate market and is consistent with the *Rental Growth Theory*.[21] This theory states that the long run average occupancy rate is the point of inflection, where the growth rate of real rents change course. In the process of changing course, the rents inhabit (however briefly) an area of stability. Since the proposed alternative definition of equilibrium is based not on growth rates, but on a change in direction of rents, this temporary stability signifies market equilibrium.

The long run average (or *natural*) vacancy rate can be a reliable indicator of the equilibrium rate for any given market, as long as adequate fluctuation over an extended period has been experienced by the market. Mueller in his research observes that the market cycle is not symmetrical and that the response of rents is different if the market is above or below the long-term average vacancy.[22] This suggests that while the historic mean vacancy rate can be calculated, forecasting rents may require an adjustment for current supply and demand characteristics. For example, if the mean is calculated at a time of peak occupancy (or vacancy), this could skew the average upward (or downward) and result in an equilibrium vacancy rate that maybe artificially high (or low).[23] This result is implied by the Fanning use of lag vacancy—a market that is forecast to grow faster may have an artificially high vacancy rate if future delivery is taken into account. It is understood that a market in equilibrium will remain in equilibrium as long as the growth in supply matches the growth in demand (both in rate and timing). A mismatch will, of course, move the market out of equilibrium because the market's actual vacancy rate will diverge from its equilibrium vacancy rate.

Mueller indicates that rental growth will be below inflation when the actual vacancy rate for a market is above the long-term average vacancy rate. Of course, the inverse is also true. Thus, in a stable market at equilibrium, the change in rent should be consistent with the change in inflation.[24] As an extension of this theory, it can be seen that new construction will not take place unless rental rate change exceeds building cost inflation to the extent that market rents are equal to or exceed new construction rent (i.e., feasibility rent).

While the vacancy rate plays a significant role in rent changes, this role may become more prominent as the vacancy rate distances itself from the equilibrium level. The research could be skewed in this direction since the further away from equilibrium the vacancy rate gets, the less likely concessions are to mask changes in face rent.

It is of interest that virtually all the indicators of equilibrium vacancy rate exceed 5%, which is the industry standard for frictional vacancy. In this context, if market demand drives vacancy rates to as low as 5%, that market is likely experiencing strong upward pressure on rents—a characteristic in conflict with market equilibrium.

19. Richard L. Parli and Norman G. Miller, "Revisiting the Derivation of an Equilibrium Vacancy Rate," *Journal of Real Estate Portfolio Management* 20, no. 3 (2014): 195–208.

20. David M. Geltner, Norman G. Miller, Jim Clayton, and Piet Eichholtz, *Commercial Real Estate Analysis & Investments* (Thomson South-Western, 2007), 106.

21. Mueller, "Real Estate Rental Growth Rates," 135.

22. Mueller, "Real Estate Rental Growth Rates."

23. This problem could be eliminated by matching the study period to a full real estate cycle(s).

24. Mueller, "Real Estate Rental Growth Rates."

Most research does not distinguish between frictional vacancy and equilibrium (natural) vacancy.[25] In fact, most recent articles do not acknowledge the existence of frictional vacancy. A possible reason for this may be that it has little use in contemporary markets. The original utility of frictional vacancy was to calculate the amount of space that excess supply could support.[26] Although the growth in certain cities has been robust over the past fifty years, it is nonetheless unusual for aggregate demand to exceed aggregate supply. Consequently, market analysts rarely need to calculate the amount of supply that excess demand can support. The more contemporary challenge is to determine the deficiency of aggregate demand relative to aggregate supply, recognizing that a certain amount of vacant space is necessary to accommodate market dynamics.

The (theoretical) relationship of frictional vacancy and equilibrium vacancy to market vacancy is demonstrated in Exhibit 3.

