J Real Estate Finan Econ (2021) 63:547–564
https://doi.org/10.1007/s11146-020-09791-4

Price Rigidity and Vacancy Rates: The Framing Effect on Rental Housing Markets

I-Chun Tsai [1]

Published online: 6 September 2020

Abstract

This paper proposes a new explanation for housing rent price rigidity. When high inflation or low inflation occurs, the bargaining process for new rent price represents negotiations representing increasing or diminishing utility for landlords. Based on framing effect theory, this study hypothesized that utility increasing-bargaining causes landlords to choose to give greater concessions and prefer short-term contracts. Although the income obtained from single contracts is comparatively lower, the high transaction volume (number of lease contracts) causes a reduction in the number of vacant properties and a higher frequency of price adjustments. Conversely, when low inflation occurs, landlords face utility decreasing-bargaining, reduce their concessions, and exhibit a preference for long-term contracts, thereby leading to an increase in the number of vacant houses and a lower frequency of price adjustments. Using US rental market data, this study explains asymmetric rent volatility and changes in the vacancy rate, and provides related evidence supporting the hypothesis that this rental market phenomenon is caused by an inflation illusion.

Keywords Housing rent price rigidity · Rent volatility · Vacancy rate · Framing effect · Inflation illusion

Introduction

Goodhart (2001) indicated that rent is a crucial variable that connects asset prices to the price of goods and services. If this variable cannot be efficiently adjusted, the asset and goods and services markets are adversely affected, resulting in the misallocation of resources. Shimizu et al. (2010) raised a question regarding rent rigidity. Japan's consumer price index for rent has remained largely stable, even during the period of

✉ I-Chun Tsai
ictsai@nuk.edu.tw

[1] Department of Finance, National University of Kaohsiung, No. 700, Kaohsiung University Rd., Nanzih District, 811 Kaohsiung, Taiwan, Republic of China

high housing market volatility in the 1980s. After examining individual data points, Shimizu et al. (2010) discovered that 90% of the samples had no changes in rents per year and that the likelihood of rent adjustment was related to the deviation between the actual rent and target level. The Japanese rental market has a high degree of rent rigidity; since the collapse of the housing market in 1990, housing prices have fallen sharply, while rents have not declined, demonstrating the downward rigidity of rent relative to housing price. In reality, this rigidity has not only occurred in Japan. Genesove (2003) reported that the percentage of nominal rental prices that were unadjusted from year to year in the United States was approximately 29%, whereas Hoffmann and Kurz-Kim (2006) found that percentage in Germany was approximately 78%. Cheung et al. (1995) examined the causal relationships between sale price changes and rental rate changes in the Hong Kong real estate market, and found that price changes lead rental rate changes.

In addition to rental market rigidity, vacancy rate changes in the rental housing market are a puzzle that remains unsolved. Alchian and Allen (1982) indicated that vacant office space is unnecessary and wasteful. Gabriel and Nothaft (1988) proposed a model of the relationship between rent adjustments and vacancy rate, indicating that rent adjustment rates are a function of the difference between the actual vacancy rate and natural vacancy rate. The natural vacancy rate is the long-term vacancy rate and is similar to the natural unemployment rate in the labor market, which exists even under conditions of long-term, full employment. Several papers, such as Muller (1991), Wheaton and Torto (1994), and Belsky and Goodman (1996), refer to the long-term vacancy rate as the equilibrium vacancy rate. Because these papers all focus on estimating the equilibrium vacancy rate, they do not sufficiently explain short-term fluctuations in the vacancy rate. Thus, the economic cycle of vacancy rate remains unclear.

Although some studies have evaluated vacancy rate fluctuations, they did so by first adding other explanatory variables or by estimating the desired or equilibrium vacancy, then indirectly obtaining the relationship between rent adjustments and deviation in the vacancy rate. For example, Shilling et al. (1987) used data over the time period 1960 to 1975 to analyze the price adjustment process for rental office space in 17 cities across the United States, the results showed that, other things equal, higher levels of vacant office space mean that landlords lower their rents and reduce the difference between desired and actual vacancies. Shilling et al. (1987) emphasized landlord adjustments when evaluating the vacancy rate and indicated that landlords hold supplemental office space as inventory to meet future rental demand increases and rent out spaces after raising rents. Gabriel and Nothaft (2001) utilized more variables in their estimation of equilibrium vacancy rates in US metropolitan areas between 1987 and 1996, including population mobility, presence of public housing units, and population growth variables. The empirical results supported that real fluctuations in rent reflected deviations from equilibrium levels in observed vacancy incidence and duration.

This study differed from previous research by attempting to connect the two puzzles of the rental market: rent rigidity and short-term fluctuation in the vacancy rate. Thus, this study utilized nominal rent and did not need to estimate the equilibrium vacancy rate, but rather directly explained the effect of nominal rent on the vacancy rate.

Although some studies have continued to analyze these two topics in recent years, they have provided empirical evidence only for individual topics. Kashiwagi (2014), for example, utilized a search model explaining the relationship between self-occupied housing and the rental market and employed the impulse responses of home prices,

rents, and housing occupancy, finding that the short-term response of home prices was greater than that of rental prices. Kashiwagi (2014) verified the rigidity and inefficiency of rent relative to home prices. Miceli and Sirman (2013) used the theory of efficiency wages to explain the natural vacancy rate in rental housing markets, and proposed that a positive vacancy rate provides landlords an incentive to invest in maintenance because if they fail to do so, some tenants will leave and the unit will sit vacant for a finite period of time. The theory proposed by Miceli and Sirman (2013) favorably explained the habitability laws introduced by numerous US states in the 1960s. However, no reasonable explanations for vacancy rate changes caused by typical economic changes have yet been provided. This paper proposes a new explanation for rent rigidity based on the inflation illusion produced by the framing effect. The framing effect is hypothesized and validated as a potential cause of asymmetric fluctuation and inflation illusion in addition to explaining vacancy rate changes.

In Section 2, an explanation for nominal rent rigidity and vacancy rate changes and the possible correlation between the two are proposed. Section 3 examines the relationships between rental market inefficiency, nominal rent rigidity, inflation rate, landlord behavior, and vacancy rate changes based on empirical results. Finally, Section 4 presents the conclusion and summarizes the theory and explainable empirical phenomenon described in this paper.

The Framing Effect and Inflation Illusion

Rent should be negatively correlated with vacancy rate. Belsky and Goodman (1996) indicated that one of the causes of the lack of this negative correlation in the United States in the 1980s was landlord rent pricing behavior, although how landlord behavior causes rental market disequilibrium was not concretely specified. The present study attempts to directly explain the effect of nominal rent on the vacancy rate and then analyzes whether or not that changes in the rental market are related to inflation. Therefore, we specifically proposed a landlord rental pricing behavior in this relationship; asymmetric behavior exists between rental pricing and bargaining attitudes under different inflation conditions.

