

**Liquidity constraints and housing prices:
Theory and evidence from the VA Mortgage Program**

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Abstract

This paper employs a simple intertemporal model to show that presence of liquidity constraints can depress the price of a durable good below its net present rental value, regardless of the overall supply elasticity. The existence of price effects implies that the relaxation of liquidity constraints is not Pareto improving, and may in fact be regressive. Historical evidence, which exploits the fact that a clearly identifiable group, war veterans, enjoyed the most favored access to mortgage credit in the postwar era, supports the model. The results suggest that more recent mortgage market innovations have served primarily to increase prices rather than home ownership rates. (JEL D91; E21; G21; R21)

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Over the past twenty years, liquidity constraints have been the subject of considerable amounts of both theoretical and empirical economic research. Macroeconomists have studied whether borrowing constraints can explain the departure of consumption behavior from the predictions of the life-cycle and permanent income hypotheses (Hall and Mishkin, 1982; Hayashi, 1985; Japelli, 1990; Zeldes, 1989; see Deaton 1992 for a thorough review). Housing economists have examined the role of liquidity constraints in household tenure decisions (Duca and Rosenthal 1994; Gyourko et al. 1999; Haurin et al. 1997; Linneman et al. 1997; Linneman and Wachter 1989; Listokin et al. 2001; Rosenthal, 2002; Zorn 1989). In principle, borrowing constraints could affect consumers' decisions to purchase other durable goods, such as automobiles and appliances. Generally speaking, these strands of literature both conclude that a significant fraction of the population behaves as though it is liquidity constrained. A frequently drawn implication of these results is that the relaxation of borrowing constraints, by allowing consumers to more closely achieve their optimal lifetime consumption profile, benefits some consumers without harming any.

A few noteworthy theoretical studies have considered the possibility that liquidity constraints influence the equilibrium prices of housing and other durable goods (Ranney 1981; Stein 1995; Ortalo-Magne and Rady 2002). This paper presents a simple intertemporal model generalizing these earlier results, allowing flexible housing supply and fully incorporating a rental market. The model also resembles those used in the theoretical literature on housing tenure choice, with the additional feature of endogenous housing prices (Artle and Varaiya, 1978; Brueckner, 1986; Henderson and Ioannides, 1983). In this model, liquidity constraints depress the equilibrium price of housing by forcing the marginal purchasing household to deviate from its optimal consumption path. Constraints depress purchase prices below the present value of rents *even when the supply of housing*

is perfectly elastic.

This study also presents the first empirical evidence documenting the strength of the relationship between liquidity constraints and housing prices, a relationship neglected by most existing analyses of variation in housing price levels (Hendershott, 1987; Mankiw and Weil, 1989; Engelhardt and Poterba 1991; Poterba 1991). The empirical test analyzes the impact of the Veterans Administration (VA) mortgage program, established by the Servicemen's Readjustment Act (GI Bill) of 1944.¹ This legislation selectively relaxed borrowing constraints for a clearly identifiable group, veterans of World War II and later conflicts. Prior to the implementation of the VA mortgage program, veterans were neither more nor less likely to own a home than other citizens with similar observed characteristics.

The results suggest that the GI bill raised the probability of home ownership for eligible veterans by 8 to 13 percentage points. In the process, relatively expensive housing markets with a high density of eligible veterans witnessed a significant increase in owner-occupied housing values relative to rental prices. The net impact of the VA mortgage program on housing prices depends on the severity of liquidity constraints in the population. The results suggest that relative to a market where the marginal consumer barely avoided borrowing constraints, extending VA-type benefits to an additional 10% of households in a market where rents are 10% higher increases housing values by roughly 6%.

Both the model and empirical results point to the conclusion that any relaxation of liquidity constraints involves a tradeoff between equity and efficiency. In the model, easier access to credit

¹ For other empirical papers analyzing the impact of the GI Bill, see Angrist (1993), Angrist and Krueger (1994), Behrman et al. (1989) Bound and Turner (2002), O'Neill (1977) Stanley (1999).

harms those households who are net purchasers of housing. Net purchasers, in turn, are most likely to be those with a low ratio of income to wealth. In theory, transfer payments could compensate these harmed households while still leaving newly unconstrained households better off. Nonetheless, it is important to note that the relaxation of borrowing constraints is an improvement by the Hicks-Kaldor definition but not the Pareto definition.

Section I provides some rudimentary empirical evidence to motivate this study. Section II presents and discusses the intertemporal model. Section III describes the empirical tests and their results. Section IV concludes.

I. Motivating evidence: housing prices, the mortgage market, and home ownership

While consumers may choose to either rent or own a wide range of consumer goods, including automobiles, furniture, and appliances, housing tenure decisions have received the greatest amount of attention from both policymakers and researchers. This can be attributed to several factors. Housing expenditures represent a significant share of household budgets, and consumption of housing services is nearly universal. Some research has shown that housing tenure decisions have important nonmarket implications for child and family development (Boehm and Schlottmann, 1997; Green and White 1997) and citizenship (DiPasquale and Glaeser 1997; see Rohe et al. 2002 for a literature review). Home ownership is frequently touted as an important determinant of household wealth accumulation, which may be true if households are myopic and utilize contributions to home equity as a commitment device (Laibson 1997). Finally, the academic interest in tenure decisions frequently feeds upon policies that affect the costs and benefits of home ownership, including the tax treatment of mortgage interest payments and other incentives (Engelhardt, 1997; Follain et al.

1987; Poterba, 1992; Poterba 1984; see Hendershott and White 2000 for a literature review).

The twentieth century witnessed a profound change in home ownership patterns.² As Table 1 indicates, between 1940 and 1960 the national home ownership rate increased by nearly 50%. In subsequent decades, Census data reveals that ownership rates have continued to increase, but at a much slower rate. Table 1 also shows that this marked increase in home ownership was accompanied by a substantial increase in the price of the typical owner occupied housing unit, relative to the cost of the typical rental unit. In 1940, the median owner-occupied housing unit was worth roughly 140 times median monthly rent. By 1960, this ratio had increased to at least 180.³ The ratio has remained at or above this general level since, with some evidence of further increases in recent decades.⁴

This escalation, while impressive, may reflect changes in the physical characteristics of owner- and renter-occupied units over time. A measure of constant-quality owner-occupied housing prices can be obtained from the National Income and Product Accounts beginning in 1929. Figure 1 plots this price index, converted to a logarithmic scale, along with the corresponding price index for all personal consumption expenditures. Both indices have been normalized to a value of zero in 1947. This graph shows that over the postwar period, constant-quality housing values have tracked overall price levels fairly closely, with two noteworthy exceptions. Housing prices

² See Collins and Margo (2001) and Masnick (2001) for analysis of home ownership patterns in the U.S. across the twentieth century.

