Owner-Occupied Housing as a Hedge Against Rent Risk

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ABSTRACT

One frequently overlooked but potentially important benefit to homeownership is avoiding the uncertainty of renting. Homeowning, with its long-term fixed-rate mortgage and owner-determined maintenance costs, provides a predictable way of paying for housing services. For renters, the long-term cost of obtaining housing is unknown, although they avoid the asset price risk inherent in homeowning. We show in a simple stylized model that risk-averse people have a greater demand for homeowning when rent uncertainty is higher and, for families with reasonable expected lengths of stay in their houses, the uncertainty of renting can dominate the asset price risk of owning. Using data from the Current Population Survey matched to MSA-level rent data, we find that the rent hedging benefit of owning significantly increases the homeownership rate: the probability of homeownership for people who expect to stay in their houses longer is 4.8 percentage points greater than for short horizon families if they live in high rent variance places rather than low rent variance places. For the average household, rent risk empirically dominates the asset price risk of owning – people in above-median rent variance MSAs are 6.3 percentage points more likely to own their homes. Older households are particularly sensitive to rent risk, with people aged 65 residing in places with above-median rent variance 7.4 percent more likely to be homeowners than people of the same age in low rent variance MSAs. Confirming that this effect is due to the rent hedging value of homeowning, the probability of homeownership drops most rapidly with age for elderly who live in high rent variance places, consistent with the value of the hedge declining with their remaining lifetimes. Finally, we find evidence that some of the hedging benefit of homeowning shows up in the multiple of rents people are willing to pay for houses. When MSAs have a one standard deviation higher rent variance their house prices increase 1.1 to 3.3 percent relative to the rental value of the housing stock.

In the U.S., 68 percent of families own the houses they live in. In order to purchase their preferred house, a family must commit a substantial portion of their wealth to the asset, 27 percent on average [Poterba and Samwick (1997)]. For households aged 65 and over, housing wealth comprises 45 percent of their non-Social Security wealth. Conventional wisdom holds that this financial position, with a high degree of exposure to an ideosyncratic real estate asset, is quite risky since fluctuations in house prices can have a sizeable effect on families' net worth.

However, the alternative to homeowning, which is renting, also is not risk-free. In particular, a renter is subject to periodic rent adjustments while a homeowner enjoys the comfort of knowing her out-of-pocket spending is fixed at a constant nominal level for the duration of her stay in her dwelling. In essence, bundled into the house purchase is a hedge against nominal rent fluctuations. Since housing costs comprise such a large budget share for most Americans, approximately one third of annual income, the ability to lock in the cost of housing services may be quite valuable. However, long-term rent contracts do not appear to exist. Genesove (1999) reports that 97.7 percent of all leases are for terms of one year or less. In addition, one cannot purchase a "rent swap" to exchange variable rent for fixed.[1] Thus the only way to hedge against uncertain annual housing costs is to own a house instead of renting it.

This rent hedging benefit of owner-occupied housing may well increase the demand for homeownership even though markets with high rent risk also have more variable house prices. Rent fluctuations affect renters every year while the asset price shock for homeowners is realized only at the end of their stays in their houses. If a family's expected move is sufficiently far in the future, avoiding rent risk may dominate the discounted asset price risk. In that case, a family

[1] We can only surmise why. One possibility is that the contracting is quite difficult. Presumably the swap would have to terminate if one party moved. But if rents fell and the renter owed a sufficient amount of money on their half of the swap, they would simply move and exit the contract. In addition, it may be expensive to put such a swap in place for a long term.

would be willing to pay a premium above the value of the service flow from the house in order to own the dwelling rather than rent it. Depending on the elasticity of supply for owned housing units, this heightened demand may show up in a higher homeownership rate, a higher price for a given house, or both. Despite this, previous research has typically ignored rent risk for the tenant, instead focusing solely on the asset price risks from homeowning.[2]

We find empirical and theoretical evidence that the rent hedging benefit of homeownership increases the demand for owner-occupied housing, for the population as a whole and especially for the elderly. Since the average real rent variance in a market is quite large, it has significant effects on the homeownership rate and on the prices people pay to own houses relative to the rents in the market. Most compelling, the families that are expected to be the most sensitive to rent risk relative to asset price risk have the greatest increases in their probability of homeowning as the rent variance rises. In addition, we find that for the average family, the annual risk of renting actually dominates the discounted end-of-stay asset price risk from homeowning so increases in housing market variance typically lead to an rise in the demand for owner-occupied housing.

[2] Little previous research is concerned with the value of housing as a hedge against rent fluctuations. The standard user cost literature, e.g. Rosen (1979), Poterba (1984), Hendershott and Slemrod (1983), estimates housing demand simply as a function of expected returns on housing. Another strand of the literature, such as Skinner (1989) and Summers (1983), considers the risk of the asset value of the house. Cocco (2000) and Haurin (1991) investigate the effects of income risk, with Cocco adding interest rate risk in a parameterized structural model of housing investment, but he rules out the possibility of renting. Only Rosen *et al* (1984), Henderson and Ioannides (1983), and Ekman and Asberg (1997) touch on rent risk. In a time series study, Rosen *et al* find that one predictor of the aggregate homeownership rate is the difference between the unforecastable volatility of the user cost of homeownership and rents. However, their measure of user cost volatility assumes that homeowners realize their capital gain every year. Rosen *et al* also assume that rental housing and owner-occupied housing are independent goods. Hence they do not allow for an endogenous relation between house prices and rent. In Henderson and Ioannides, the rent risk is to the landlord, not the tenant. In their model, the tenant may not properly care for the property. This incentive compatibility problem raises the average rent for renters but does not involve volatility. Ekman and Asberg construct a two-period model where families either rent or own in the first period and must rent in the second period, and show that families will choose homeowning if house price variance is less than the variance in the price of rental apartments bought by landlords. However, in their model homeowning does not hedge against rent risk because duration of stay under each tenure mode is only one period. Instead, their result is generated when families trade off a lower, but uncertain, cost of homeowning against a higher, fixed rent that compensates landlords for the capital risk they take. Eckman also assumes that the price processes for owner-occupied housing and apartment buildings are independent.

We begin by showing that a simple model with endogenous house prices predicts that the demand for homeowning increases with rent variance and that the relative importance of rent risk increases with expected length of stay in the house. The model also finds that the annual rent risk should dominate the asset price risk from owning as long as homeowners do not expect to sell in the very short term. Our stylized model of the ownership decision reduces the problem to one of minimizing the risk-adjusted cost of housing services. While both rents and house values may fluctuate, renters must pay different rents each period but homeowners only realize a change in house value when they sell. House values are determined by the capitalized value of market rents. As long as the realization of the house price is sufficiently discounted, either because the homeowner expects to remain in the house for a long enough time or her discount rate is sufficiently high, people in markets with larger rent variances should have higher probabilities of homeownership and/or higher house prices relative to rental values. Owners who expect to stay in their houses longer are shown to experience a greater benefit from the rent insurance from homeownership.

Of course, there are many other reasons why people might own their houses.[3] However, avoiding rent risk also appears to be an important one. We estimate our model using cross sectional data from the Current Population Survey matched to metropolitan area-level rent data. To control for metropolitan area heterogeneity, we consider how the probability of homeownership differs for people with varying expected lengths of stay in markets with different rent variance. We find that people with rent variance in the top quartile are 5.4 percentage points more likely to be homeowners and of those, the ones in the top quartile of expected length of stay in their houses are another 4.8 percentage points more likely to be homeowners. A one standard deviation increase in

[3] For example, income, demographics and tax benefits [Rosen (1979)], inflation [Summers (1981)], or the agency costs of renting [Henderson and Ioannides (1983)],

the effective rent variance raises the average probability of homeownership by 4.2 to 5.3 percentage points, to 70 percent. This result is particularly pronounced for the elderly. People aged 65 are 7.4 percentage points more likely to own their home if they live in a market with above-median rent variance. However, as the end of life approaches, the rent hedge afforded by homeownership becomes less valuable as the number of periods for which a homeowning household expects to be insured against rent risk falls. Indeed, we find that the very old in high rent variance markets have a more steeply declining probability of homeownership with age. Finally, people in markets with higher rent variance also are willing to pay a greater multiple of market rents in order to own their residence. We find that a one standard deviation increase in the rent variance raises the average price-to-rent ratio in a market from 15.7 to between 15.9 and 16.2, an increase of between 1.1 and 3.3 percent depending on whether controls for metropolitan statistical area [MSA] fixed effects are included.