Relevant studies have proposed that exploring the rental pricing behavior of landlords is necessary for understanding rental market characteristics (Furth-Matzkin, 2017; Bar-Isaac and Gavazza, 2015). Furth-Matzkin (2017) describe the control that landlords have over rental agreements, and some landlords even propose agreements that are unfair to tenants for their own benefit. In the 70 cases studied by Furth-Matzkin (2017), although the average tenancy period is 12 months, the period varies greatly from 6 to 43 months, indicating that the tenancy period is also a condition that landlords adjust for reasons of self-interest.

Bar-Isaac and Gavazza (2015) study the decision-making behavior of landlords and assume that landlords make choices between different rental agreements and contemplate whether to rely on agents to seek tenants to maximize their long-term returns. Bar-Isaac and Gavazza (2015) propose that landlords provide agents with incentives to encourage them to search for suitable tenants to establish an agreement beneficial to landlords. The so-called favorable tenancy conditions also include the choice between long-term and short-term tenancy. However, Bar-Isaac and Gavazza (2015) assert that

landlords' preference for long-term or short-term tenancy is determined by market conditions. Relevant studies such as that of Genesove (2003) propose nominal rigidity of rent; and because future rent rigidity for long-term tenancies causes a decline in contract value, landlords prefer long-term tenancies and are willing to pay more agency fees to seek long-term tenants in a market with a high vacancy rate or a cold market.

Adjustments show time lag because rent is paid on a contractual basis. Studies on Germany (Hoffmann and Kurz-Kim, 2006), Japan (Shimizu et al., 2010), and the United States (Genesove, 2003) have all indicated that a high proportion of rents are not adjusted annually; rent may lag behind when reacting to already realized price level changes. In addition to market conditions (i.e., hot or cold), tenancy period and inflation level affect landlords' profits, so landlords should consider inflation level when deciding tenancy conditions.

When landlords draw up new leases (including renewals or new lease contracts), they may encounter one of three situations: (1) the need to respond to inflation information in their new rent price, (2) the need to respond to deflation information in their new rent price, and (3) no need to adjust rent based on inflation or deflation. Traditional economic theory assumes that all parties in a transaction are rational and that the price sufficiently and accurately responds to the information available. However, behavioral finance proposes that when parties respond to information, they may be affected by the characteristics of the information, resulting in asymmetric attitudes. For example, Tversky and Kahneman (1986) proposed that positive or negative depictions of information affect the judgment of individuals engaging in a transaction, which is referred to as the framing effect. Because inflation and deflation have different meanings for different members of the public, asymmetric responses are likely to occur. For example, Fehr and Tyran (2001) claimed that negative and positive nominal shocks have asymmetric effects because of money illusion. Baqaee (2019) indicated that when a household has a fixed nominal income, inflation is viewed negatively and deflation is viewed positively. Thus, the household exhibits a greater response to inflation than to deflation.

The types of information that cause the framing effect are too numerous to list and have been applied in various fields. Levin, Schneider, and Gaeth (1998) proposed a categorization of framing effects by organizing the results in the literature, one category of which was goal framing. Goal framing refers to the positive or negative depiction of a goal. For example, positive framing could be "if we take this action we will profit," whereas negative framing would be "if we don't take action we will suffer a loss." We hypothesized that when landlords adjust rents, they also have different goal framing accompanied by different bargaining effects of varying degrees of utility. Neale and Bazerman (1985) claimed that the framing of conflict and negotiator overconfidence would influence the negotiator behaviors, by asking 100 subjects to negotiate a five-issue contract under controlled conditions, they found that a positive frame led to more concessionary behaviors and successful performances than a negative frame.

The three situations that landlords can face when establishing a new lease with a tenant are as follows:

(1) Inflation has occurred. The rent dictated by the old lease contract was established at the beginning of the previous period and has not been adjusted for inflation. The real rent stipulated in the old lease contract is too low and disadvantageous to landlords.

The new nominal rent should be adjusted upward to respond to inflation. For landlords, the utility of each new rental lease increases progressively. According to goal framing theory, new lease contract bargaining in this situation represents a positive goal: taking action (proactively negotiating) will result in profit. Furthermore, this situation represents utility increasing-bargaining because the rent may be continually adjusted upward through negotiating new leases, resulting in increased utility. According to Neale and Bazerman (1985), when faced with utility-increasing bargaining, landlords exhibit more concessionary behaviors, meaning that landlords provide more concessions to facilitate reaching a contractual agreement.

Thus, this study inferred that when inflation occurs, landlords exhibit a preference for short-term contracts providing lower one-time income, thus increasing the rental transaction volume, reducing the number of vacant properties, and increasing the frequency of price adjustments in the rental market.

(2) Deflation has occurred. The current unadjusted rent is too high and is advantageous to landlords (high real rent); negotiations for the new nominal rent should be adjusted downward in response to deflation. For landlords, each new lease represents diminishing utility, and according to goal framing theory, new lease negotiations represent a negative goal: taking action (proactively negotiating) can reduce losses. This is a type of utility decreasing-bargaining because negotiations for a new lease will lead to continual downward rent adjustments and decreasing utility. When facing utility decreasing-bargaining, landlords exhibit fewer concessionary behaviors and choose to provide fewer concessions, thus leading to greater difficulty in reaching a contractual agreement.

Thus, this study inferred that when deflation occurs, landlords exhibit a preference for long-term contracts providing higher one-time income, thus decreasing the rental transaction volume, increasing the number of vacant properties, and decreasing the frequency of price adjustments in the rental market.

(3) Neither inflation nor deflation has occurred. The current rental price is suitable, and the new nominal rent is identical to the old nominal rent. For landlords, each new lease has the same utility as the last. According to goal framing theory, new lease negotiations represent a type of bargaining with invariant utility; landlords do not exhibit any particular preferences.

Thus, this study inferred that when neither inflation nor deflation has occurred and other external factors have not changed, the rental market transaction volume, number of vacant properties, and prices do not exhibit any considerable changes.

Although tenants may have different preferences based on market conditions, studies have indicated that the behavior of asset owners has a more significant effect on the market than that of tenants. For instance, loss and risk aversion are both property seller behaviors (Genesove and Mayer, 2001; Engelhardt, 2003) and are applicable to landlord behaviors in the context of the rental market (Shilling et al., 1987; Belsky and Goodman, 1996). Furth-Matzkin (2017) describes the control that landlords have over rental agreements; tenants may even accept unreasonable tenancy restrictions. This may

be due to the effects of noneconomic conditions on tenant preferences during the rental period, cause by school, work, and life planning (marriage, childrearing) factors.