³ It is not possible to pinpoint the exact ratio after 1940 because housing value data are intervalled.

⁴ The sample of owner-occupied units used to construct these statistics consists of nonfarm, non-condominium occupied single family units with no commercial uses, on lots of less than ten acres. In 1940, it is not possible to distinguish multifamily units or units with commercial units, however respondents were instructed in that year to omit the value of units they did not occupy or commercial space when providing their estimate of market value.

accelerated above inflation in the immediate postwar era and remained relatively higher than the prices of other consumer goods until the mid-1970s.⁵ This pattern corroborates the acceleration of owner-occupied housing values displayed in Table 1. Beginning in 1982, housing prices began another period of acceleration.⁶ This acceleration has persisted to the present day.

A number of factors can influence the level of housing prices relative to rents (Poterba 1984). The time series plotted in Figure 1 provide evidence against one such factor: the favorable tax treatment of owner-occupied housing.⁷ Housing prices tracked consumer prices closely during the 1970s, a period of “bracket creep” that tended to push marginal tax rates higher for many households. Housing price acceleration occurred through the 1980s, a period of shrinking marginal tax rates. The two periods of housing price escalation do, however, coincide with major relaxations in borrowing constraints. Table 2 presents a timeline of major events in the modern history of the mortgage market (Jackson, 1985; Bruskin et al. 2000; Listokin et al. 2001; Martinez 2000).

A. World War II-era relaxations in borrowing constraints

At the onset of the Great Depression, when the time series graph in Figure 1 begins, families interested in purchasing a home generally were expected to make a down payment of at least 30% of the home’s value. The loan they received would not be fully amortized, requiring a balloon

⁵ Figure 1 also shows that the price of owner-occupied housing fell relative to the price of other consumer goods during World War II. This may reflect the wartime rationing of goods other than owner-occupied housing.

⁶ Interestingly, these time series indicate that the period of rapid home price acceleration in the 1970s, analyzed by Mankiw and Weil (1989) and many subsequent researchers, can be viewed as a simple manifestation of overall price level increases or increases in housing unit quality over the same time period.

⁷ Mortgage interest has been deductible since the imposition of income taxes in 1913 (Bourassa and Grigsby 2000).

payment (or refinancing) after five to ten years. During the depression, a large number of households defaulted on their mortgage payments, leading to foreclosure in many cases. Over an eleven-year period beginning in 1933, government innovations, including the creation of the Federal Housing Administration (FHA) and Veterans' Administration (VA) mortgage insurance programs, and the establishment of a secondary market for mortgage debt, radically changed the nature of the mortgage market. By 1944, it was possible for many households to receive a fully amortized, twenty to thirty-year mortgage with down payments of 10% or less. The VA mortgage program was the most generous of those introduced during this time period, since it enabled eligible veterans to purchase a home with no down payment whatsoever and no mortgage insurance premium. As with the FHA program, the Federal government insured lenders against default risk.

The impact of these innovations on home ownership rates and housing prices was somewhat delayed by depression and war. Ownership rates reached a local minimum in the 1940 Census, and Figure 1 shows that housing prices continued to sink relative to other consumer goods until the end of World War II. The coincidence of rapidly increasing ownership rates and housing prices in the postwar era suggests an important role for relaxed liquidity constraints.

B. The impact of the VA mortgage program

The empirical tests of the relationship between liquidity constraints and prices presented below rely on the presumption that a readily identifiable group, war veterans, had significantly greater access to credit than otherwise identical householders in 1970. Given the plethora of mortgage market innovations that drove the postwar boom in home ownership, it is not inherently clear that the advantaged conferred by the VA mortgage program was significant. The probit

specifications presented in Table 3 address this concern by looking for evidence that veterans' greater access to credit translated into higher probabilities of home ownership.

These ownership probits use data on householders from the Integrated Public Use Microdata Samples (IPUMS) of the US Census in 1940 and 1970. Coefficients reported in the table indicate the marginal effect of a one-unit change in the independent variable when all other variables are set equal to their respective means.⁸

Table 3 first addresses the concern that veteran status might be a poor proxy variable for access to credit. Such a concern would be valid if veterans had greater (or lesser) demand for owner-occupied housing for other unobserved reasons. To test the validity of these concerns, the first two specifications examine home ownership in 1940, prior to the implementation of the VA mortgage program. While ownership is significantly more common among households headed by older, married, male, non-black, and native-born individuals, and varies significantly by household size and region, there is no evidence to suggest that veterans were either more or less likely to own a home than otherwise identical householders. Comparison of the first two columns shows that inclusion of the veteran control has virtually no impact on other estimated coefficients.

Comparable probit specifications for 1970, reported in the subsequent columns, distinguish veterans by their projected eligibility for the VA mortgage program.⁹ Ineligible veterans, similar to

⁸ Summary statistics for all reported regression covariates appear in Appendix Table A1.

⁹ Only veterans who served after 1941 are eligible for the VA mortgage program. The IPUMS data does not explicitly list dates of service, but rather identifies whether veterans served in a particular war (World War I, World War II, Korea or Vietnam) or in peacetime only. I count all veterans with service in World War II, Korea or Vietnam as eligible for the program. Moreover, I also include veterans serving in peacetime only who were under the age of 50 in 1970. The age distribution of peacetime-only veterans in the 1970 IPUMS sample is bimodal, with a local minimum occurring at age 50. In 1970, the VA mortgage benefit was also restricted to veterans who had served for at least 90 days. Unfortunately, the IPUMS data do not indicate a veteran's length of service. Thus the measure employed here likely misidentifies some ineligible veterans as eligible.

all veterans in 1940, have home ownership patterns statistically indistinguishable from otherwise identical householders. Eligible veterans, on the other hand, are significantly more likely to own their home. When all other variables are evaluated at their means, the magnitude of the veteran effect is 7.6 percentage points. The fourth regression in Table 3 indicates that eligibility for the VA mortgage program confers an advantage comparable to a one-standard deviation increase in wage and salary income, or two additional years of age. Given that 43% of householders were eligible veterans in 1970, these results suggest that about 20% of the overall increase in home ownership rates between 1940 and 1970 can be attributed to the VA mortgage program.