Choosing to own rather than rent in order to obtain the hedging benefit of homeowning may be costly. Our results suggest the rent hedging benefit of homeownership may provide a partial explanation for the failure of the elderly to transit out of homeownership as early as life-cycle models would predict. [Venti and Wise (2000); Megbolugbe, *et al* (1997)]. One potential reason for their failure to draw down housing equity is that seniors do not wish to face the risk of renting and avoid it by continuing to be homeowners.[4] This could reduce their non-housing consumption. In addition, the rent hedging benefit of homeowning may help explain why families are willing to distort their portfolio allocation [Brueckner (1997), Goetzmann (1993), Flavin and Yamashita

[4] Presumably the transactions costs of moving combined with a desire to continue to consume housing services prevents seniors from trading down to a smaller house. This finding underscores the need for viable reverse mortgage markets to enable households to avoid rent risk by continuing to own their houses while annuitizing their housing wealth. To date, these markets have not been particularly successful [Caplin (2001)].

(1998), and Fratantoni (1997)] and vary their savings and consumption behavior [Engelhardt (1996), Skinner (1989)] in order to become homeowners.

The remainder of this paper proceeds as follows. In the first section, we present a simplified model of the benefit of homeowning as a mechanism to reduce the risk in housing costs. Section two describes our data sources and variable construction. The empirical methodology and results are reported in the third section. Section four briefly concludes.

I. A simple model of the hedging benefit of owner-occupied housing

This section presents a stylized model of tenure choice in the face of housing market risk, simplified in order to highlight a few key tensions between the risks of renting versus those of homeowning. In particular, rent fluctuations are generated by exogenous shocks to the housing market. Renters' leases have a one-year term, so the price renters must pay for the same quantity of housing services can vary from year to year. On the other hand, homeowners fix the annual cost of obtaining housing services by purchasing their houses outright. However, at the end of their stay in the house, homeowners realize a capital gain or loss while renters have no asset price exposure. House prices are simply the capitalized value of the rental stream, so they move with housing market shocks as well. The relative volatility of rents and house prices depends on the persistence in the rent process, with more persistent rent shocks leading to larger house price volatility.

The testable implications of the model follow almost immediately from this basic description. The relative importance of rent risk to house price risk for a family deciding whether to rent or own is determined by just a few factors. First, what is the family's expected length of stay in the house? Someone who expects to be in the house longer would be exposed to more rent movements as a renter while the asset risk from homeowning would occur later and thus would be more greatly discounted. Second, what is the relative volatility of rents and prices? If house prices are much more volatile than rents, then the asset price risk of homeowning becomes more important relative to the annual rent shocks.[5] If overall a family perceives the rent risk to be more important than the asset price risk, an increase in housing market volatility will raise the demand for owning relative to renting. That is more likely to be the case for families with long expected lengths of stay, since the discounted capital gain or loss attendant with homeowning will pale next to the early rent fluctuations that come from renting. As long as price variance is greater than rent variance, an increase in housing market volatility may cause families with short expected lengths of stay to prefer to *rent* more since they are exposed to few rent adjustments as renters and the asset price risk from owning arrives early.

The remainder of this section expands upon the outline above. To isolate the effect of rent risk we abstract from other features of housing markets that do not directly bear on the dynamic relationship between house prices and rent risk. The previous literature has focused on essentially static and deterministic models of the user cost, for example identifying the effects of taxes. The dynamic, stochastic effects at issue here apply above and beyond these previously studied features of the tenure decision.

Consider a risk-averse household with an N-year horizon for housing services, with the years labeled t=0, 1, …, N-1. The household has already decided on the optimal quantity of housing space it wants to consume each year, for simplicity assumed to be constant. The household's goal is to maximize the expected utility of its after-housing wealth, or equivalently to

[5] This statement is mitigated by the fact that for house prices to be more volatile than rents, rent shocks must be more persistent. Persistent rent shocks impose a greater risk for the renter since an adverse shock early in the holding period can have a large effect on total housing costs.

minimize the risk-adjusted cost of securing its desired housing services. For convenience we assume that rental units and houses provide the same flow of housing services.[6]

To begin with, suppose the household is choosing between renting for all N years, or buying a house in year 0 and then selling it after N years.[7] The current real rent r_0 and house price P_0 are observable, but the future rents r_1 to r_{N-1} and terminal house sale price P_N are stochastic. Accordingly the household's goal is to minimize the risk-adjusted discounted value of its housing outlays.[8] For simplicity we abstract from other factors that affect homeownership and rental costs, such as the tax treatment of homeownership. Such factors may affect the relative cost of owning and renting, but they will not change the comparative statics at issue here regarding the effects of increases in the riskiness of rent.[9]

The discounted cost of renting is $C_r = r_0 + \delta r_1 + \ldots + \delta^{N-1} r_{N-1}$. The discount factor δ reflects the opportunity cost of funds, as in the traditional definition of user cost. The risk associated with renting can be measured by the risk premium that would leave the household indifferent between C_r, which is stochastic, and its mean. This risk premium depends on the stochastic process for rent.

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[6] Equivalently, the household can be thought of as choosing between owning or renting the same house. The comparative statics below can be generalized to allow the services from the owner-occupied house to exceed those from renting (perhaps due to agency problems). In practice rent risk might also reduce the desired size of rental space (the intensive margin). While this effect is consistent with the hedging motives at issue, it would make it more difficult to find an effect on the rent versus own (extensive) margin analyzed empirically.

[7] Below we show that if the household buys a house, it will generally want to buy as early as possible. Hence other options e.g., renting for one year and then buying, will not be relevant. For convenience below, the sale is assumed to take place at the beginning of year N.

[8] We have intentionally abstracted from capital market imperfections leading households to want to smooth their year-to-year housing expenditures. While we believe this may be an important extension, modeling it would be unnecessarily complex and would probably only strengthen the results here.

[9] Since interest rates are nearly constant across the country and depreciation schedules are set at the federal level, variance in them over time will not affect our empirical results. Property taxes are incorporated in rents and thus do not differ between owners and renters. Maintenance costs are deferrable for owners and are incorporated into rents for renters and thus show up in our rent variance measure. Berkovec and Fullerton (1992) argue that taxes provide some risk sharing between homeowners and the government. We will control for tax regime changes over time in the estimation but do not want to unduly complicate the model.

Suppose rents follow a general AR(1) process with drift μ: $r_t = \mu + \rho\, r_{t-1} + \eta_t$, where $\rho \in [0,1]$ and η is distributed IID$(0,\sigma^2_r)$.[10] The resulting risk premium can be approximated by

(1) $\pi(C_r) \approx ½\, \alpha\, \sigma^2_r\, [(\delta+\rho\delta^2+\ldots+\rho^{N-2}\delta^{N-1})^2 + (\delta^2+\rho\delta^3+\ldots+\rho^{N-3}\delta^{N-1})^2 + \ldots + (\delta^{N-1})^2]$,

where α measures risk aversion.[11] To interpret this risk premium, note that the square brackets include N-1 terms in parentheses that correspond to the N-1 rent innovations η_1 to η_{N-1} and the later innovations are discounted more heavily. For instance, if the rent shocks are IID with $\rho=0$, then the risk premium is proportional to $[\delta^2 + \delta^4 + \ldots + \delta^{(N-1)2}]\, \sigma^2_r$. If the innovations are persistent, $\rho>0$, each innovation η_t continues to augment the risk premium in subsequent periods, in proportion to its persistence ρ. Thus the risk premium for renting, $\pi(C_r)$, is increasing in σ^2_r and in N.