Exhibit 3 Relationship of Equilibrium Vacancy to Frictional and Overall Vacancy Rates

Market in Equilibrium

Overall Vacancy = Equilibrium Vacancy

Equilibrium Vacancy — Frictional Vacancy — Overall Vacancy

Oversupplied Market

Overall Vacancy > Equilibrium Vacancy

Equilibrium Vacancy — Frictional Vacancy — Overall Vacancy

Undersupplied Market

Overall Vacancy < Equilibrium Vacancy

Equilibrium Vacancy — Frictional Vacancy — Overall Vacancy
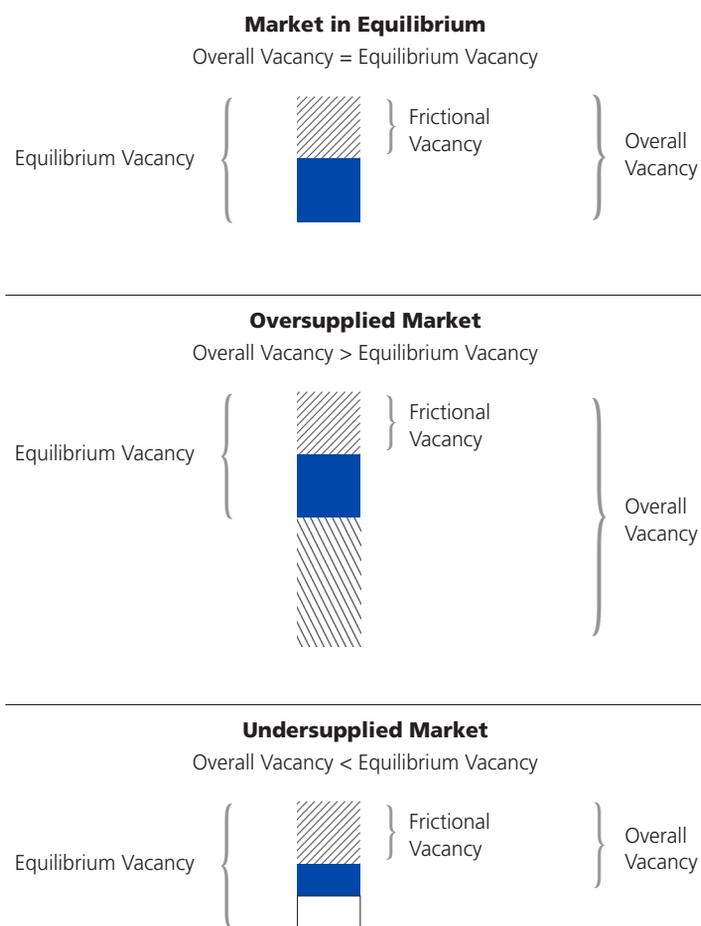
Equilibrium Vacancy Rate Applications

It has been shown that the simple average of a market's long-term vacancy rate can be a reliable indication of that market's equilibrium vacancy rate. What value is this knowledge to the market analyst? As discussed by Mueller, there are at least three main benefits of this information:[27]

- Knowing the distance that current vacancy is from equilibrium vacancy, and the expected direction of vacancy movement, can be indispensable to developing a reliable cash flow model on a property. Rental rates should not change direction until the market passes through equilibrium.

- Knowing the slope of the change in rental rates is important. This can be inferred from the slope of previous changes that occurred under similar circumstances. Segmenting a change and regressing the data can provide the slope of the change, and project growth/decline in future rents.

- There is good reason to associate equilibrium vacancy with development feasibility. That is, until rents are ascending, development plans will naturally be postponed; rents will not ascend until vacancy has dropped below equilibrium level. The commitment to develop is based on many factors other than the movements of rent, but

25. See for example, Clapp, *Dynamics of Office Markets*; Petros S. Sivitanides, "The Rent Adjustment Process and the Structural Vacancy Rate in the Commercial Real Estate Market," *Journal of Real Estate Research* 13, no. 2 (1997): 195–209; John Krainer, "Natural Vacancy Rates in Commercial Real Estate Markets," *FRBSF Economic Letter*, Federal Reserve Bank of San Francisco, No. 2001-27, October 5, 2001; and Mark Thoma, "The Natural Vacancy Rate for Housing," *Economist's View*, blog, November 29, 2005.

26. See for instance, Hauser and Jaffe, "The Extent of the Housing Shortage."

27. Mueller, "Real Estate Rental Growth Rates."

financial feasibility is a major consideration. McDonald described the equilibrium vacancy rate as "being consistent with a net rent that provides no incentive to change the size of the stock of space."[28]

Exhibit 4 illustrates the role of vacancy in market cycles.