Comparing coefficient estimates across years reveals that the impact of many observable characteristics on home ownership probabilities changed significantly between 1940 and 1970.¹⁰ In spite of these significant differences, the final specification reported in Table 3 pools the two IPUMS cross-sections in order to estimate a true difference-in-difference style estimate of the impact of the VA mortgage program. A year effect is added to this probit regression to capture the overall increase in ownership probabilities over time. Relative to otherwise identical veterans, those eligible for VA mortgages were 13.5 percentage points more likely to own a home. Overall, these results show that eligibility for the VA mortgage program had a significant impact on housing tenure decisions.

C. Recent relaxations in borrowing constraints

The second period of escalating relative house prices, beginning around 1982, coincides with further innovations in the mortgage market. Until the 1980s the secondary mortgage market, which encouraged lending by pooling the risk that individual financial institutions assumed when extending

¹⁰ Collins and Margo (2001) also note this pattern.

credit, was an avenue open only for loans that “conformed” to underwriting standards governing borrower creditworthiness and property characteristics. A secondary market for “non-conforming” loans, mortgages that entities such as the Federal National Mortgage Association (FNMA) refused to securitize, grew rapidly through the 1980s and into the 1990s. The definition of “conforming” loans was itself relaxed in response to Federal legislation in 1992. By 1994, lenders had initialized programs that allowed qualified households to borrow more than the value of a home, effectively creating a negative down payment that could be applied towards closing costs or received in cash. These innovations enabled some previously ineligible households to purchase a home, and provided many others with increased buying power given current wealth levels (Bruskin et al., 2000). As Table 1 indicates, these new mortgage market innovations are not associated with any appreciable change in home ownership rates. They do, however, coincide with the current period of relatively high prices for owner-occupied housing, as shown in Figure 1.¹¹

This section has provided some casual empirical evidence linking periods of relaxed borrowing constraints with price appreciation, as well as more specific evidence that the VA mortgage program altered housing tenure patterns for eligible veterans. The following section uses an intertemporal model to generate the prediction that prices escalate in the wake of liquidity constraint relaxation, and Section 4 tests the model’s predictions using the VA mortgage program as a case study.

¹¹ As previously noted, this period of housing price escalation has coincided with a period of general declines in marginal tax rates, arguing against the hypothesis that the tax treatment of mortgage interest is responsible for long-term trends in housing values.

II. Tenure choice, liquidity constraints, and prices: a simple model

There have been several noteworthy theoretical studies of housing prices and more generally of housing demand (Ranney, 1981; Poterba, 1984; Schwab 1982; Stein, 1995; Ortalo-Magne and Rady 2002; see Smith et al. 1988 for a review of housing market models). Stein (1995), in particular, uses a static model to show that borrowing constraints reduce housing prices. Stein's result can be attributed to the assumption of a fixed housing stock, and the fact that households must pay for housing prior to consuming and earning income. Under different assumptions, particularly if housing supply is close to perfectly elastic, this type of model produces radically different results.

The model presented here is an advancement over Stein's model in several respects. It is a two-period intertemporal model. There is no restriction on the price elasticity of housing supply. Finally, there is a fully integrated rental market for housing as well as a market for owner-occupied housing.¹² The model shows that liquidity constraints can depress the price of owner-occupied housing below the present value of rents, regardless of the local price elasticity of supply.

Agents i derive utility from two consumption goods, housing services H_i and a numeraire commodity X_i . They are endowed with varying amounts of a single physical asset, A_i , which can be interpreted as land. They are also endowed with varying amounts of effective labor, L_i , which they supply inelastically to firms. Competitive firms purchase labor and rent land in competitive factor markets and transform them into the numeraire commodity. Any quantities of land not used in the production process in a given period can be costlessly transformed into housing services. In the first period, agents may buy, sell or rent land. Only consumers may purchase land, but either consumers

¹² In an appendix, Stein (1995) incorporates a rental market, but requires that renters pay an arbitrary premium relative to owner-occupied housing prices. This model can also generate such a premium as a result of liquidity constraints, rather than by assumption.

or firms may rent it. Agents' net housing consumption in each period is A_t , less the net amount sold A_i^S and the net amount rented to other agents A_i^R .

Using X_{it} to denote numeraire consumption in period t , assuming that utility is time-separable, and that agents making decisions in the first period discount second-period utility by a factor δ , the consumer's maximization problem can be stated as follows:

$$(1) \quad \text{Max}_{X_{1i}, X_{2i}, A_i^S, A_i^R} U(H_i, X_{1i}) + \delta U(H_i, X_{2i}),$$

subject to the accounting identity

$$(2) \quad H_i = A_i - A_i^S - A_i^R.$$

Assuming that agents can store the numeraire commodity without risk or return between periods, the maximization in equation (1) is undertaken subject to the lifetime budget constraint:

$$(3) \quad VA_i^S + 2rA_i^R + 2L_i w - X_{1i} - X_{2i} \geq 0,$$

where w is the market wage, equal to the marginal product of effective labor, r equals the marginal product of land in the production of the numeraire, and V is the endogenously determined price of a unit of land.

Agents with asset holdings that are sufficiently small relative to their labor income will find it desirable to borrow against their second period income. Such borrowing is governed by the relation:

$$(4) \quad VA_i^S + rA_i^R + L_i w - X_{1i} \geq -\mu_i.$$

In words, excess of first-period consumption over total first-period income may not exceed μ_i .¹³ In scenarios where borrowing is prohibited, $\mu_i=0$. Less stringent regulations on borrowing involve

¹³ Stiglitz and Weiss (1981) present a model justifying the existence of credit rationing in markets with imperfect information.

some greater value of μ .

With this setup, it is quite simple to show that per-unit housing values V fall below the present value of rents, $2r$, in the presence of liquidity constraints. Denoting the Lagrange multiplier from the lifetime constraint (3) as λ_1 and the multiplier from the intertemporal constraint (4) as λ_2 , the first order conditions of the consumer's problem yield the following relation between V and r :

$$(5) \quad V = \frac{2\lambda_1 + \lambda_2}{\lambda_1 + \lambda_2} r.$$

When the intertemporal constraint is nonbinding, this expression for V reduces to $2r$, the present value of rents. As liquidity constraints become more binding, increasing the shadow value of first-period assets, this expression falls further below the present value of rents.¹⁴ Intuitively, liquidity constraints drive consumers to sell land on the open market and consume housing by renting instead. If the excess supply created by liquidity-constrained consumers wishing to sell land cannot be absorbed by unconstrained consumers willing to buy, the equilibrium price must fall.¹⁵

The distributional implications of relaxing liquidity constraints are easily derived. Consumers can be divided into two groups on the basis of their value of λ_2 . Initially, less-constrained households are net purchasers of housing, and realize the benefits of depressed prices either by increasing their housing consumption or renting additional units of land to finance numeraire consumption. More-constrained households adopt the opposite strategy, selling to finance additional numeraire consumption in the first period. Any general relaxation of liquidity constraints

¹⁴ This model can thus endogenously generate premiums for rental housing, observationally equivalent to discounts for owner-occupied housing, similar to those derived by Henderson and Ioannides (1983) and imposed by assumption in Stein (1995).