The alternative to renting is to buy the house. The discounted cost of owning is $C_o = P_0 - \delta^N P_N$. While owning avoids the N-1 risks associated with renting, it adds the discounted house price risk associated with P_N, denoted by $\pi(Co)$. Although a general equilibrium analysis of house prices is beyond the scope of this paper, the house price would generally capitalize the associated rental payments and therefore $\pi(Co)$ would be an increasing function of the rent variance, σ^2_r and a decreasing function of N.

The *net* risk premium associated with renting, $\pi(C_r) - \pi(Co)$, therefore would be proportional to σ^2_r. The sign of this net premium determines whether renting is on balance riskier than owning. If the sign is positive, then renting is riskier and the hedging demand for owning will increase with σ^2_r, ceteris paribus. If the sign is negative, the demand for owning would decrease with σ^2_r. In either case, an increase in the household's holding period, N, would increase the

[10] We take the rent process as given, without modeling its underlying determinants, for example, shocks to demand for housing space. Analogous to term structure models of long versus short maturity bonds, the process for one period (short) rental rates is the input into the model.

demand for owning.[12] A longer holding period discounts the asset price risk of owning and increases the number of rent risks, making the net risk premium increasingly positive.

Importantly, the net risk premium is proportional to σ^2_r times an increasing function of N. That is, families with long horizons heavily discount asset price risk but are sensitive to rent shocks, so greater rent variance drives them towards owning. People with shorter horizons are more sensitive to asset price risk, which is just a function of rent risk, and exposed to fewer rent shocks, so the risk premia offset each other. This drives the net risk premium towards zero and, in some cases it can become negative. Thus the effect of increasing the holding period ($\uparrow$N) rises with σ^2_r, the magnitude of each rent risk; and the effect of larger rent risk ($\uparrow\sigma^2_r$) increases with the holding period.

For illustration, consider an economy with a horizon of N=3. Suppose that in equilibrium P_3 is determined such that households are indifferent between owning and renting, so that both owned and rented housing units are occupied. For this case one can show that the equilibrium price-to-rent differential

(2) $P_0 - r_0 =$

$$(\mu/(1-\delta) + r_0\rho)\delta/(1-\delta\rho) \quad + ½\, \alpha\, \sigma^2_r\, [(\delta+ \delta^2\rho)^2 + \delta^4 - \delta^6\, (1+\rho^2+\rho^4)/(1-\delta\rho)^2]/(1-\delta^3)\ .$$

To interpret this result consider again IID rent shocks, with ρ=0. Then (2) implies that

$P_0 - r_0 = \mu\delta/(1-\delta) + ½\, \alpha\, \sigma^2_r\, [(\delta^2 + \delta^4 - \delta^6)/(1-\delta^3)]$. The first term is the present value of the expected future rent payments, since $E_0 r_t = \mu$ in the IID case.[13] If the rent payments are

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[11] As usual the quantitative results for risk premia are in general based on local approximations, but for exponential preferences they hold exactly.

[12] It also depends upon the relative variances of rents and prices. Price variance being greater than rent variance makes the net risk premium more likely to be negative. The ratio of σ^2_p to σ^2_r is increasing in the persistence term, ρ, though not linearly.

[13] We assume a stationary equilibrium in which analogous conditions apply to the households buying the house in year 3. This is the source of the factor $1/(1-\delta^3)$. (We assumed that P_3 is determined when r_3 is observed at the start of period 3 in order to maintain this stationarity.)

deterministic (σ^2_r =0) or if households are risk neutral (α=0), then the house price P_0 reflects only these expected payments, as in Poterba (1984). But if rent is stochastic and households are risk-averse, the price also reflects the net risk premium, which is in the second term. The part in brackets includes the two premia for the two rent risks (r_1 and r_2) avoided by owning the house, appropriately discounted, minus one premium for the risk due to the stochastic terminal house price P_3. Because the rent shocks are IID, the house price risk is of the same magnitude as the rent risks, but comes further in the future and so is discounted more heavily. Therefore the rent risks dominate, and the net risk premium is necessarily positive. That is, risk averse households will bid up P_0 relative to r_0 because of the hedging benefit that the house provides against rent risk. If instead rent shocks are fully persistent, with ρ=1, then (2) implies that $P_0 - r_0 = (\mu/(1-\delta) + r_0)\delta/(1-\delta) + ½\, \alpha\, \sigma^2_r\, [\{(\delta+ \delta^2)^2 + \delta^4 - 3\delta^6/(1-\delta)^2\}/(1-\delta^3)]$. In the third term in the brackets the house price risk is now larger, reflecting the fact that all three rent shocks are now fully persistent and so affect the house price. The net risk premium can therefore be negative, unlike the IID case. For example, for patient households the terminal price risk is more likely to outweigh the earlier rent risks.

In our MSA-level rent data ρ is about 0.6-0.7. In this case, using a discount factor of 0.94,[14] the net risk premium in (2) is positive so long as the holding period is greater than 3 to 4 years. However, in this stylized model the absolute level of the net premium is not as interesting as the fact that it still rises with the holding period. Generalizing the model to an N-period horizon, the price-to-rent differential $P_0 - r_0$ increases with N. In a more realistic setting with households with different horizons, given the supply of housing, prices would be determined by households of a particular holding period. For households with a longer holding period than this, owning provides

[14] This is consistent with a real mortgage rate of about 6%.

insurance against an even larger number of rent risks. Hence the hedging benefit of housing should still rise with the holding period in our micro data, even with endogenous house prices.

How a higher demand for homeowning as a hedge against rent risk is manifested depends on the elasticity of supply of owner-occupied housing. If the supply is very elastic, an increase in demand for owning units rather than renting them will result in a larger supply of units to be owned without much change in price.[15] The homeownership rate will rise. On the other hand, if the supply of units to be owned is inelastic, the increase in demand will be capitalized into higher house prices until families are indifferent between owning and renting again. In that case, we would observe an increase in house prices but not the homeownership rate. The most likely outcome is that we would find some effect on the homeownership rate and some effect on house prices, so we will empirically estimate the effect of rent risk σ^2_r on both.

Although the model presented in this section is stylized, its implications are quite general. Among the advantages and disadvantages of owning a home, one potentially important but previously neglected advantage is the hedge that it provides against rent risk. The model provides several empirical predictions. First, the demand for homeowning should increase in N and increase most in the interaction of N and σ^2_r. Second, for people with lengths of stay above some threshold, the demand for homeowning should increase in σ^2_r and for people with very short lengths of stay, the demand for homeowning may decrease in σ^2_r. We empirically test these predictions using the probability of homeownership and the price-to-rent ratio in the remainder of this paper.

II. Data and variable construction

[15] The supply of owner-occupied houses in this context could be quite elastic even if land is inelastically supplied. The insurance benefit of homeownership should only affect how a family obtains their housing service flow – by purchasing the house or renting it – and not the quantity of housing they demand. Thus in a market where a high rent

To estimate the model described in section I, we need rent and house price data at the market level and individual level information on homeownership and demographic characteristics. To this end we combine four data sets.

For rent variance and growth rate, an index of median apartment rents by MSA was obtained from Reis, a commercial real estate information company.[16] The index runs annually from 1981 to 1998, with 47 MSAs observed consistently throughout the sample. Rents are converted to real dollars using the CPI excluding shelter. For the empirical work, we calculate a de-trended variance over a 10-year period. The growth rate is defined as the constant term from a regression of log rent on a constant. Rent variance is computed from the residuals from the growth regression, and is thus expressed as a percentage of the base rent. Both rent growth and variance are backwards-looking, computed over the preceding ten years. We use log rent to keep places with high rent levels from appearing to have an artificially high rent variance.