Empirical Results

Data

This study employed US housing rent and consumer price index (CPI) data for between 1960:Q1 and 2018:Q2 to calculate real rents. Rent data were collected from the American Enterprise Institute (AEI) housing center (www.AEI.org/housing). The AEI housing center conducts research to expand knowledge of housing markets and finance and provides objective and transparent housing market indicators. The database of the AEI housing center contains information on the values and rents of residential properties in the United States. The data are constructed by following the methodology provided by Davis et al. (2008).

Davis et al. (2008) constructed a quarterly time series of the rent-price ratio for the aggregate stock of owner-occupied housing in the United States, starting in 1960, by merging micro data from the Decennial Census of Housing (DCH) surveys. For capturing variation in the quantity of housing services provided by each unit, for each DCH, they regress log gross rents of renters on a set of dummy variables. In each year, only non-permanent-site housing units (such as mobile homes, trailers, boats, tents, and vans) are excluded from all the calculations. For more illustrations of the organization of the rent data, please refer to Davis et al. (2008).

CPI data were collected from the National sources, Bank for International Settlements Consumer price series.[1] Because the use of CPI data that includes rent may cause bias in estimation results, the index used in this study is CPI less shelter.

In addition, to verify the hypotheses of this study, we used vacancy rate and asking rent data provided by the United States Census Bureau.[2] The period covered by the vacancy rate data is also from 1960:Q1 to 2018:Q2. However, because the median asking rent data provided by the US Census Bureau begins from 1988:Q1, the period covered by the asking rent data is from 1988:Q1 to 2018:Q2. Because the nominal rent of the AEI Housing Center is annual rent, and the median asking rent data provided by the US Census Bureau is monthly rent, the nominal rents are divided by 12 to obtain the monthly average rent for empirical analysis.

Rental Market Inefficiency

Figure 1 illustrates the nominal rent and real rent. As expected, the nominal rent increased steadily. However, the inflation changes during the same period (Fig. 2) were considerable, thus causing a large change in real rent and a significant increasing trend. If the nominal rent exhibits rigidity, it is unable to sufficiently reflect the inflation data, causing market disequilibrium and an increase in the vacancy rate (when the real rent is excessively high). To determine whether rent changed efficiently under changes in inflation,

[1] For more information, please visit http://www.bis.org/statistics/cp.htm/.
[2] For more information, please visit https://www.census.gov/housing/hvs/data/histtabs.html/.

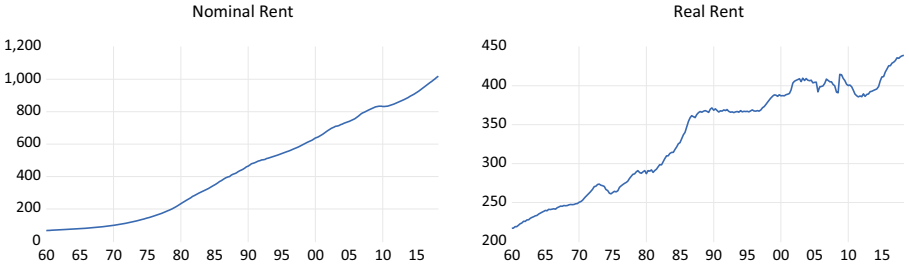

Fig. 1 Nominal and real rent (dollars)

Table 1 presents results of tests of whether the real rent was stable or divergent. Two types of unit root test were employed, the first being a traditional unit root test—the Augmented Dickey–Fuller (ADF) test—and the second being a unit root test considering one-time structural changes—the minimize Dickey–Fuller test (Vogelsang, 1997).

The results of both tests indicate that real rent was divergent and unstable. The estimations also indicate that structural changes may have occurred in 1981:Q2. Although Fig. 1 does not indicate any particular changes in nominal rent in 1981, Fig. 2 illustrates that inflation dramatically decreased in that year. Calculated using the CPI, the average inflation prior to 1981:Q3 was 5% and after 1981:Q3 was 1.93%. The nominal rent, however, exhibited stable increases in relative terms during this period. Furthermore, the nominal rent did not significantly decrease in response to periods of disinflation, thus causing real rent to exhibit upward divergence. Thus, the inefficiency of real rent caused fluctuation in the vacancy rate and an inability to maintain the natural vacancy rate. An excessively high real rent leads to an excessively high vacancy rate, wasted space, and landlord losses. The results in Table 2 verify the existence of real rent inefficiencies; however, to test whether excessively high real rent was related to the irrational nonadjustment of nominal rent by landlords during periods of low inflation, we first attempt to examine the periods in which real rent exhibited significant inefficiency.

A dynamic unit root test was employed for estimation. Phillips et al. (2015) proposed the Backward Sup ADF (BSADF) test, which dynamically detects whether unit roots exist in the null hypothesis, with the alternative hypothesis being the statistical measure of market overheating (BSADF statistic). We employed the method proposed by Phillips et al. (2015) to estimate the real rent and identify periods in which the real rent was excessively high. Figure 3 illustrates the BSADF statistic and critical value. If the BSADF statistic is greater than the critical value, the real rent was

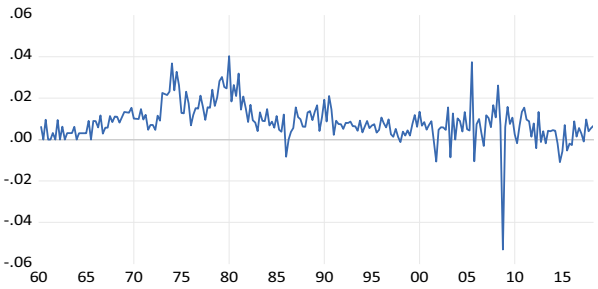

Fig. 2 Inflation rate (%)

Table 1 Unit root test for real rent

Null Hypothesis: Real rent has a unit root		
Augmented Dickey-Fuller test		
	t-Statistic	*p* value
Test statistic	−0.8307	0.8081[a]
Minimize Dickey-Fuller t-statistic		
Break Date: 1981Q2	*t*-Statistic	*p* value
Test statistic	−2.6486	0.8508[b]

Notes: [a] denotes MacKinnon (1996) one-sided *p* values. [b] denotes Vogelsang (1993) asymptotic one-sided *p* values

excessively high, implying that irrational prices existed in the rental market. Figure 3 indicates that real rents were excessively high in five primary periods—1971:Q2 to 1973:Q2, 1982:Q4 to 1990:Q2, 1998:Q1 to 1999:Q2, 2001:Q3 to 2002:Q4 and 2016:Q4 to 2018:Q1. Through the three types of unit root tests, we not only confirmed the inefficiency of the rental market, but also detected the periods during which real rents were most unreasonable.