¹⁵ General equilibrium effects complicate this intuition somewhat. In practice, the equality required by equation (5) could be achieved either by a decrease in V or an increase in r . Under the assumption of diminishing marginal product, higher r implies greater labor intensity and lower equilibrium wages. In general, lower wages will have the effect of reducing liquidity constraints.

naturally yields positive benefits to net sellers of housing and negative benefits to net purchasers.

In this model, less-constrained households will tend to be those with high asset holdings relative to income, or equivalently low income in relation to asset holdings. It is thus difficult to determine a priori whether the relaxation of liquidity constraints is progressive or regressive. If households with low income also tend to have a low ratio of income-to-assets, then easier access to credit can actually be a regressive policy.¹⁶

Another implication of this model, which will be of importance for the empirical tests below, is that exogenous increases in the rental rate r should increase the discount applied to V . Intuitively, since the net rental holdings of households are negative, a higher r increases per-period income relative to net assets. Any increase in per-period income relative to asset holdings will increase households' desire to borrow to finance first-period consumption.

It is worth reiterating that this model's result holds without any reference to the price elasticity of supply for housing. In this model, the elasticity of housing supply depends on the second derivative of firms' production functions with respect to the physical asset. If the marginal product of land is constant, then the elasticity of supply for housing is infinite: increases in demand for housing translate entirely into changes in the quantity consumed.¹⁷ Even when the rental price is constant, however, liquidity constraints can influence the purchase price of housing. Some previous empirical studies of liquidity constraints and tenure choice dismiss the possibility of price

¹⁶ There is some empirical evidence to support the notion that credit access programs do not benefit the long-term poor. Goodman and Nichols (1997) show evidence that the FHA mortgage program primarily benefits young households – likely those with low asset holdings in relation to present and future income – rather than poor households.

¹⁷ In this model, the housing supply elasticity can only be infinite up to a point – determined by the total endowments of land in the economy. Also note that increased housing demand may have a feedback effect, since reduced utilization of land may change the marginal product of labor in production, and hence wages.

effects with arguments related to the supply elasticity of housing (see, for example, Monroe, 2001).¹⁸ The results presented in this section show that these arguments are insufficient to assuage concerns that easier access to credit creates inflationary pressure in the housing market. The following section presents empirical evidence documenting such effects.

III. Empirical evidence

This exercise uses data from the 1940 and 1970 Integrated Public Use Microdata Samples (IPUMS), each of which provides information on 1% of all enumerated households in the relevant year. The data include standard demographic and socioeconomic information regarding the household head, including age, race, sex, income, and metropolitan area of residence. Veteran status is collected from a subset of householders in 1940; in 1970 all householders were asked whether they were veterans and if so whether they served in one of four wars (World War I, World War II, Korea, or Vietnam) or in peacetime. In both samples, contract monthly rent is observed for each renting household, and each owner provides an estimate of his or her property's current market value.¹⁹

Between 1940 and 1970, as shown in Table 1, home ownership rates increased dramatically nationwide and average owner-occupied housing values increased relative to average rents. Several mortgage market innovations adopted close to the beginning of this period are widely credited with the first trend. The evidence presented here connects these innovations with the second trend.

¹⁸ Several empirical studies have concluded that the price elasticity of housing supply is considerably less than infinite (Capozza, Green and Hendershott 1996; Topel and Rosen 1988; Malpezzi and Mayo 1997).

¹⁹ In 1940, owners of multifamily units were asked to estimate the value of their own unit only. It is not possible to determine which housing units are part of multifamily structures in these data. The 1970 sample used here excludes owners of multifamily dwellings. In both years, farms are excluded from the analysis. Previous research has shown that owners tend to overestimate their property's true market value, but estimation errors appear to be random (Goodman and Ittner, 1992). The 1940 value data are coded at the dollar level; the 1970 value data are intervalled.

A. Basic trends in the ratio of values to rents

As explained above, any liquidity constraint-induced discount applied to owner-occupied housing should be greater in markets where rent levels are exogenously higher. Table 4 presents a test of this hypothesis using IPUMS data, where individual housing markets are equated with metropolitan areas. For each metropolitan area, a median rent statistic is calculated on the basis of IPUMS observations.²⁰ The regressions reported in the first four columns of Table 4 relate the natural logarithm of this median rent to the natural logarithm of owner-occupied housing values in each market in 1940 and 1970, respectively.²¹

Simple univariate regressions of log housing values on log median rents, reported in the first and third columns of Table 4, show a relationship that increases in magnitude between 1940 and 1970.²² The point estimate in the first column suggests that metropolitan areas with higher rents in 1940 had less-than-proportionately higher values. The 1970 point estimate suggests the reverse, that ratios of value to rent were higher in high-rent markets.²³ While suggestive, it should be noted that neither of these coefficients can be statistically distinguished from one, and they are not significantly

²⁰ Since the independent variable of interest is a sample statistic, each observation in the regression is weighted by the square root of the sample size used in calculating the statistic, in order to avoid heteroskedasticity problems. Unweighted regressions yield similar results, though $\ln(\text{rent})$ coefficients in both 1940 and 1970 are smaller in absolute value, as should be expected when noisier observations are given greater weight in the regression.

²¹ Although the unit of observation in these regressions is an owner-occupied housing unit, the number of independent observations is effectively restricted to the number of metropolitan areas in each year. For this reason, the Huber-White correction has been applied to the standard errors in these regressions.

²² In an infinite-horizon model without liquidity constraints, $V = r/\delta$. Taking logs, we find $\ln(V) = \ln(r) - \ln(\delta)$. The intercept of this regression can thus be interpreted as the negative value of the logarithm of the rate of return used to compute housing values. The parameter estimates in Table 4 yield annual rates of return on the order of 6.8 to 7.7 percent. One alternative interpretation of the slope coefficient in the 1940 regression is that the relevant rate of return on investments in high rent markets is higher.