In describing real estate cycles, Mueller focuses on demand and supply growth rates and defines *demand/supply equilibrium* as being when "demand and supply growth rates are equal (dg = sg) at the peak and trough of the market cycle (thus existing space plus new construction exactly matches new demand)." Mueller indicates agreement with Pyhrr, Webb, and Born in stating, "the only real demand/supply equilibrium point is at the peak of the real estate cycle where supply growth finally catches up to demand growth." Mueller clarifies this equilibrium condition in the real estate cycle as being the peak point, stating that at the peak "the space market is usually at its tightest level (occupancy rates highest) and the rental growth rate should also be at its highest level." Yet, Pyhrr, Webb and Born, indicate that "equilibrium occurs in this apartment market when occupancy rates are in the range of 92–96 percent."[29] We interpret this to mean that the peak of the market is when actual vacancy meets frictional vacancy, producing hyper-supply. As such, the "demand/supply equilibrium" identified in Exhibit 4 should not be confused with a market equilibrium as defined in this article; market equilibrium is represented by long-term average occupancy.[30]

One final observation: it appears that equilibrium vacancy rates tend to be lower for residential properties and higher for office properties. Although there appears to be no direct research comparing the equilibrium vacancy rates by property type, there is anecdotal evidence to sup-

Exhibit 4 Long-Term Vacancy and Market Cycles
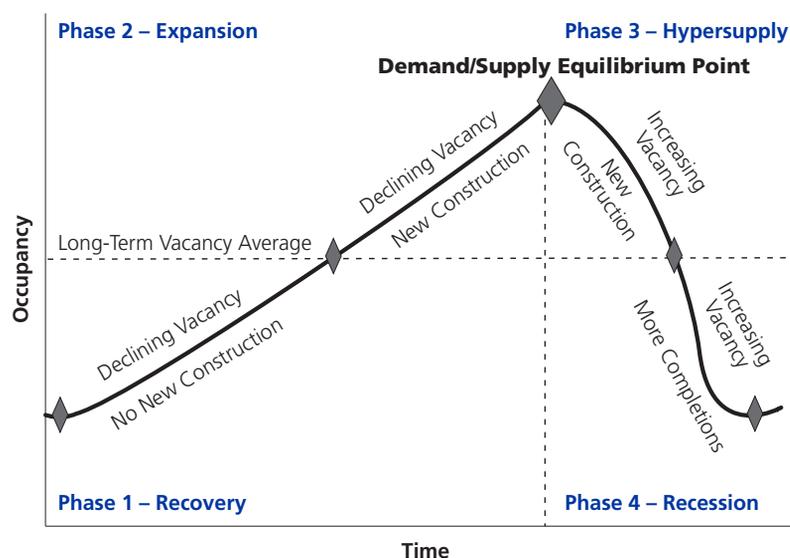
port this conclusion. For example, Hagen and Hansen conclude that for the Seattle and surrounding King County market, the equilibrium vacancy rate for residential rental properties was between 4.97% and 5.25%.[31] This is quite low in comparison with the results of Parli and Miller for Seattle Class A office space of about 10%.[32] It is expected that this relationship is similar in kind, if not in degree, in other markets. One reason for the differences by property types can be explained by market friction. Residential properties have lower friction, with less lumpy demand, than office properties. There are also structural differences. Residential growth may be more predictable since it is a function of household growth rates, which seldom move radically. Job growth may change faster, thus needing more space in equilibrium for the office market to handle the more volatile demand characteristics.

28. John F. McDonald, "Rent, Vacancy and Equilibrium in Real Estate Markets," *Journal of Real Estate Practice and Education* 3, no. 1 (2000): 59.

29. Stephen A. Pyhrr, James R. Webb, and Waldo L. Born, "Analyzing Real Estate Asset Performance during Periods of Market Disequilibrium under Cyclical Economic Conditions: A Framework for Analysis," in *Research in Real Estate*, ed. S. Kapplin and A. Schwartz, vol. 3 (Greenwich, CT: JAI Press, 1990), 84, 465.