House price growth is computed in a similar manner for each MSA using the Freddie Mac repeat-sales house price index over the same time periods. To obtain the level of house prices in a given year, we inflate the MSA's median house price from the 1990 Census by the growth in the Freddie Mac index and convert to real dollars using the CPI excluding shelter. To estimate the effect of rent variance on house prices, we merge the rent and house price data sets by MSA, yielding 44 MSA-level observations per year.[17] Due to the lags required, we can compute rent variance only for the 1990-1998 period, giving us a total of 396 MSA-year observations when the data is pooled.

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variance induces more families to own, it is not necessary to develop new housing, merely convert rental into owner-occupied housing.

[16] Reis collects its data from surveys of owners of "Class A," or top-quality, apartment buildings in each MSA.

[17] Of the 47 MSAs with rent data, three do not have matching house price data.

On average, MSAs exhibit substantial rent variance, as can be seen in Table 1. Between 1990 and 1998, the mean (across and within MSAs) standard deviation of real rent was 2.9 percent. This variability dwarfed real rent growth– between 1989 and 1998 real rents grew only two-tenths of one percent on average. Real house price growth, as well, was approximately zero. Real house prices are about 50 percent more variable than real rents, averaging a 4.6 percent standard deviation over the 1990 to 1998 period. Homeowners typically pay nearly 16 times the MSA's annual median apartment rent for their houses, though this figure varies considerably across MSA's.[18]

Most of the means are fairly constant over time, exhibiting little difference between the 1990-1998 averages in the first panel and the values for 1998 alone in the second panel. This implies that much of the variation comes from the cross section of 44 MSAs rather than from changes over time. However, in 1998, the house price and rent variances were much closer together than they were earlier in the decade: the average standard deviation of real rent in 1998 was 2.3 percent and the standard deviation of real house prices was 2.9 percent.

Homeownership rates and individual-level data are obtained from the 1990 and 1999 Current Population Survey (CPS) March Annual Demographic Supplements. For each household, the CPS reports whether they own or rent their dwelling, the household's total income, and a number of demographic variables such as age, race, education, occupation, number of children, and marital status. In addition, we impute the probability of an individual's staying in the same house for another year as the proportion of people in that person's age-occupation-marital status cell, excluding the individual in question, who did not move in the previous year. The sample averages of the key variables are reported in table 2. In particular, 65 percent of persons in the CPS live in

[18] Part of the reason that owner-occupied housing commands such a large multiple to rent is that the median house price reflects a greater quantity of (equivalently, "nicer") house than the median apartment rent does. As long as the difference between the amount of housing in the median house and in the median apartment does not spuriously vary across MSAs in a way that is correlated with rent variance, it will not affect our estimation.

an owner-occupied house and 86 percent did not move in the last year. The market-level rent and house price data is matched to each CPS household based on their MSA of residence. MSA-level homeownership rates are computed by taking the average across all CPS households in an MSA. Across MSAs, rents have a standard deviation anywhere from 1.4 percent in Fort Lauderdale to 7.2 percent in Austin. The cross sectional variation in homeownership rate is enormous, especially considering the national average homeownership rate has changed only 2 percentage points in the last 20 years, from 65 to 67 percent. While 81 percent of people in Richmond own their house, only 33 percent of those in New York and 53 percent of those in San Jose do.

III. Empirical methodology and results

Our primary goal is to empirically test the hypothesis that homeowning provides a rent hedging mechanism, as outlined in section I. In addition, it will be interesting to know whether, on average, the risk of renting outweighs the asset price risk of owning. That is, is the net risk premium positive? One simple prediction of the model in section I is that people in markets with higher rent variance should be more likely to be homeowners since they place a greater value on the rent insurance benefit of homeownership. Testing that prediction would also provide an estimate of the sign of the risk premium for the average person. A stronger test of the rent hedging hypothesis is that "stayers," people who do not plan to move houses, should be more sensitive to the rent variance than "movers" so the difference in homeownership rates between stayers and movers should increase with rent variance. We will apply both tests in several contexts.

If owner-occupied residences were perfectly elastically supplied, people who live in markets with higher rent variance would simply be more likely to be owners and the homeownership rate would be higher in those MSAs. On the other hand, if owner-occupied houses are at all inelastically provided, at least some of the increase in demand for ownership will be capitalized into a higher price of housing rather than showing up in the homeownership rate. The insurance benefit of homeownership does not affect the underlying demand for space to live in and therefore should not affect the rental price of space. However, owners would be willing to pay a higher premium over the rental value to own the space rather than rent it in places with higher rent variance. Since we do not have strong prior beliefs about the elasticity of supply of owner-occupied housing, we investigate the effect of rent variance both on the homeownership decision and the price-to-rent multiple.

III.1 The effect of rent variance on homeownership

We begin by estimating the following probit model on individual level data from the 1999 CPS:

$$OWN_{ik} = b_0 + b_1 f(s_{r,k}) + b_2 g(P(STAYS))_i + b_3 f(s_{r,k}) \times g(P(STAYS))_i + qX_i + yZ_k + w_i + h_k + e_{ik} \qquad (2)$$

where *i* indexes the individual and *k* the MSA she lives in. "Own" is an indicator variable that takes the value of one if the person owns their house and zero otherwise. The standard deviation of rent in market *k* is denoted by $\sigma_{r,k}$ and is computed over the 1989-1998 period. P(stays) is the imputed probability that person *i* does not move in the next year. We impute the expected probability of staying as one minus the average probability of moving in the last year for other people in the same age, occupation, and marital status categories. Due to both the transactions costs of buying and selling a house and a less-discounted asset price risk of homeowning, low expected duration families are predicted to be less likely to be homeowners; thus β_2 should be positive. X_i is a vector of individual level controls from the CPS including log income, the log tax price, and dummy variables for race, education, occupation, 10-year age categories, and marital status.[19] MSA-level controls in the Z_k vector include the median apartment rent and median house price in 1998, and the average real rent and house price growth rates over the 1989-1998 period. Unobservable individual level characteristics are denoted by ω_i and MSA-level factors by η_k. Since we do not have strong priors about the functional form through which rent variance and mobility should enter the regression, we denote transformations of the standard deviation of rent with $f(\cdot)$ and of the probability of staying with $g(\cdot)$.

The simple prediction of the model, that the probability of homeowning should increase with the standard deviation of real rent, can be tested by restricting β_3 to be zero and seeing whether β_1 is positive. The most straightforward test is to compare whether the probability of homeowning for people in "high" rent variance locations exceeds that for people in "low" rent variance locations. We use a probit model to estimate that equation. Since a number of variables, including the standard deviation of rent, vary only across markets, we correct the standard errors to account for the correlated shocks within MSAs.

Indeed, people in high rent variance places are much more likely to be homeowners. The first column of table 3 reports the results when we define $f(\sigma_{r,k})$ to be an indicator variable that is equal to one when $\sigma_{r,k}$ is greater than 2.5 percent, the standard deviation of rents for the median unweighted MSA and for the 75th percentile if population weighted. People in such high rent variance locations are 6.3 percentage points more likely to own their own houses than people who live in MSAs with $\sigma_{r,k}$ below 2.5 percent.[20] With a standard error of 2.7, this effect is statistically distinguishable from zero. This result suggests that rent risk outweighs house price risk for a

[19] We can separately identify marital status, age, and occupation, from the probability of staying since it is imputed using the interaction of marital status, age, and occupation rather than the individual variables' levels.

person with the average expected length of stay in our data, which is just under 7 years (1/(1–0.85)).

People with long expected lengths of stay are also more likely to be homeowners. In column 1, g(P(STAY)) equals one for people in the top quartile of the imputed probability of staying and zero otherwise. The estimated coefficient implies that people with the longest horizons, or "stayers" are 5.1 percentage points more likely to own their own homes than "movers."[21]

While the results in column (1) are suggestive, they may not be a conclusive test of the hypothesis that hedging rent risk increases demand for homeownership. In particular, one might worry that MSA-level heterogeneity may lead to a spurious correlation between homeownership rates and rent variance. A stronger test can be obtained by utilizing our result that the rent hedging benefit of homeowning increases with the amount of time a family expects to stay in its house. Then one would expect to find that families with longer expected lengths-of-stay should be more sensitive to the rent variance when deciding whether to own or rent. In other words, the hedging value of homeowning for a family that expects to move after a year or two does not increase as much when the rent variance rises as does the value for a family that expects to remain in the house for a long time. Empirically, we should expect to see that the difference in the probability of homeowning between longer and shorter expected duration families should increase with the rent variance.