²³ In 1970, about 4% of owner-occupied housing units have topcoded value observations. This topcoding most likely biases the rent coefficient downward; omission of topcoded observations from the sample results in lower coefficient estimates.

different from each other.

The ideal source of variation in median rents for this exercise would be exogenous differences across markets in terms of local amenities or opportunity costs of supplying housing units. The median rent values used here might confound this type of variation with that arising from characteristics of a metropolitan area's residents, most notably their income levels. To more effectively isolate location-based variation in median rents, the remaining regressions in Table 4 control for a basic set of housing market characteristics, including householders' median age, the fraction of householders working in manufacturing industries, the fraction of householders with a college education, and Census region effects. The 1970 regression also includes a measure of recent housing supply growth, the fraction of all housing units built after 1960, to account for the possibility that supply responses may have differentially closed gaps in rents and values across housing markets. The 1940 IPUMS data lack information necessary to construct this data; omission of this variable from the 1970 regressions does not alter the results.

Controlling for housing market characteristics, the relationship between rents and values across housing markets in 1940 weakens considerably. For every 1 percent increase in median rents, predicted owner-occupied housing values increase by slightly more than 0.5 percent. A very different pattern emerges in 1970: a 1 percent increase in median rents predicts a 1 percent increase in values as well. The 1940 coefficient is significantly less than one and significantly different from the 1970 coefficient. This pattern corresponds exactly to the model's predictions: in a liquidity-constrained world, housing values in high-rent areas are discounted; when the constraints are relaxed

these discounts disappear.²⁴

The ideal source of variation in median rents would also account for differences in the quality of renter- and owner-occupied housing units across markets. Unfortunately, it is impossible to account for these factors using 1940 IPUMS data, since they contain no information on housing unit structural characteristics. In 1970, however, it is possible to perform such an exercise; the final regression in Table 4 presents the results. In this regression, the median rent variable for each metropolitan area has been replaced with each area's mean residual from a regression of $\ln(\text{median rent})$ on a basic set of structural characteristics.²⁵ This modified rent variable thus accounts for differences in observed rental unit characteristics across markets. The same set of structural characteristics also appear as regressors in the reported specification, though their coefficients are not reported here. Controlling for observable differences in housing unit quality has a modest effect on the estimated relationship between median rents and housing values. Comparing the fourth and fifth regressions in Table 4, the coefficient falls from 1.03 to 0.91, a difference that is not statistically significant. On the basis of this evidence, the failure to consistently account for housing unit quality across markets over time does not appear to influence the basic message reported in Table 4: that the ratio of housing values to median rents leveled upwards between 1940 and 1970.

²⁴ An alternative explanation for the patterns in Table 5 focuses on cyclical effects. Since housing values should reflect the present discounted value of rents, rents should display more cyclical volatility than values. In recessions, the ratio of values to rents should be higher; in expansionary periods the ratio should be lower. According to the National Bureau of Economic Research, the 1940 Census was taken nearly two years into a seven year-long expansion, while the 1970 Census was taken in the midst of a nearly year-long recession. Note, however, that a universal reduction in the ratio of values to rents should alter the intercept term of these regressions, not the coefficient on median rent. The median rent coefficient would change only if recessions differentially affect the ratio of values to rents in high-rent markets.

²⁵ Added structural characteristics include categorical variables for number of rooms, year structure built, presence of basement, number of units in structure (rental units only), whether unit is detached (owner-occupied units only), number of units at address (rental units only), number of bathrooms, and presence of window or central air conditioning.

B. Using veteran status as a proxy for access to credit

The relaxation of liquidity constraints during the postwar period did not apply equally to all citizens. The VA mortgage program, perhaps the most generous of all lending innovations since it enabled home purchases with no down payment and no mortgage insurance premiums, was open only to veterans serving in the World War II era or later. As Table 3 documents, this program had a significant impact in terms of raising home ownership rates of veterans relative to otherwise identical householders. Across metropolitan areas, the fraction of households headed by an individual eligible for the VA mortgage program varied significantly, from approximately one-fourth to one-half in 1970. The regression results presented in Table 5 use the density of veterans in a metropolitan area as a proxy for the extent of borrowing constraint relaxation in that area. Theoretically, the escalation of value-to-rent ratios in high rent markets should be more acute among markets with a high density of veterans. The independent variable of interest in these regressions is therefore the interaction between veteran density and the logarithm of median rent.²⁶ Each regression also includes the main effects of median rent and veteran density, as well as the set of housing market characteristic controls introduced in Table 5.²⁷

This strategy would be suspect if, for example, veterans generally had stronger tastes for owner-occupancy, particularly in high-rent markets. Table 3 provided some evidence that this is not the case, since veterans ineligible for the VA mortgage program consistently display home ownership rates indistinguishable from the general population, controlling for basic observable factors. As a

²⁶ As in the preceding table, the unit of observation is the owner-occupied housing unit. Standard errors have been adjusted to reflect clustering of these observations by metropolitan area.

²⁷ Exclusion of the housing market characteristic variables changes the magnitudes of some coefficients in Table 6, but does not influence their statistical significance.

further check on this methodology, the first two regressions reported in Table 5 use data from the 1940 IPUMS. Since the VA mortgage program did not exist at this time, there is no reason to expect that a higher density of veterans in the population influences the relationship between median rents and house values across metropolitan areas. Any evidence of such a relationship in this early data would cast doubt on the empirical strategy employed using later data. While the first regression shows that values tend to be lower in markets with many veterans – a pattern that will appear consistently in all results – the second confirms that there is no statistically significant effect of veteran share on the relationship between rents and values.

The same regression specifications, using 1970 IPUMS data in place of the 1940 sample, reveal a very different pattern.²⁸ The third regression in Table 5 shows that veterans continue to be concentrated in low-value metropolitan areas overall, though the magnitude of the “veteran discount” has been reduced significantly. The fourth regression reveals that the interaction between veteran share of the population and median rent is positive and statistically significant at the 1% level. The point estimates imply that across metropolitan areas with an average density of VA-eligible veterans (equivalent to 42% of all householders), a 1 percent increase in median rents predicts a 1 percent increase in housing values – there is no additional discount for owner-occupied units in high-rent areas. Across metropolitan areas with a veteran density one standard deviation below the mean, a 1 percent increase in median rents predicts only a 0.8 percent increase in values.

The next specifications reported in Table 5 pool data from the 1940 and 1970 IPUMS cross sections, to directly test the significance of the difference in coefficients between the two years.