Nominal Rent Rigidity and Inflation

Table 2 presents estimates of the correlation between nominal rent rigidity and inflation. Because rent showed a divergent sequence, in the following empirical verification, we use the growth rate of data. We employed a model that measured heterogeneous volatility to estimate the growth rate of the nominal rent. In addition to the existence of

Table 2 Rent rigidity and inflation

	$\Delta \ln Rent_t$	
Variable	Coefficient	*p* value
$\Delta \ln Rent_{t-1}$	0.6893	0.0000
$\Delta \ln Rent_{t-2}$	0.2389	0.0003
Constant	0.0008	0.0017
σ^2_{t-1}	0.4296	0.0002
h_{t-1}	0.6010	0.0000
$\pi_{t-1}\times 10$	0.0003	0.0337
Constant	0.0000	0.0921
Log likelihood	1077.8290	

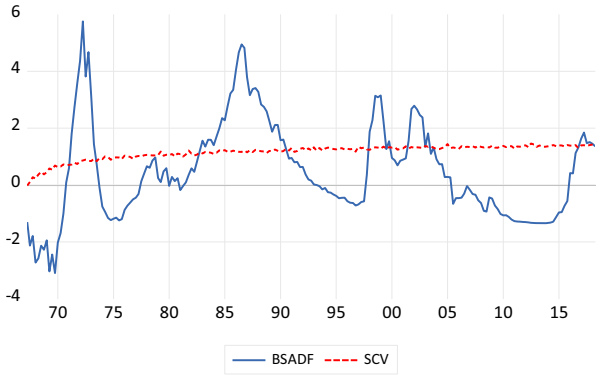

Fig. 3 BSADF and critical value

autocorrelation between the mean and variance of the growth rate of rent, the conditional variance was also significantly and positively influenced by the inflation rate, indicating that the volatility of the growth rate of rent increased along with inflation.

When slowing inflation or disinflation occurred, however, nominal rent exhibited rigidity because the rate of return volatility decreased. Table 2 indicates that a negative inflation rate could significantly result in the nominal rent rigidity. To determine whether this was the reason for the excessively high real rent, Fig. 4 plots the conditional variance of the growth rate of rent detailed in Table 2. The shaded area in Fig. 4 represents the periods during which real rent was excessively high (Fig. 3). In Fig. 4, other than in 1987:Q4, the shaded area indicates periods during which volatility declined significantly; that is, periods during which nominal rent was rigid. The estimations are consistent with the hypothesis of this study: that when slowing inflation occurs, landlords prefer long-term contracts providing high one-time income, thus leading to less frequent rental market price adjustments and market inefficiency.

Rigidity exists when rent price cannot be adjusted efficiently, which causes the vacancy rate to rise. Two puzzles in the rental market that this study explains are rigidity of rents and short-term volatility of vacancy rate. The periods of low volatility (higher rigidity) of nominal rent can be seen in Fig. 4. Therefore, the change in vacancy rate plotted in Fig. 5 can be compared with Fig. 4. In Fig. 5, the shaded area represents

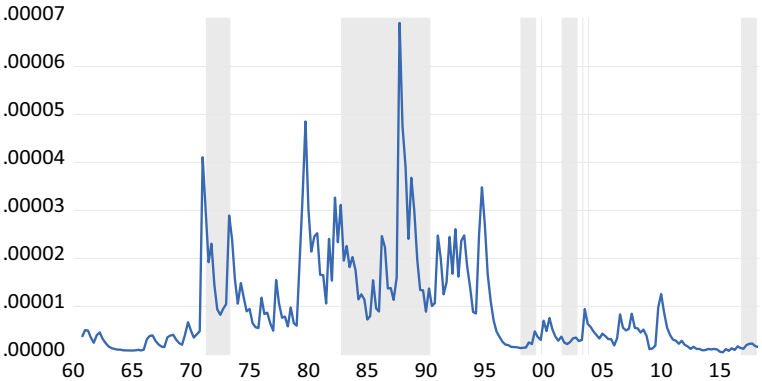

Fig. 4 Conditional variance of rent

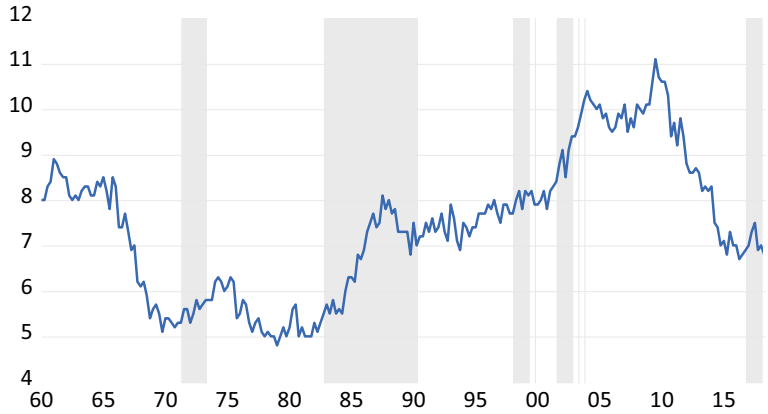

Fig. 5 Rental vacancy rate (%)

the period when the actual rent is excessively high, that is, the period when the nominal rent is not adjusted with inflation. During these periods, the vacancy rate increases significantly. During the shaded area, except for at the end of 1987 and the third quarter of 2017, the vacancy rate rises progressively. This may be due to the rigidity of nominal rents (i.e., actual rents are excessively high when nominal rents are unadjusted for inflation), causing the increase in vacancy rate.

However, because this study does not consider other factors in the rental market, such as population, number of households, housing stock, and rental policy subsidies, it is unable to explain some periods of change in the rental market. For example, substantial reductions in nominal rents at the end of 1987 caused a drop in vacancy rate. This could have been due to the Tax Reform Act of 1986 that extended the depreciation period of real estate, which caused a major change in the depreciation allowance of real estate and also resulted in changes to rental market housing stock.

The results presented in Table 2 and Figs. 4 and 5 explain the relationship between low inflation, rent rigidity, and rental market inefficiency. However, we further tested whether the correlations between these variables were caused by landlord behavior under different inflation conditions to provide additional evidence. The median asking rent was employed to evaluate average landlord

behavior. The estimated values in Table 3 represent whether landlords' asking rent is related to inflation rate, and the findings reveal that inflation rate significantly affects landlords' rental pricing behavior in the subsequent period. The volatility of median asking rent increases when the inflation rate increases, and the median asking rent becomes rigid when the inflation rate decreases because the estimated results indicate that the volatility of median asking rent decreases.