The interaction of the probability of staying and the standard deviation of rent tests the hypothesis that the sensitivity of homeownership to the rent variance should increase with expected

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[20] The average standard deviation of real rents is 3.8 percent for people in high rent variance places and just 1.4 percent for those in low rent variance places.
[21] The average probability of staying in the house for another year is 82 percent for people in the bottom three quartiles of the "staying" distribution and 96 percent for those in the top quartile.

stay. Thus a significantly positive value for β_3 will confirm the importance of the rent insurance value of homeowning. In addition, while unobservable MSA level characteristics may bias the estimated coefficient β_1 on the standard deviation of rent, β_3 still should be consistent since it depends only on the interaction of individual level characteristics with the MSA-level rent variance. Since we are in effect comparing the homeownership probabilities of high- and low-mobility families within MSA, in order to bias our result the MSA-level unobservable characteristics would need to affect the homeownership decision for high- and low-mobility families differentially in each MSA, and that differential impact would have to vary across MSAs in a way that happened to be correlated with the rent variance. We believe this to be unlikely.

Similarly, if unobservable individual level characteristics happen to be correlated with rent variance and the homeownership decision, our estimated coefficient on the standard deviation of rent could be biased. However, as long as those characteristics are constant within mobility groups across MSAs, the interaction of mobility and rent variance will be unaffected.

Returning to table 4, column 2 reports the results from estimating the full equation (1). The interaction term is set to one if the person lives in an MSA with a standard deviation of real rent above 2.5 percent (the top quartile of people) and is in the top quartile of the expected length of stay in the house. The estimate of β_3 is 0.048 (0.021), indicating that relative to the difference between "movers" and "stayers" in low rent variance places, "stayers" in high rent variance places are 4.8 percentage points more likely to own their houses than "movers" in the same places. In addition, even the lower expected duration families, who have an average imputed probability of staying of 82 percent, are 5.4 percentage points more likely to own their houses if they live in a high rent variance location. This result supports the hypothesis that the rent hedging aspect of homeowning increases the demand for homeownership.

Since our variable of interest is a combination individual/MSA-level effect, we can control for all possible observable and unobservable MSA characteristics and still identify β_3. In column 3, we include MSA dummies for that purpose, at the expense of not identifying purely MSA-level characteristics, such as the standard deviation of rent. The estimated coefficient on the mobility/rent variance interaction decreases in magnitude slightly and the statistical significance rises a bit, but there is no meaningful difference.[22]

The second panel of table 3 imposes a different functional form restriction on the standard deviation of rents and the probability of staying. Instead of using an indicator variable for whether the values were above a threshold, we include each linearly. The interaction term (β_3) is simply the interaction of the standard deviation of rent and the probability of staying and a positive estimated coefficient would indicate that the effect of rent risk on the probability of homeownership is greater for people with longer expected lengths of stay in the house than for those with short horizons. In column 5 of table 3, the estimated coefficient on the interaction term is 5.33 and, with a standard error of 2.65, is statistically significant at the 95 percent confidence level. The second-to-last row of table 3 translates the coefficient on the mobility/rent variance interaction term into a more economically meaningful number by multiplying by the standard deviation of the interaction term, 0.010, which we consider to be a measure of the exposure to rent risk. The estimates show that the rent insurance benefit of homeowning has a large effect on the homeownership rate; a one standard deviation increase in the interaction term from the mean would increase the probability of homeownership by 5.3 percentage points from a base of 65 percent. When we substitute MSA dummies for the MSA-level covariates in column 6, the estimated

[22] The number of MSAs available increases to 47 since one MSA for which we observed the rent series but not the house price series can now be included as the house price variables are subsumed by the MSA dummies.

magnitude of the coefficient on the interaction term declines slightly to 4.2 with a standard error of 2.1.

While the estimated coefficients on the linear standard deviation of rent term are not statistically different than zero in columns 4 and 5, they are consistent with the predictions of the model. In column 4, the coefficient on the standard deviation of real rent is positive, suggesting that on average the probability of homeownership increases with rent risk. In column 5, the coefficient on the standard deviation of rent is negative, indicating that for the shortest horizon people, the asset price risk in a more highly variable market outweighs the benefits of rent smoothing. However, given the positive coefficient on the interaction term, one only needs to expect to stay in the house for 2.4 years (1/(1–3.15/5.33)) before the rent smoothing benefit negates the asset price risk. Nearly 99 percent of our sample falls in that category.

III.2 Rent variance affects housing demand for the elderly

The value of homeownership as a rent hedge may provide a partial explanation for why homeownership rates are so high among the elderly. If older or retired households are more risk averse, they will value more highly the hedging benefit of owning and will be more likely to own. Counteracting that effect, however, is that the closer a homeowner is to the end of her life, the less hedging value she receives from homeowning. In other words, expected remaining lifespan is a good measure of the expected length of stay in the house, N. Thus we would expect to find that older people should generally be more likely to own, but the probability of owning should decline as they approach the end of their lifetimes.

While we would like to attribute a rising-then-falling life-cycle pattern of homeownership to the rent hedging value of owning, there are many other possible explanations. For example, low mobility among the elderly may explain their higher homeownership rates and declining health may cause them to be more likely to move out as they age further. However, the rent hedging hypothesis predicts that homeownership rates among the elderly should be highest in high rent variance places since the value of the rent hedge would be the largest there. In addition, the decline in the probability of homeownership should be steepest in high rent variance places since the hedging value there, based on $\sigma^2_r \times N$, is much more sensitive to the time until death. The life-cycle pattern of homeownership that is driven by other causes should not be affected by rent variance.

This exact difference in life-cycle patterns of homeownership can be seen in the unconditional homeownership rates by age. We pooled the 1990 and 1999 CPS cross-sections and divided our 44 MSAs into high- and low-variance markets depending upon whether they were above or below the median MSA unweighted rent variance of 2.5 percent, and computed the average unconditional homeownership rate by age in each type of market.[23] The result, smoothed for readability by averaging the homeownership rate across five adjacent ages, is presented in figure 1. In both high- and low-rent variance MSAs, 30-year-olds have the same homeownership rates, approximately 48 percent. However, by age 35, the homeownership rates start diverging, with higher rent variance markets having higher homeownership rates. This gap peaks for people in their mid 60s, with 66-year-olds exhibiting homeownership rates of 76 percent in low-variance places and 84 percent when rent variance is high. While the unconditional probability of homeownership declines with age starting in the late 60s, it falls fastest for people in high rent variance MSAs, matching the more rapid decline in the value of the rent hedge there. By the time people are in their late 70s, with presumably short expected remaining lifetimes, the

[23] The number of MSAs drops from 46 to 44 because two MSAs that are present in 1999 data are not available in 1990.

homeownership rate in high- and low-rent variance MSAs has converged to a 4 percentage point difference or less.

While figure 1 presents unconditional homeownership rates by age, we would like to control for other observable factors that may vary systematically by age or with rent variance. Estimating the homeownership rate by 10-year age categories in high- and low-variance markets and conditioning on a complete set of individual controls including income, year, MSA, race, education, occupation, and marital status yields age profiles that look very similar to those in figure 1. In this model, after correcting the standard errors for any correlation of the shocks within each of the MSAs, the hypothesis that the age profiles in the high- and low-variance MSAs are the same can be rejected at the 99 percent confidence level.