²⁸ Only veterans eligible for the VA mortgage program are used in calculating the veterans’ share variable for 1970. Using the procedure for predicting eligibility described above, over 97% of veteran heads of household were eligible for the mortgage program in 1970.

Since Table 3 revealed significant differences in coefficient values across years, these specifications interact the housing market characteristic controls with a year effect to preserve flexibility in fitting the data. The first pooled-data regression confirms that veterans generally lived in areas with low housing values in both years. This regression also confirms the result shown in Table 4, that the slope of the relationship between median rents and values increased significantly between 1940 and 1970. Controlling for the interaction of median rent and the 1970 year effect, the main 1970 year effect is insignificant, implying that real housing value escalation between 1940 and 1970 can be attributed entirely to an elimination of the disproportionate discount for owner-occupied properties in high-rent areas.

The second pooled-data regression introduces the second order interaction between share of veterans, the logarithm of median rent, and the 1970 year effect. The coefficient on this interaction term is of similar magnitude to the coefficient of interest in the 1970 regression, and is statistically significant at the 5% level. As in the 1940 regression, there is no evidence of a relationship between share of veterans in the population, median rents, and housing values prior to the adoption of the VA mortgage program.

The final regression returns to the 1970 dataset, making two innovations over the specification employed in the fourth column. The median rent variable is replaced with the residual measure first introduced in the last specification in Table 4, and structural controls are added to the right hand side of the equation. These innovations have virtually no effect on the estimated interaction effect of veteran density and median rent. Controlling for observable differences across metropolitan areas in housing unit quality, a 1 percent increase in median rent across metropolitan areas with an average veteran density predicts a 0.92 percent increase in values, while the same rent

increase across markets with a veteran share one standard deviation below the mean predicts only a 0.71 percent increase in values. All the evidence presented here points to the conclusion that high-rent housing markets with a high density of veterans witnessed a significant increase in owner-occupied housing prices in the twenty-six years following the implementation of the VA mortgage program.

This reduced-form analysis cannot directly provide universal estimates of the elasticity of housing prices with respect to borrowing constraint regulations. The results can, however, gauge the impact of extending VA-style access to credit markets to an additional fraction of the population. Both theory and empirical evidence suggest that this impact varies with the initial extent to which liquidity constraints are binding. Suppose a market exists where VA-style mortgage innovations are superfluous because liquidity constraints are (just barely) not initially binding. Theoretically, we would expect to observe no impact on the ratio of values to rents.²⁹ The results suggest that in a market with rent levels 10% higher than this unaffected city, extending VA-style mortgage benefits to an additional 10% of the population would increase the ratio of housing values to rents by about 6%.

Over the past twenty years, further innovations in the mortgage market have afforded a very large number of households access to borrowing regimes equivalent to, or in many cases more advantageous than, the VA mortgage program. Extrapolating from these results, extending VA borrowing privileges to the 60% of the population that was not eligible (as of 1970) would lead to

²⁹ In Table 5, we observe that increases in eligible veterans' share in low-rent markets have the effect of lowering housing values. This effect is present both in 1940 and 1970, suggesting that this pattern has more to do with nonrandom sorting of veterans than the VA mortgage program itself. The thought experiment conducted here starts with the presumption that the VA mortgage program would have no impact on prices in a housing market where liquidity constraints were not binding initially.

value increases of 36% in metropolitan areas where rents exceeded those in a marginally unaffected city by 10%. Effects on housing values in low-rent areas, of course, would be decidedly more muted. Table 1 shows that relative to median rents, median housing values have increased by roughly 10 to 20 percent since 1970. While the evidence presented here is insufficient to directly link recent price increases to mortgage market innovations, the magnitude of the implied effect is consistent with such a link.

IV. Conclusion

Previous research has frequently implicated borrowing constraints as significant obstacles to home ownership. This literature, as well as the general literature on liquidity constraints and consumption, has to a surprising extent ignored the possibility that the relaxation of impediments to borrowing might have an inflationary effect on prices. Some authors have argued that elastic housing supply would dampen any price effects. This paper has shown, in a simple intertemporal model, that such an effect can indeed exist, regardless of the overall price elasticity of supply. Moreover, it has provided empirical evidence, centered around one of the great liquidity constraint-removing policy programs of the mid-twentieth century, that supports the existence of such an effect.

The implications of these price effects are quite noteworthy. The relaxation of borrowing constraints, by increasing the equilibrium price for durable goods such as housing, reduces the welfare of some households: those that were net purchasers of housing in the pre-relaxation equilibrium. In more familiar terms, the type of household that suffers from the relaxation of borrowing constraints is the type which has already saved for a down payment, only to witness the elimination of down payment requirements – and a concomitant increase in the price of owner

occupied housing – prior to their purchase.

These results can be interpreted as a caveat to those interested in the policy goal of increasing home ownership rates, or rates of ownership of other durable goods. The relaxation of borrowing constraints, frequently touted as a central policy tool for achieving this goal, comes with a cost, even in the absence of borrower default risk. As theory and the evidence drawn from the VA mortgage program indicates, easier credit for some can make prices higher for all.

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Table 1: Housing prices and home ownership rates, 1940-2000

Year	Median value	Median monthly contract rent	Ratio of median value to median monthly contract rent	National home ownership rate
1940	\$2,750	\$20	137.5	43.6%
1950	—	—	—	55.0
1960	11,250	55	182-227	61.9
1970	16,250	87	172-201	62.9
1980	47,500	195	231-256	64.4
1990	85,000	362	221-249	64.2
2000	112,500	510	196-245	66.2

Note: Median value sample consists of owner-occupied nonfarm single family units, excluding vacant-for-sale and condominium properties, and properties with commercial uses. In 1940, values are for all nonfarm owner-occupied units; owners of multifamily or commercial-use units were instructed to report only the market value of their own unit. Median rent sample uses contract rent observations for all nonfarm rental units with cash rent. Ranges reported for ratio of median value to median rent when value data are reported in intervals only.

Source: IPUMS samples, 1940-1990; Census 2000 Supplementary Survey Public Use Microdata Sample. The 1950 IPUMS sample contains no information on housing values or rents.