Rent and Vacancy Rate

Tests of the relationship between real rent and natural vacancy rate were conducted on the assumption that real rent and natural vacancy rate were both correctly measured. To avoid errors and reduce assumptions, this study directly tested the relationship between nominal rent and vacancy rate. The vector error correction model, which describes long-term equilibrium and short-term behavior changes, was employed to measure the

Table 3 Asking rent rigidity and inflation

	$\Delta \ln ARent_t$	
Variable	Coefficient	p value
$\Delta \ln ARent_{t-1}$	−0.2416	0.0015
Constant	0.0166	0.0005
σ^2_{t-1}	0.1446	0.0647
h_{t-1}	0.4154	0.1025
π_{t-1}	0.0851	0.0060
Constant	0.0009	0.1051
Log likelihood	177.6677	

long-term and short-term relationships between nominal rent and vacancy rate. The results indicated that rent changes were significantly influenced by the error of the cointegration vector, indicating that rent was adjusted toward long-term equilibrium with the vacancy rate (Table 4). These results are consistent with the two-variable correlation proposed by past studies (Gabriel and Nothaft, 1988; Gabriel and Nothaft, 2001). The literature also indicates that landlords have a preferred vacancy rate and when the vacancy rate is excessively high (low), landlords decrease (increase) the rent. The results presented in Table 4 also indicate that, in the short-term, the vacancy rate was affected by rent changes that occurred in the previous quarter. When rent increased, the vacancy rate increased. In addition, the vacancy rate and rent were both significantly autocorrelated in short-term fluctuations. The results in Table 4 verified the rent correction behavior toward long-term equilibrium and the response of the vacancy rate to short-term rent adjustments. Rosen and Smith (1983) indicated that short-term correlation between vacancy rate and the rental price adjustment mechanism is not consistent with the results presented in the literature. We believe that this may be due to the lack of consideration of inflation illusion by other studies.

To more accurately evaluate fluctuation in the short-term vacancy rate, the endogenous effects of inflation were considered, and we utilized a vector autoregressive model (VAR) model including the growth rate of nominal rent, fluctuation in the vacancy rate, and inflation rate for measurement (Table 5).

The results in Table 5 illustrate that the growth rate of nominal rents is affected by the inflation rate of the previous period. The coefficient is significant at 0.05, signifying that nominal rents increase accordingly if the inflation rate of the previous period increases. In addition, a significant autocorrelation is identified in the growth rate for nominal rents (a coefficient of 0.86), indicating that the adjustment of nominal rents is continuous. If the rents in the previous period have been raised, the rents in the current period increase. The vacancy rate exhibits a significant and negative autocorrelation (a coefficient of −0.2), indicating that the behavior of vacancy rate adjustment is obvious.

Table 4 Rent and vacancy

Cointegrating Equation		
v_{t-1}	1.0000	
$Rent_{t-1}$	−0.0076 [−7.6688]	
Constant	−4.0109	
Variable	Δv_t	$\Delta Rent_t$
z_{t-1}	0.0178 [1.1057]	−0.3186*** [−5.2268]
Δv_{t-1}	−0.2322*** [−3.4800]	−0.0222 [−0.0879]
$\Delta Rent_{t-1}$	0.0297** [2.3357]	0.6814*** [14.1420]
π_{t-1}	−1.0566 [−0.4902]	2.7433 [0.3360]
Constant	−0.1178** [−2.0652]	1.3058*** [6.0438]
Log likelihood	−399.2854	
Akaike information criterion	3.5456	
Schwarz criterion	3.7238	

Notes: The table shows the relationship between the nominal rent and the vacancy rate. The estimated model is shown as follows

$$\Delta Rent_t = \varphi_{12} z_{t-1} + \varphi_{22} \Delta v_{t-1} + \varphi_{32} \Delta Rent_{t-1} + \varphi_{42} \pi_{t-1} + constant + \varepsilon_{2,t}.$$

$$\Delta v_t = \varphi_{11} z_{t-1} + \varphi_{21} \Delta v_{t-1} + \varphi_{31} \Delta Rent_{t-1} + \varphi_{41} \pi_{t-1} + constant + \varepsilon_{1,t}$$

where *Rent* is the nominal rent. v is the vacancy rate. π denotes the inflation rate. z_t is the error term of cointegration relationship. The lag length of the model is selected by using the Schwarz information criterion. The entry in parenthesis stands for the t-statistic. *** indicates significance at the 1% level. ** indicates significance at the 5% level.

A high vacancy rate in the previous period may cause landlords to change their strategies, resulting in a decline in the vacancy rate in the current period. Nonetheless, the relationship between vacancy rate and other variables does not exist in Table 5, which cannot demonstrate variables used to adjust the vacancy rate. Moreover, the inflation rate in Table 5 also displays a positive autocorrelation, and the rent growth rate in the previous period has increased. Although the CPI used to calculate the inflation rate does not include rent, changes in rent can affect the cost of various goods; in particular, the cost of retailers drives the prices of goods.

After an inflation increase, rent increased in the next quarter. Because increases in market prices should cause an increase in the excess supply, studies have inferred that the vacancy rate increases after rent increases. However, Table 5 shows that if rent increases were reactions to inflation, the vacancy rate did not change. The phenomenon in which the vacancy rate (Table 4) lagged behind rent changes was nonsignificant (Table 5), indicating that the relationship between rent and vacancy rate might depend on the market condition. As inferred by this paper, when inflation occurs, landlords prefer short-term leases providing lower one-time income, thus increasing the rental transaction volume and decreasing the number of vacant properties in the rental market. In addition, this paper infers that landlords experience an inflation illusion due to the

Table 5 VAR model

Variable	$\Delta \ln Rent_t$		$\Delta \ln v_t$		π_t	
	Coefficient	*p*-value	Coefficient	*p*-value	Coefficient	*p*-value
$\Delta \ln Rent_{t-1}$	0.8610	0.0000	0.8956	0.0614	0.5516	0.0000
$\Delta \ln v_{t-1}$	-0.0049	0.2886	-0.2001	0.0023	-0.0097	0.4267
π_{t-1}	0.0536	0.0347	-0.4365	0.2165	0.1935	0.0038
Constant	0.0012	0.0031	-0.0075	0.1680	0.0005	0.6069

Notes: The table shows the relationship between the nominal rent, vacancy rate, and inflation rate. The estimated model is shown as follows.