30. Exhibit 4 also shows construction as being triggered/dampened by the cycles' relationship to the long-term average occupancy. Testing this theory would be problematic due to the small sample size typically associated with most markets.

31. The Hagen and Hansen study, "Rental Housing and the Natural Vacancy Rate," includes apartment projects of twenty or more units over 35 biannual periods, beginning in September 1988 and ending in September 2005.

32. The Parli and Miller study, "Revisiting the Derivation of an Equilibrium Vacancy Rate," covers Class A office space within the city of Seattle over 56 quarters, beginning January 2000 and ending December 2013.

Conclusions

The research reviewed in this article indicates convincingly that vacancy influences rental rates. Market observation, however, indicates that rental rates also influence vacancy. At a fundamental level, both rents and vacancy are responsive to economic demand for space relative to supply. Demand absorbs vacant space to the point that rents are driven up, which stimulates new construction, which may drive average rents up (due to the premium charged for new space) or down (due to an oversupply). This cyclical pattern produces variations in vacancy rates that tend toward a central point, known as the market's natural vacancy rate. The analysis in this article reveals that the natural vacancy rate is a reliable indicator of the market's equilibrium vacancy rate, and a type of market trigger that can be used to forecast changes in future rental rates.

Given that vacancy can and does significantly influence rent changes, and that stable rents are a characteristic of market equilibrium, it follows that there must be some level of vacancy—the equilibrium vacancy rate—that produces stable rents. Vacancy in excess of this rate will produce downward pressure on rents; vacancy of less than this rate will produce upward pressure on rents. Although inflationary/deflationary pressure on rents can cause market-wide movement, this issue and others are avoided by relying on the mean vacancy rate for an indication of the market's equilibrium rate. In doing so, however, one must recognize the limitations of using the historical mean vacancy rate given that the equilibrium rate is likely dynamic and asymmetrical. It is dynamic in that it is a moving target, shifting with each new vacancy rate. It is asymmetrical in that, even though it is an extension of the theory of real estate cycles, rents would be expected to respond differently to changes in vacancy depending on the relative relationship to the equilibrium rate.

The equilibrium vacancy rate hypothesis is not in conflict with the presence of frictional vacancy. Accepting frictional vacancy as a necessary component only allocates the numbers and does not change the relationship. For example, if frictional vacancy for a given office market is assumed to be 5%, then the equilibrium vacancy rate almost certainly exceeds this amount. Because search, contracting, and moving costs cause some vacancy in every market, a portion of the vacancy of the equilibrium condition is most certainly associated with friction.

Knowledge of equilibrium vacancy is a valuable component of market analysis and valuation. It can be used to forecast when a change in vacancy will produce a change in rent, something critical to any cash flow prediction. The discussion has demonstrated that just because the vacancy rate is moving does not mean rental rates will move. Instead, movement in rents is altered when the vacancy rate crosses the critically important equilibrium rate, and this rate may in fact be a range, and vary by property types and local market.

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Additional Reading

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Additional Resources

Suggested by the Y. T. and Louise Lee Lum Library

Appraisal Institute
- **Education—Courses**

  https://www.appraisalinstitute.org/education/
  - *Advanced Concepts and Case Studies*
  - *Advanced Market Analysis and Highest & Best Use*

Federal Reserve of St. Louis, FRED Economic Data—Rental rates and vacancy

https://fred.stlouisfed.org/search?st=rental+rates+and+vacancy

Integra Realty Resources—*Viewpoint, 2017 Commercial Real Estate Trends*

http://www.atrustrealty.com/images/IRR_2017_Annual_Viewpoint.pdf

National Apartment Association—*2016 NAA Survey of Operating Income and Expenses in Rental Apartment Communities*

https://www.naahq.org/sites/default/files/naa-documents/about-membership/IncomeandExpense2016
-EXECSUMMARY.pdf

Northeastern University—"How Vacancy Rate Points to an Unaffordable Housing Market"

http://www.northeastern.edu/rugglesmedia/2016/04/20/how-vacancy-rate-points-to-an-unaffordable-housing-market/

US Census Bureau—Housing vacancies

https://www.census.gov/housing/hvs/index.html