Table 2: Important events in the history of the mortgage market

1920s	Typical mortgage lasts 5-10 years, requires at least 30% down payment, and is less than fully amortized.
1932	250,000 nonfarm foreclosures nationwide.
1933	Home Owners Loan Corporation established, makes fully amortized 20-year loans.
1934	FHA establishes program of insuring against homeowner default on long-term, fixed-rate loans. Enables down payments of less than 10% of property value, 25-30 year loan periods with full amortization. Borrowers pay a mortgage insurance premium in exchange for coverage.
1938	Fannie Mae established, creates secondary market for mortgage loans that “conform” to underwriting standards covering borrower creditworthiness and property characteristics.
1944	Servicemen’s Readjustment Act creates Veterans Administration mortgage insurance program, which enables qualifying veterans to purchase a home with no down payment and no mortgage insurance premiums.
1968	Fannie Mae privatized, Ginnie Mae established to fund FHA and VA mortgage programs.
1970	Freddie Mac established as an additional secondary market conduit.
1982	Beginning of rapid growth in the secondary market for “non-conforming” loans; mortgages that Fannie Mae and other agencies are unwilling to securitize.
1992	Federal Housing Enterprises Financial Safety and Soundness Act directs Fannie Mae and Freddie Mac to acquire more loans made to low-income borrowers. This directive leads to more flexible terms for “conforming” loans.
1993	\$100 billion worth of non-conforming loans securitized in the secondary market.
1994	Establishment of loan programs that allow qualified buyers to borrow up to 125% of property value.

Sources: Jackson (1985), Bruskin et al. (2000), Listokin et al. (2001), Martinez (2000).

Table 3: Predicting home ownership in 1940 and 1970

Independent Variable	Probit regression results: Dependent variable equal to one if respondent owns home				
	1940	1940	1970	1970	1940/1970
Age	0.025 (0.001)	0.025 (0.001)	0.042 (4.72*10 ⁻⁴)	0.039 (4.90*10 ⁻⁴)	0.036 (0.001)
Age squared	-1.46*10 ⁻⁴ (1.31*10 ⁻⁵)	-1.50*10 ⁻⁴ (1.33*10 ⁻⁵)	-3.33*10 ⁻⁴ (5.21*10 ⁻⁶)	-2.95*10 ⁻⁴ (5.44*10 ⁻⁶)	-2.53*10 ⁻⁴ (4.91*10 ⁻⁶)
Married	0.065 (0.007)	0.065 (0.007)	0.282 (0.004)	0.284 (0.004)	0.244 (0.003)
Female	-0.054 (0.009)	-0.055 (0.009)	0.061 (0.004)	0.092 (0.004)	0.078 (0.004)
Black	-0.125 (0.007)	-0.125 (0.007)	-0.221 (0.003)	-0.216 (0.003)	-0.200 (0.003)
Foreign Born	-0.028 (0.006)	-0.029 (0.006)	-0.208 (0.004)	-0.192 (0.004)	-0.154 (0.003)
ln(wage and salary income)	0.067 (0.003)	0.067 (0.003)	0.093 (0.001)	0.092 (0.001)	0.107 (0.001)
Household size	0.028 (0.002)	0.028 (0.002)	0.059 (0.001)	0.059 (0.001)	0.059 (0.001)
Northeast region	-0.127 (0.007)	-0.127 (0.007)	-0.092 (0.003)	-0.092 (0.003)	-0.105 (0.003)
South region	-0.014 (0.008)	-0.014 (0.008)	0.039 (0.003)	0.040 (0.003)	0.035 (0.003)
Midwest region	-0.040 (0.007)	-0.040 (0.007)	0.040 (0.003)	0.041 (0.003)	0.026 (0.003)
Veteran	—	-0.012 (0.007)	—	-0.015 (0.010)	-0.053 (0.007)
Veteran eligible for VA mortgage	—	—	—	0.076 (0.010)	0.135 (0.007)
1970 year effect	—	—	—	—	0.093 (0.004)
N	44,449	44,449	279,505	279,505	323,954
Pseudo-R ²	0.117	0.117	0.215	0.217	0.219

Note: Table entries represent the marginal change in predicted probability associated with a unit change in the independent variable when all other covariates are set equal to their means. Veterans designated eligible for VA mortgages in 1970 are those reporting service in World War II, Korea or Vietnam, or those under 50 reporting peacetime military service only. Sample consists of metropolitan area-resident nonfarm householders in the merged 1940 (sample line persons only) and 1970 (Form 2 metro sample) IPUMS. All coefficients in this table except South region in 1940 and Veteran in columns 2 and 4 are significantly different from zero at the 0.1% level.

Table 4: Relationship between median rents and owner-occupied house values, 1940 and 1970

Independent variable	Dependent variable: ln(value) for owner-occupied units in year:				
	1940	1940	1970	1970	1970
ln(median rent)	0.915 (0.074)	0.554 (0.081)	1.068 (0.146)	1.027 (0.122)	0.909 (0.124)
Intercept	5.173 (0.248)	—	5.055 (0.699)	—	—
Housing market characteristic controls?	No	Yes	No	Yes	Yes
Median rent adjusted for structural characteristics?	No	No	No	No	Yes
Structural characteristic controls?	No	No	No	No	Yes
N	66,050	66,050	192,581	192,581	192,581
Number of metropolitan areas	137	137	124	124	124
R ²	0.040	.044	0.143	0.150	0.529

Note: Huber-White robust standard errors in parentheses. Regression observations are weighted by the size of the sample of rental units used to create the median rent measure. Sample consists of owner-occupied nonfarm housing units. In 1940, sample is restricted to units where the householder is a sample line person; owners of multifamily dwellings were instructed to report only the value of their own dwelling. In 1970, multifamily dwellings are excluded from the sample. Housing market characteristic controls include median householder age, percent of householders who are college-educated, percent of householders in the labor force that work in manufacturing industries, region effects, and in 1970, percent of housing units built in the past ten years. Structural characteristic controls include categorical variables for number of rooms, year structure built, presence of basement, number of units in structure (rental units only), whether unit is detached (owner-occupied units only), number of units at address (rental units only), number of bathrooms, and presence of window or central air conditioning. All coefficients reported in this table are significantly different from zero at the 0.1% level.