$$\Delta \ln Rent_t = \sum_{i=1}^{n} \varphi_{i1} \Delta \ln Rent_{t-1} + \sum_{i=1}^{n} \omega_{i1} \Delta \ln v_{t-1} + \sum_{i=1}^{n} \tau_{i1} \pi_{t-1} + constant + u_{1,t}$$

$$\Delta \ln v_t = \sum_{i=1}^{n} \varphi_{i2} \Delta \ln Rent_{t-1} + \sum_{i=1}^{n} \omega_{i2} \Delta \ln v_{t-i} + \sum_{i=1}^{n} \tau_{i2} \pi_{t-i} + constant + u_{2,t}$$

$$\Delta \pi_t = \sum_{i=1}^{n} \varphi_{i3} \Delta \ln Rent_{t-1} + \sum_{i=1}^{n} \omega_{i3} \Delta \ln v_{t-1} + \sum_{i=1}^{n} \tau_{i3} \pi_{t-i} + constant + u_{3,t}$$

where *Rent* is the nominal rent. v is the vacancy rate. π denotes the inflation rate. The lag length of the model is selected by using the Schwarz information criterion.

framing effect, which causes landlords to adopt different attitudes when facing inflation and deflation. This study next determined whether the correlation between nominal rent, vacancy rate, and inflation changes under different inflation conditions using Balke's (2000) threshold VAR model.3

To rigorously determine whether the results presented in Table 5 were affected by the degree of inflation, we first conducted threshold VAR model testing. The results are listed in Table 6 and demonstrate that the threshold effect was significantly evident in the VAR model. Additionally, the relationships between variables were discovered to be influenced by inflation level. The best threshold value provided highest log likelihood value was 0.006. The threshold approaching 0 indicates that correlations between rental market variables can be discussed using inflation and deflation as differentiators for discussion. However, to achieve high rigor, we defined inflation higher than 0.006 as a high inflation state and inflation lower than 0.006 as a low inflation state.

Table 7 presents the results obtained using the VAR model in both states. In the high inflation state, the results in Table 7 are consistent with those of Table 5 but more significantly demonstrate that the growth rate of nominal rent lagged behind inflation changes by one quarter. Furthermore, the inflation listed in Table 7 influenced the growth rate of nominal rent more strongly, with a coefficient of 0.10; twice that of the

Table 6 Threshold effect in the VAR model test

Best threshold value	0.0063
LR Statistic	86.9099***
Degrees of freedom	18

Notes: *** indicates significance at the 1% level

Table 7 Threshold VAR model

Variable	$\Delta \ln Rent_t$		$\Delta \ln v_t$		π_t	
Higher inflation	Coefficient	p value	Coefficient	p value	Coefficient	p value
$\Delta \ln Rent_{t-1}$	0.8501	0.0000	0.5600	0.3328	0.5632	0.0000
$\Delta \ln v_{t-1}$	−0.0092	0.1584	−0.2421	0.0032	−0.0156	0.3107
π_{t-1}	0.0973	0.0278	−0.2006	0.7142	0.2597	0.0135
Constant	0.0007	0.2793	−0.0062	0.4431	−0.0003	0.8534
Lower inflation	Coefficient	p value	Coefficient	p value	Coefficient	p value
$\Delta \ln Rent_{t-1}$	0.7623	0.0000	2.9457	0.0298	−0.1468	0.5280
$\Delta \ln v_{t-1}$	0.0071	0.1804	−0.1567	0.1806	0.0231	0.2555
π_{t-1}	0.0114	0.6349	−0.5078	0.3380	0.0486	0.5976
Constant	0.0021	0.0001	−0.0239	0.0394	0.0062	0.0024

Notes: The table shows the asymmetric relationship between the nominal rent, vacancy rate, and inflation rate. The estimated model is shown as follows

$$\Delta \ln Rent_t = \sum_{i=1}^{n} \varphi_{i1} \Delta \ln Rent_{t-i} + \sum_{i=1}^{n} \omega_{i1} \Delta \ln v_{t-i} + \sum_{i=1}^{n} \tau_{i1}\ \pi_{t-i} + constant + u_{1,t}$$

$$\Delta \ln v_t = \sum_{i=1}^{n} \varphi_{i2} \Delta \ln Rent_{t-i} + \sum_{i=1}^{n} \omega_{i2} \Delta \ln v_{t-i} + \sum_{i=1}^{n} \tau_{i2}\ \pi_{t-i} + constant + u_{2,t}$$

$$\Delta \pi_t = \sum_{i=1}^{n} \varphi_{i3} \Delta \ln Rent_{t-i} + \sum_{i=1}^{n} \omega_{i3} \Delta \ln v_{t-i} + \sum_{i=1}^{n} \tau_{i3}\ \pi_{t-i} + constant + u_{3,t}$$

where *Rent* is the nominal rent. v is the vacancy rate. π denotes the inflation rate.

coefficient in Table 5. Table 7 also confirms that, in the high inflation state, vacancy rate changes only exhibited positive autocorrelation.

However, the low inflation state results demonstrate that the growth rate of nominal rent only exhibited positive autocorrelation. Table 7 depicts that, when subject to a low inflation rate, the nominal rent is not adjusted with the prices of goods. This is consistent with the results obtained in Table 2, showing that money illusion exists in the adjustment of nominal rent. Such money illusion causes inefficient adjustment in the rental market, which also leads to a high vacancy rate. In the low inflation state in Table 7, vacancy rate is significantly and positively affected by nominal rent, that is, vacancy rate increases as nominal rent increases. The results verify the inferences of this study and also explain why rental market inefficiency can result in a high vacancy rate. Because nominal rent was not adjusted downward due to deflation, real rent was excessively high and downward adjustments of the vacancy rate following rent adjustments did not exist.

Table 8 presents the covariance values and matrices of the three variables, as obtained using the threshold VAR model. In addition, for comparison, Table 8 also lists the covariance values and matrices presented in Table 5 using the conventional VAR model. The conventional VAR model calculation results were discovered to

Table 8 Covariance Correlation Matrix

Higher inflation	$\Delta \ln Rent$	$\Delta \ln v$	π
$\Delta \ln Rent$	0.00001174	−0.06875	0.19596
$\Delta \ln v$		0.001832	−0.08383
π			0.00006594
Lower inflation	$\Delta \ln Rent$	$\Delta \ln v$	π
$\Delta \ln Rent$	0.00000272	0.0631	−0.01691
$\Delta \ln v$		0.001328	−0.01318
π			0.00004014
All	$\Delta \ln Rent$	$\Delta \ln v$	π
$\Delta \ln Rent$	0.00000838	−0.04188	0.15446
$\Delta \ln v$		0.001644	−0.06381
π			0.00005633

Notes: *Rent* is the nominal rent. v is the vacancy rate. π denotes the inflation rate

fall between the results for the high and low inflation conditions. When inflation was high, changes in the nominal rent were significantly greater, with a variance value four times that in the low inflation situation, and nominal rent adjustments were more strongly correlated with inflation (higher covariance value). This result confirms the existence of the framing effect, because rent reacted more strongly to inflation information and was adjusted during periods of high inflation. During periods of low inflation, however, the higher nominal rental rate of return was more likely to lead to an increase in the vacancy rate because the covariance value of the two variables was positive (0.06), thus also confirming that market inefficiency (high vacancy rate) caused by inflation illusion was more likely to occur during periods of low inflation.