We test these hypotheses with a more parametric specification by estimating the following spline equation using a probit model:

$$\begin{aligned} OWN_{ik} = \gamma_0 + \gamma_1 AGE \times UNDER65_i + \gamma_2 OVER65_i + \gamma_3 AGE \times OVER65_i + \gamma_4 HIGH_k + \\ \gamma_5 UNDER65 \times AGE \times HIGH_{ik} + \gamma_6 OVER65 \times HIGH_{ik} + \gamma_7 OVER65 \times AGE \times HIGH_{ik} + \\ \theta X_i + \psi Z_k + \eta_k + \upsilon_{ik} \end{aligned} \quad (3)$$

where AGE is the age in years of individual *i*, UNDER65 is an indicator variable that takes the value of one if the person is under 65 years of age, OVER65 is an indicator variable that takes the value of one if the person is 65 years old or greater, and $HIGH_k$ is a dummy variable that equals one if MSA *k* has an above-the-median rent variance. This specification traces out the dashed line in figure one with γ_0 to γ_3. The terms that are interacted with the high rent variance dummy measure the difference in slope between the solid, high rent variance, and the dashed, low rent variance, lines in figure 1. The hypothesis that older families are more sensitive to rent variance is tested by the OVER65xHIGH interaction, and OVER65xAGExHIGH tests whether the age-ownership profile is more steeply declining in high variance places. The equation is estimated on a sample that pools the 1990 and 1999 CPS cross sections and the rent variance for each MSA is estimated over the previous nine years.[24] Once again, detailed individual controls are included for income, year, MSA, race, education, occupation, and marital status, and the standard errors are corrected for any correlation of the shocks within each of the 44 MSAs.

The results, in the first column of table 4, bear out the predictions of the rent insurance hypothesis. As a baseline, in MSAs with below-median rent variance the homeownership rate for people aged below 65 increases at a rate of 1 percent per year. Supporting our hypothesis, homeownership among older households is sensitive to the rent variance. In high rent variance MSAs, people aged 65 are 7.4 percentage points more likely to be homeowners than people of the same age in low rent variance places.[25]

True to our predictions, elderly homeownership declines more rapidly with age in high rent variance places. Relative to people over 65 in low rent variance places, the probability of homeownership for people over 65 in high rent variance MSAs falls 0.30 percent (0.15) more per year of age. This is a considerable difference because, controlling for other covariates, the probability of homeownership for people over 65 in low rent variance places is basically flat over their remaining lifetimes.[26]

These results are robust to specification changes. The second column of table 4 summarizes the results for a specification where the age profile of homeownership is quadratic in age and allows that profile to be different in high- and low-variance places. Again, older people in

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[24] 1990 is our earliest available year of data and 1999 is the most recent when we maximize the amount of time between observations and the potential variation in rent variance. Since the rent variance for 1990 is estimated over the 1981-1989 time period and the 1999 rent variance is computed from 1990-1998, there is no overlap in our rent variance sample when we combine 1990 and 1999.

[25] The coefficient on the "High variance MSA" variable is not well-identified since differences across MSAs in rent variance are picked up primarily by the MSA dummies. Some MSAs move from above to below the median rent variance (and vice versa) between 1990 and 1999 so we can technically estimate an effect, but it is reassuring that the estimated coefficient is insignificantly different from zero.

high variance places have a higher overall probability of homeownership but a steeper decline with age, with the differences being statistically significant at conventional levels. We have also replaced the "over 65" indicator with a CPS measure of retirement, with similar qualitative results.

III.3 The effect of rent variance on house prices

The model in section I predicts that families should be willing to pay an premium to own a dwelling rather than rent it and that premium should be increasing in the variance of rent. In the previous subsections, we found evidence that some of the hediging demand for ownership was met by increasing the supply of owner-occupied housing and thus increasing the homeownership rate. In this subsection we look for direct evidence in house prices. We estimate the following OLS equation:

$$\frac{P_{kt}}{R_{kt}} = d_0 + d_1 s_{r,kt} + y Z_{kt} + g_t + m_k, \qquad (4)$$

where P/R is the price-to-rent multiple in MSA k in year t, $\sigma_{r,kt}$ is the standard deviation of rent, and Z_{kt} is a vector of observable MSA characteristics, namely the real rent growth rate. Just as a price-earnings multiple for stocks should be higher for companies with higher expected future earnings growth, P/R should be higher for cities with higher expected future rent growth. Since R_{kt} captures the effect of overall demand for living space, the rent hedging value of ownership should show up as a higher multiple of rents. That is, using the ratio of prices to rents controls for shocks to the overall housing market, which impact both owner-occupied housing and rental housing. Controlling for the growth rate of rent, the price-rent multiple then will include the risk premia

[26] For people aged 65 or higher in below-median rent variance MSAs, the probability of homeownership falls 1 percent every one hundred years.

associated with rent variance. Differences over time that are common to all MSAs are controlled for using year dummies, γ_t.

We begin by estimating this model on a panel of 44 MSAs observed over the 1990-1998 time period. We calculate real rent variance and growth over the prior nine-year period, so 1990 (with $\sigma_{r,k}$ and rent growth calculated over 1981-1989) is our earliest available year and 1998 (with $\sigma_{r,k}$ and rent growth calculated over 1990-1997) is the latest.

We find consistent evidence that the rent hedging benefit of owner-occupied housing is capitalized into the price-to-rent multiple. The first column of table 5 presents the results from the pooled cross section. Places with a higher standard deviation of rent have a significantly greater price-to-rent multiple, with the estimated coefficient on δ_1 being 31.5 (12.4). The last row of table 5 provides some insight into the economic significant of this result – a one standard deviation increase in $\sigma_{r,kt}$, 0.017, is estimated to increase the price-to-rent ratio by 0.52. Since the mean price-to-rent ratio is 15.7, this amounts to a 3.3 percent rise in house prices for a given rent. As expected, real rent growth is capitalized into the price-to-rent multiple. The estimated coefficient of 46.3 implies that a one standard deviation increase in rent growth (0.02) would cause the multiple to be 0.93 higher.

We next incorporate MSA fixed effects to control for MSA level observable and unobservable characteristics that do not change over time. Since we also have year dummies controlling for factors that may affect both the rent variance and house price multiple over time, we are using the within-MSA variation in rent variance, rent growth, and the price-to-rent ratio over time to identify the rent insurance effect. Rent variance changes within MSA over time as the window over which we compute it moves. If MSA-level heterogeneity is driving our previous results, adding the MSA dummies should correct the problem. However, doing so removes a potentially powerful source of variation in rent variance – differences across MSAs.[27]

Even controlling for MSA and year fixed effects, in column 2 we find that when rent variance in a given MSA is higher, the price-to-rent ratio is higher. The estimated coefficient on the standard deviation of rent, 9.9 (4.9), indicates that a one standard deviation increase in $\sigma_{r,kt}$ leads to a 0.17 increase in the price-to-rent multiple. While economically smaller than the previous result, it accounts for a 1.1 percent increase in house prices for a given rent level and is statistically significant. When one considers that this result applies to changes for a given MSA rather than differences across MSAs, the magnitude of the effect seems to be reasonable.[28] Rent growth, too, continues to have the expected positive effect when MSA and year dummies are included, with an estimated coefficient of 11.04 (3.42). In column 3, we account for MSA level heterogeneity by estimating equation (4) in first-differences. This specification emphasizes the new information in the rent variance – the difference between one year's value and the previous one is due to adding a more recent year of data and discarding the oldest one. The results are almost identical, although more precisely measured, to the fixed-effects specification, with an estimated coefficient on the standard deviation of rent of 8.37 (3.17).

III.4. What are some determinants of cross-MSA differences in rent variance?

To this point, we have assumed that MSAs are endowed with their underlying rent variances. Our prior belief is that fluctuations in rents are determined by movements in the demand

[27] Note that one would not find much by looking at changes in the probability of homeowning within MSAs over time since homeownership and housing construction is slow to respond to changes in rent variance. However, we expect that prices adjust easily, so news about expected rent variance should be quickly incorporated into prices and thus detectable in the data.

[28] In any case, it jibes with our expectation that changing the mix of owned and rented housing stock is fairly elastic given that the overall quantity of housing stock does not need to change when the rent variance does.

for living space, presumably caused by local economic growth, combined with the elasticity of supply of housing. We expect MSAs with volatile housing demand to have more rent variance. MSAs with more inelastic housing supply should also exhibit higher rent variance as the housing or apartment stock is less able to adjust to demand fluctuations. In this subsection, we try to find some empirical evidence on which underlying factors affect rent variance. Due to the nature of this exercise, however, the regressions will largely be descriptive in nature. In other words, we will be looking for MSA-level factors that presumably do not change over time that affect MSA rent variance. That limits us to trying to find empirical effects in a cross section of a few dozen MSAs, with all the accompanying problems due to noisy data, a small sample, and our inability to control for heterogeneity in a cross-section.

With that caveat, we turn to table 6, where we regress the de-trended standard deviation of rents in an MSA on a proxy for the volatility of demand for space and proxies for the elasticity of housing supply. The demand proxy is the de-trended standard deviation in the MSA's aggregate employment, constructed in a parallel manner to the rent variance. We proxy for the inelasticity of supply of living space with two variables from Mayer and Somerville (2000), whether the MSA charges impact fees to developers and the number of months it takes to obtain a building permit. The former adds a transaction cost to building so that developers would wait for a larger increase in rents before adding more housing stock. The latter reduces the speed in which developers can respond to demand shocks and adds uncertainty to the development process, which is another transaction cost.

Variation in demand for space has a strong effect on rent variance. In the first column, we include only the standard deviation of MSA employment on the right-hand-side. This leaves us with our full sample of 43 MSAs in 1998. The coefficient on employment volatility is positive and significant, with a coefficient of 0.52 (0.17) and the regression has an R-squared on 0.19. Thus an MSA with a one standard deviation higher standard deviation of employment (0.008 on a mean of 0.019) has a one-half standard deviation higher standard deviation of rent.

Our proxies for whether supply is inelastic in the MSA also appear to have an effect. In column two, we use the indicator variable for whether the MSA charges impact fees and the time-to-obtain-permit variable as covariates. Our sample size falls to 38 since the supply elasticity variables are not available for all MSAs in our sample. The impact fee dummy has a strong and statistically significant impact on rent variance with an estimated coefficient of 0.0084 (0.0026). Presumably, our impact fee variable proxies for other deterrents to development in the market. The estimated coefficient on the length of time to obtain a development permit variable has the expected positive sign, 0.00069 (0.00036), and is significant at the 93 percent confidence level.

In column 3, we show that both the demand- and supply-side factors have an effect on rent variance in the MSA by including all three covariates. The point estimate on the standard deviation of employment changes only slightly, falling to 0.42 (0.18). The impact fee dummy remains statistically significant: its estimated coefficient of 0.0061 (0.0027) implies that rent variance is about 30 percent higher than the mean of 0.020 in markets where impact fees are charged. The coefficient on the development permit variable falls in magnitude to 0.00040, reducing its t-statistic of just over one so it is not statistically distinguishable from zero. This outcome is not surprising, given the measurement error in the variable and our limited number of observations. The R-squared increases to 0.38, suggesting that we are able to account for a substantial portion of the variation across MSAs in rent variance with this small set of explanatory variables.[29]

[29] One may be tempted to instrument for rent variance with employment variance, especially since in a regression of rent variance on employment variance, MSA dummies, and year dummies on 43 MSAs over the 1989-1998 period produces a statistically significant coefficient on employment variance of 0.17 (0.06) and an R-squared of 0.62. However, while employment variance explains rent variance, it probably is not orthogonal to the rent/own decision. In

While the regression in column three suggests that both demand variance and supply inelasticity contribute to rent variance in a market, one might expect that both factors must work in concert to create high rent variance. In other words, demand fluctuations may be innocuous if housing supply can easily adjust and inelasticity of supply would be moot if demand were not volatile. We provide a crude test of that hypothesis in column 4 by interacting the impact fee dummy variable with the employment variance variable. Indeed, only the interaction term matters in that regression, showing that the standard deviation of employment affects rent variance only in markets with impact fees. The point estimate of 0.63 (0.35) is significant at the 90 percent confidence level.

IV. Conclusion

One frequently overlooked but potentially important benefit to homeownership is avoiding the uncertainty of renting. We examine one aspect of the risk of renting – the unpredictability of rental costs. Homeowning, with few out-of-pocket carrying costs and homeowner-determined maintenance costs, provides a predictable way of paying for housing services. With renting, the annual cost of obtaining housing is uncertain. However, homeowners face asset risk while renters do not. Thus while homeownership is a hedge against rent risk, its value is tempered by the asset price risk.

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particular, given the transactions costs of ownership, uncertainty about income probably discourages people from homeownership. [Cocco (2000), Haurin (1991)] In our regressions, excluding employment variance from the set of covariates would cause us to *under*estimate the effect of rent variance on homeownership since our primary effect of higher rent variance causing people to be more likely to desire to be homeowners would be partially offset by people with higher income variance wanting homeownership less. Indeed, the estimated coefficients on the rent variance and standard deviation of rent interacted with mobility variables increase in magnitude slightly when we add the standard deviation of MSA employment on the right-hand-side. However, when we include individual covariates, the MSA employment volatility variable is not itself statistically different from zero. One reason that omitting this variable has such a limited impact on our baseline results is that we examine the difference in homeownership rates between two groups that have different sensitivities to rent variance. Thus the overall level of employment variance in the MSA is subsumed by the MSA fixed effects.

We show in a simple model that the demand for homeownership should increase in rent variance, especially for people who expect to stay in their houses a long time so the asset price risk is more discounted. We also show that except for people with very short expected lengths of stay in their houses, the rent risk dominates the asset price risk. Risk-averse people should be willing to pay a premium over the capitalized rental value for a house to own it rather than rent it solely to avoid uncertainty about the total cost of homeownership over their expected stay in the residence. Thus, to the degree that the insurance benefit is capitalized into house prices, the price-to-rent multiple should be higher in places with higher rent variance and, to the degree that the supply of owned housing is elastic, the probability of homeowning should also rise with the variance of rent. The model also implies that the insurance value of homeownership increases with expected duration.

We use these results to motivate an empirical investigation into the effect of rent variance on the probability of homeowning and on house prices. We control for MSA-level heterogeneity and other factors by comparing groups that should be differentially affected by rent variance because of different expected durations in their homes. We find that on average, people in above-median rent variance MSAs are 6.3 percentage points more likely to own their own houses and that effect is significantly greater for long expected length of stay families than for more mobile ones. A one standard deviation increase in the exposure to rent variance (mobility interacted with the variance of rent) would lead to a 4.2 to 5.3 percentage point increase in the homeownership rate. Older households are particularly sensitive to rent risk, with people aged 65 residing in places with above-median rent variance 7.4 percentage points more likely to be homeowners than people of the same age in low rent variance MSAs, conditional on observable individual characteristics and controlling for MSA fixed effects. Confirming that this effect is due to the rent hedging value of homeowning, the probability of homeownership drops most rapidly with age for elderly who live in high rent variance places, consistent with their hedging value declining with their remaining lifetimes. Finally, we find evidence that some of the hedging benefit of homeowning shows up in the multiple of rents people are willing to pay for houses. Even controlling for MSA-level fixed effects, we find that when MSAs have higher rent variance their house prices increase relative to the rental value of the housing stock.

These results have a number of implications for housing markets and other areas where housing wealth is important. The rent hedging benefit of homeownership appears to be a significant factor in the demand for homeownership. For comparison, a typical cross-section estimate of the user cost elasticity of homeowning would imply that a one standard deviation increase in user cost would lead to about a 2.5 percentage point rise in the homeownership rate, less than half the effect of moving from the bottom three quartiles to a top quartile MSA in terms of rent variance.