Finally, the impulse response function subject to high and low inflation is explained. Table 8 reveals the effect of inflation on rent and the effect of rent on vacancy rate. Figure 6a illustrates that the response of rent to inflation adjustment is greater for high inflation than for low inflation. When the inflation level is high, rents immediately rise sharply in response to inflation. Figure 6b shows that during high inflation periods, the changes in vacancy rate are more subject to the influence of rents. The results in Fig. 6 verify that the adjustment of rents and vacancy rates are inconsistent during periods of high and low inflation. During high inflation periods, the rent adjustment and the response to the reduction of vacancy rate also occur faster, indicating that landlords tend to surrender parts of the profits. By contrast, during low inflation periods, the rent adjustment and the response of lower rents to the increase in vacancy rate are slower.

Conclusion

In this paper, we infer that the inflation illusion in the rental market might be attributed to the framing effect. We propose that because rent is changed on a

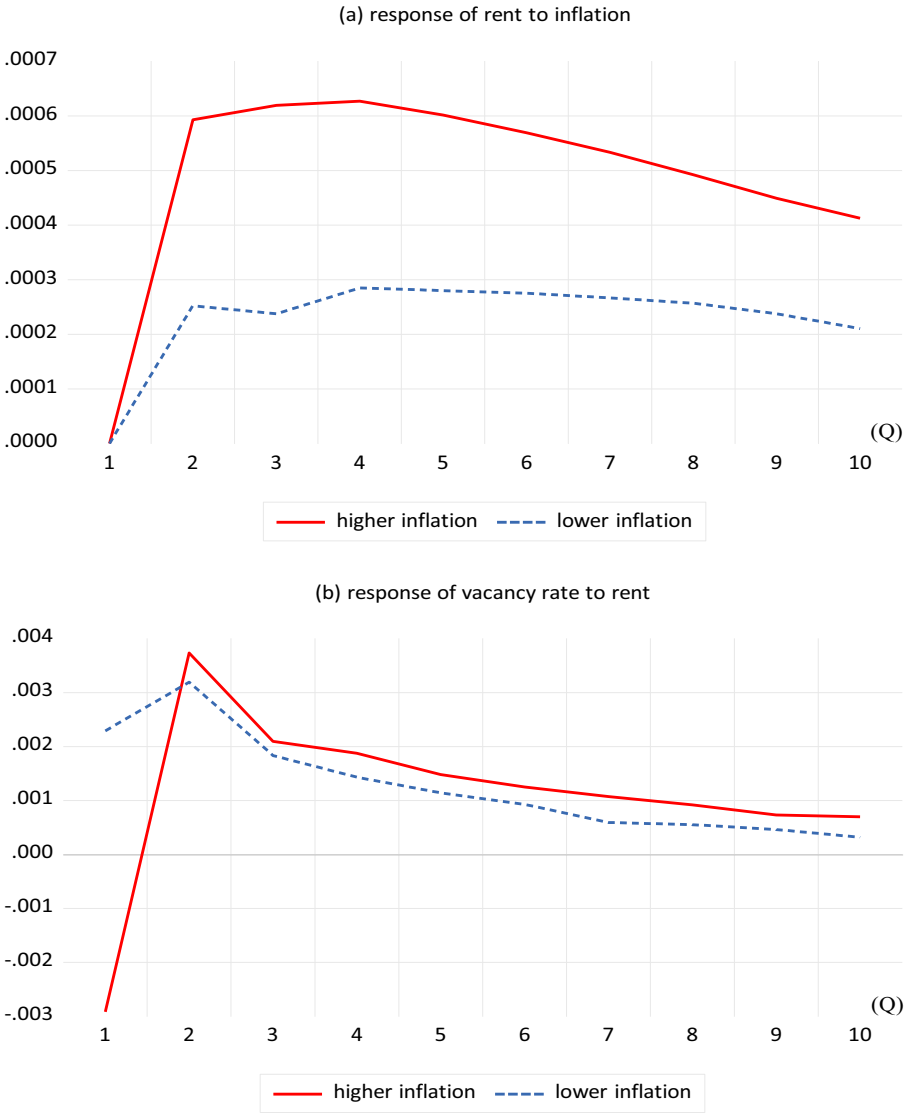

Fig. 6 Impulse Responses Function

contractual basis, reactions to inflation exhibit time lags; new leases principally respond to inflation that occurred in the past. If high inflation occurs, old leases stipulate excessively low real rent and are disadvantageous to landlords. Thus, new nominal rent responds to the inflation and is adjusted upward from the previous rent price. For landlords, such a new lease has higher utility. Based on framing effect theory, this study inferred that utility increasing-bargaining causes landlords to choose to provide greater concessions for facilitating the successful establishment of contracts. As a result, when high inflation occurs, landlords prefer short-term contracts providing lower one-time income, thus increasing the rental transaction

volume and reducing the number of vacant properties in the rental market. Conversely, if low inflation occurs, landlords face utility decreasing-bargaining and reduce concessions, showing a preference for long-term contracts and thus increasing the number of vacant properties and reducing the price adjustment frequency.

This study used US rental market data from between 1960:Q1 and 2018:Q2 to first verify rental market inefficiency and identify periods during which real rent was most unreasonable. We identified periods during which the real rent was excessively high—periods that had low inflation or even deflation, in addition to nominal rent rigidity. These were periods in which the asking rent was corrected excessively slowly. These results are consistent with the hypothesis of this study: when low inflation occurs, landlord behavior causes infrequent price adjustment in the rental market, resulting in market inefficiency.

In addition, this study discovered that typically, rent is corrected to achieve long-term equilibrium with the vacancy rate. In the short-term, the vacancy rate is affected by changes to rent in the previous quarter; if the rent had increased, the vacancy rate increases. However, rent does not respond to low inflation. Because nominal rent does not decline due to disinflation, the real rent is excessively high and the vacancy rate is not adjusted downward following rent adjustments. Lastly, this study verified that when inflation is high, changes in nominal rent are significantly greater. Furthermore, because adjustments to nominal rent are related to inflation, the existence of the framing effect is verified, and rent is more likely to be adjusted in reaction to inflation data. During periods of low inflation, a higher growth rate of nominal rent leads to increases in the vacancy rate, thus confirming that conditions in which an inflation illusion causes market inefficiency (high vacancy rate) are more likely to occur during periods of low inflation.

The literature has shown the existence of two puzzles: nominal rent rigidity and existence of inefficient vacancy rates in the rental market. This paper proposes a possible explanation, and the findings of this study simultaneously explain both of these puzzles. In addition, our use of long-term US rental market data also provides related evidence supporting the hypothesis that this rental market phenomenon is caused by an inflation illusion. This study does not consider other factors in the rental market but only provides explanations and empirical evidence for the possible effect of inflation illusion on the rental market. Nevertheless, this study is unable to explain some changes to fundamental variables in the rental market, which requires the addition of other variables (e.g., population, number of households, housing stock, or subsidies for rental policies) for a comprehensive discussion.

Acknowledgments I am immensely grateful to Professor James B. Kau (Editor-in-Chief) and the anonymous referee for the constructive comments of this paper. Funding from the Ministry of Science and Technology of Taiwan under Project No. MOST-107-2410-H-390-016-MY3 has enabled the continuation of this research and the dissemination of these results.

References

Alchian, A. A., & Allen, W. R. (1982). *Exchange and production: Competition, coordination, and control.* Belmont: Wadsworth.

Balke, N. (2000). Credit and economic activity: Credit regimes and nonlinear propagation of shocks. *Review of Economics and Statistics, 82*, 344–349.

Baqaee, D. R. (2019). Asymmetric inflation expectations, downward rigidity of wages, and asymmetric business cycles. *Journal of Monetary Economics*, In press. https://doi.org/10.1016/j.jmoneco.2019.04.014.
Bar-Isaac, H., & Gavazza, A. (2015). Brokers' contractual arrangements in the Manhattan residential rental market. *Journal of Urban Economics, 86*, 73–82.
Belsky, E., & Goodman, J. L. (1996). Explaining the vacancy rate - rent paradox of the 1980s. *Journal of Real Estate Research, 11*(3), 309–323.
Cheung, Y., Tsang, S., & Mak, S. (1995). The causal relationships between residential property prices and rentals in Hong Kong: 1982–1991. *Journal of Real Estate Finance and Economics, 10*, 23–35.
Davis, M. A., Lehnert, A., & Martin, R. F. (2008). The rent-price ratio for the aggregate stock of owner-occupied housing. *Review of Income and Wealth, 54*(2), 279–284.
Engelhardt, G. V. (2003). Nominal loss aversion, housing equity constraints, and household mobility: Evidence from the United States. *Journal of Urban Economics, 53*, 171–195.
Fehr, E., & Tyran, J.-R. (2001). Does money illusion matter? *American Economic Review, 91*(5), 1239–1262.
Furth-Matzkin, M. (2017). On the unexpected use of unenforceable contract terms: Evidence from the residential rental market. *Journal of Legal Analysis, 9*(1), 1–49.
Gabriel, S., & Nothaft, F. E. (1988). Rental housing markets and the natural vacancy rate. *Real Estate Economics, 16*(4), 419–429.
Gabriel, S., & Nothaft, F. E. (2001). Rental housing markets, the incidence and duration of vacancy, and the natural vacancy rate. *Journal of Urban Economics, 49*(1), 121–149.
Genesove, D., & Mayer, C. (2001). Loss aversion and seller behavior: Evidence from the housing market. *Quarterly Journal of Economics, 116*, 1233–1260.
Genesove, D. (2003). The nominal rigidity of apartment rents. *Review of Economics and Statistics, 85*(4), 844–853.
Goodhart, C. (2001). What weight should be given to asset prices in the measurement of inflation? *Economic Journal, 111*(472), 335–356.
Hoffmann, J. & Kurz-Kim, J.-R. (2006). Consumer price adjustment under the microscope: Germany in a period of low inflation. Discussion paper series 1: Economic studies 2006, Deutsche Bundesbank Research Centre.
Kashiwagi, M. (2014). A search-theoretic model of the rental and homeownership markets. *Journal of Housing Economics, 26*, 33–47.
Levin, I. P., Schneider, S. L., & Gaeth, G. J. (1998). All frames are not created equal: A typology and critical analysis of framing effects. *Organizational Behavior and Human Decision Processes, 76*(2), 149–188.
MacKinnon, J. G. (1996). Numerical distribution functions for unit root and cointegration tests. *Journal of Applied Econometrics, 11*, 601–618.
Miceli, T. J., & Sirmans, C. F. (2013). Efficiency rents: A new theory of the natural vacancy rate for rental housing. *Journal of Housing Economics, 22*(1), 20–24.
Muller, R. (1991). Rent control and vacancy rates in Canada. QSEP research report 275, McMaster University.
Neale, M. A., & Bazerman, M. H. (1985). The effects of framing and negotiator overconfidence on bargaining behaviors and outcomes. *Academy of Management Journal, 28*(1), 34–49.
Phillips, P. C. B., Shi, S., & Yu, J. (2015). Testing for multiple bubbles: Historical episodes of exuberance and collapse in the S&P 500. *International Economic Review, 56*, 1043–1078.
Rosen, K. T., & Smith, L. B. (1983). The price-adjustment process for rental housing and the natural vacancy rate. *American Economic Review, 73*(4), 779–786.
Shilling, J. D., Sirmans, C. F., & Corgel, J. B. (1987). Price adjustment process for rental office space. *Journal of Urban Economics, 22*(1), 90–100.
Shimizu, C., Nishimura, K. G., & Watanabe, T. (2010). Residential rents and price rigidity: Micro structure and macro consequences. *Journal of the Japanese and International Economies, 24*(2), 282–299.
Tversky, A., & Kahneman, D. (1986). Rational choice and the framing of decisions. *Journal of Business, 59*(4), 251–278.
Vogelsang, T. J. (1993). Essays On Testing for Nonstationarities and Structural Change in Time Series Models. Unpublished Ph.D. Dissertation, Princeton University, Princeton, NJ.
Vogelsang, T. J. (1997). Wald-type tests for detecting breaks in the trend function of a dynamic time series. *Econometric Theory, 13*(6), 818–849.
Wheaton, W. C., & Torto, R. G. (1994). Office rent indices and their behavior over time. *Journal of Urban Economics, 35*(2), 121–139.