For older households, the rent insurance aspect of homeowning may help explain why the elderly usually do not become renters and, when they do, it is very late in life. [Venti and Wise (2000); Megbolugbe *et al* (1997)] Because they value hedging rent risk so highly, it is more costly for them to become renters than previous analyses have assumed. This effect also implies that one should not simply assume that all housing wealth of the elderly is available for consumption. In the absence of viable reverse mortgage markets that let elderly consume their housing wealth, the insurance benefit of homeowning may keep many elderly from selling their housing asset.[30] Those elderly that would be most likely to sell are ironically those that live in the highest rent variance places, though they would not sell until late in life.

[30] We presume that the transactions costs involved in moving to a smaller owned unit make such a transition not worthwhile for most elderly.

The results suggest some interesting avenues for future research. In our model, people own houses to avoid uncertainty about total housing costs. Presumably, they would need to less liquid saving to buffer those costs than if they were renting the same unit. Also, if one extends the model to encompass imperfect capital markets, so people own houses to smooth their housing costs over time, one should see that homeowners actually enjoy less variable consumption than renters. In addition, one should see that homeowners whose incomes covary positively with rents should be more likely to rent than own in order to better smooth non-housing consumption.

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Table 1: Summary statistics for MSA-level data

	1990-1998		1998 only	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Standard deviation of real rent	0.029	0.017	0.023	0.012
Standard deviation of real house price	0.046	0.031	0.028	0.016
Price-to-rent ratio	15.72	4.08	15.52	3.57
Real rent growth	0.001	0.019	0.002	0.013
Real house price growth	0.006	0.031	-0.001	0.021
Average real rent	6,331	1,505	6,748	1,607
Median real house price	102,773	49,841	107,527	48,415
Number of observations	396		44	

Notes: The first panel reports the average for all MSAs over the 1990-1998 time period. The second panel reports the average across the 44 MSAs in 1998 only. The standard deviation of rent, rent growth, and house price growth are all computed over the preceding ten years. The rent data are obtained from Reis. House price growth is computed from the Freddie Mac repeat sales house price index. To compute house prices, the MSA median house price from the 1990 Census is inflated to the current year using the Freddie Mac index. All dollar values are in real (1990) dollars, deflated by the CPI less shelter.

Table 2: Summary statistics for CPS data (1999)

	Mean	Standard deviation
Proportion owning	0.652	0.476
Proportion not moving	0.855	0.352
Imputed probability of not moving		
…entire sample	0.852	0.106
…if in the bottom 75 percent of the "not moving" distribution	0.816	0.099
…if in the top 25 percent of the "not moving" distribution	0.958	0.014
Standard deviation of real rent		
…entire sample	0.019	0.012
…if in the bottom 75 percent of the rent variance distribution	0.014	0.006
…if in the top 25 percent of the rent variance distribution	0.038	0.074
Standard deviation of real house price	0.029	0.017
Probability of not moving x standard deviation of real rent	0.016	0.010

Notes: Number of observations is 35,221. The standard deviation of rent is computed over the 1989-1998 time period. The rent data are obtained from Reis. Moving is defined as having moved in the last year.

Table 3: Greater rent variance yields an increase in homeownership

	(1)	(2)	(3)	(4)	(5)	(6)
	Indicator variables for high rent variance and high probability of staying			Continuous variables		
Standard deviation of real rent (σ_r)	0.063 (0.027)	0.054 (0.026)		1.291 (1.340)	-3.153 (2.442)	
Probability of staying (N)	0.051 (0.013)	0.041 (0.014)	0.044 (0.011)	0.632 (0.064)	0.527 (0.081)	-0.538 (0.071)
Staying x standard deviation of real rent ($\sigma_r \times N$)		0.048 (0.021)	0.040 (0.016)		5.330 (2.650)	4.202 (2.087)
MSA controls	Yes	Yes	No	Yes	Yes	No
MSA dummies	No	No	Yes	No	No	Yes
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	34,657	34,657	35,221	34,657	34,657	35,221
Pseudo R-squared	0.2172	0.2174	0.2317	0.2181	0.2183	0.2338
A one standard deviation in staying x σ_r leads to…					0.053	0.042
A one standard deviation in σ_r leads to…				0.015	0.015	

Notes: Estimated coefficients are marginal effects from probit regressions estimated on data for 1998. For specifications that do not include MSA dummies, the standard errors are adjusted for potential non-independence in the errors within MSAs. Dependent variable takes the value of one if family is a homeowner. MSA controls include median real rent, median real house price, real rent growth, and real house price growth. Individual controls include dummies for occupation, age, race, education, marital status, and controls for log income and log tax price. MSAs are deemed to have high rent variance if σ_r is above 2.5 percent. High probability of staying is high if it is 94 percent or above. Both correspond to the top quartile. All dollar values are in real (1990) dollars, deflated by the CPI less shelter. Number of MSAs equals 47 in regressions (3) and (6), 46 otherwise.

Table 4: Rent Insurance Makes Elderly More Likely to Own

	Spline	Quadratic
Age if under 65	0.0101 (0.0003)	
Aged 65+	0.403 (0.006)	
Age if over 65	-0.0001 (0.0010)	
High variance (σ_r above median MSA)	-0.015 (0.018)	-0.065 (0.039)
Age if under 65 $\times$ High variance	0.0009 (0.0004)	
Aged 65+ $\times$ High variance	0.074 (0.023)	
Age if over 65 $\times$ High variance	-0.0030 (0.0015)	
Age		0.023 (0.001)
Age $\times$ High variance		0.0034 (0.0016)
Age^2		-0.143 (0.010)
$Age^2 \times$ High variance		-0.030 (0.015)
MSA dummies:	Yes	Yes
Individual controls:	Yes	Yes
R-squared	0.2254	0.2259

Notes: Estimated coefficients are marginal effects from probit regressions. The dependent variable is an indicator that takes the value of one if the individual is a homeowner. These regressions pool the 1990 and 1999 data, for a total of 65,520 observations. Controls that are included in the regressions but are not reported here are log income and dummies for year, 44 MSAs, race, education, occupation, and marital status. MSAs are deemed to have high rent variance if σ_r is above 2.5 percent.

Table 5: Greater rent variance yields a higher price-to-rent multiple

	(1)	(2)	(3)
Standard deviation of real rent (σ_r)	31.52 (12.40)	9.93 (4.89)	8.37 (3.17)
Real rent growth	46.27 (11.46)	11.04 (3.42)	13.16 (4.22)
Constant	14.71 (0.67)	13.68 (0.37)	0.15 (0.08)
Controls for MSA fixed effects?	No	MSA dummies	First differences
Number of observations	396	396	352
R-squared	0.03	0.95	0.15
A one standard deviation increase in standard deviation of rent leads to…	0.52 (0.21)	0.17 (0.08)	0.14 (0.05)

Notes: Standard errors in parentheses. Dependent variable is the price-to-rent ratio. Number of observations equals 44 MSAs per year over the 1990-1998 time period. All specifications include year dummies. The most recent year used in the computation of the standard deviation of real rent and real rent growth is one year prior to the P/R observation on the left-hand-side of the regression.

Table 6: Some Factors That Affect Rent Variance

	(1)	(2)	(3)	(4)
Standard deviation of MSA employment	0.52 (0.17)		0.42 (0.18)	0.08 (0.29)
Dummy - Use Impact Fees		0.0084 (0.0026)	0.0061 (0.0027)	-0.0061 (0.0068)
Months for permit, >50 Units		0.00069 (0.00036)	0.00040 (0.00037)	
SD employment X use impact fees				0.63 (0.35)
Constant	0.010 (0.003)	0.011 (0.003)	0.011 (0.003)	0.014 (0.005)
R-squared	0.19	0.29	0.38	0.41
Observations	43	38	37	38

Notes: Dependent variable is the de-trended standard deviation of real rents, as defined in the text. Standard errors in parentheses. Sample year is 1998.

Figure 1: Unconditional age profile of homeownership, by rent variance