Table 5: Housing values and the density of veterans in the population, 1940 and 1970

Independent variable	1940	1940	1970	1970	1940/1970	1940/1970	1970
ln(median rent)	0.591*** (0.075)	0.828*** (0.176)	0.920*** (0.132)	-1.978** (0.733)	0.601*** (0.079)	0.530*** (0.106)	-1.696*** (0.491)
Share of veterans in the population	-5.132*** (1.339)	4.616 (6.416)	-2.101*** (0.632)	-35.60*** (8.872)	-6.515** (1.366)	-7.848*** (2.812)	-2.856*** (0.320)
Veterans' share*ln(median rent)	—	-3.162 (2.172)	—	7.212*** (1.887)	—	0.829 (1.007)	6.276*** (1.254)
1970 Year effect	—	—	—	—	-0.954 (0.949)	10.03*** (3.701)	—
ln(median rent)*1970	—	—	—	—	0.283* (0.145)	-2.125*** (0.783)	—
Veterans' share*1970	—	—	—	—	4.186** (1.706)	-23.13** (10.50)	—
Veterans' share*1970 *ln(median rent)	—	—	—	—	—	5.315** (2.400)	—
Housing market characteristic controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Median rent adjusted for structural characteristics?	No	No	No	No	No	No	Yes
Structural characteristic controls?	No	No	No	No	No	No	Yes
N	66,050	66,050	192,581	192,581	258,631	258,631	192,581
R ²	0.045	0.045	0.160	0.165	0.636	0.637	0.544

Note: Huber-White robust standard errors in parentheses. Regression observations are weighted by the size of the sample of rental units used to create the median rent measure. Sample consists of owner-occupied nonfarm housing units. In 1940, sample is restricted to units where the householder is a sample line person; owners of multifamily dwellings were instructed to report only the value of their own dwelling. In 1970, multifamily dwellings are excluded from the sample. Housing market characteristic controls include median householder age, percent of householders who are college-educated, percent of householders in the labor force that work in manufacturing industries, region effects, and in 1970, percent of housing units built in the past ten years. Structural characteristic controls include categorical variables for number of rooms, year structure built, presence of basement, whether unit is detached, number of bathrooms, and presence of window or central air conditioning.

*** denotes a coefficient significant at the 1% level, ** the 5% level, * the 10% level.

Figure 1: The price of owner-occupied housing relative to all personal consumption

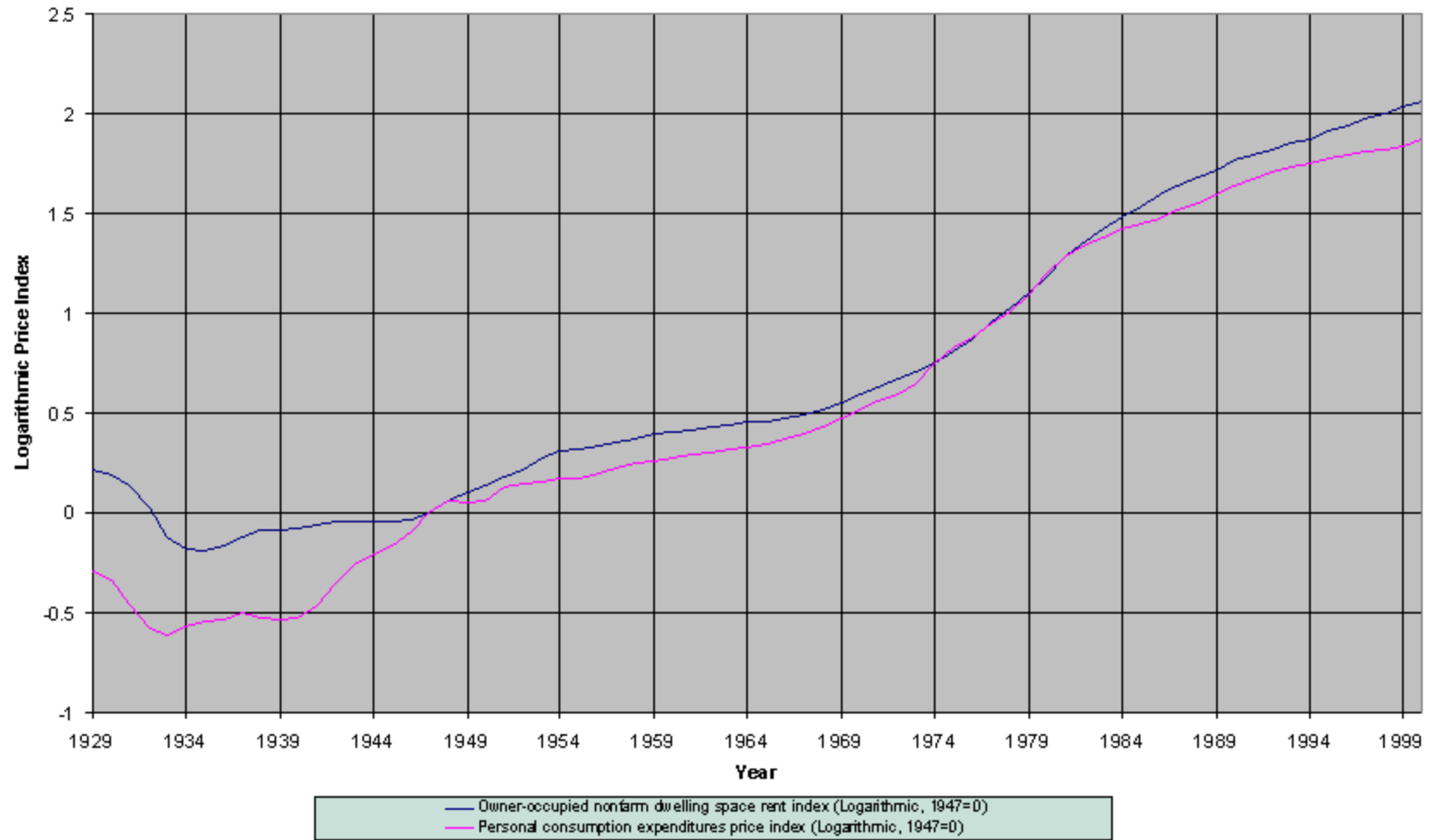


Table A1: Summary statistics for regression covariates

Variable	1940					1970				
	N	mean	std. dev.	minimum	maximum	N	mean	std. dev.	minimum	maximum
Householder owns home	44,449	0.303	—	—	—	279,505	0.569	—	—	—
Age	44,449	42.701	12.468	15	100	279,505	42.629	13.636	14	100
Married	44,449	0.779	—	—	—	279,505	0.756	—	—	—
Female	44,449	0.139	—	—	—	279,505	0.160	—	—	—
Black	44,449	0.081	—	—	—	279,505	0.107	—	—	—
Foreign Born	44,449	0.198	—	—	—	279,505	0.085	—	—	—
ln(wage and salary income)	44,449	6.991	0.849	0.000	8.517	279,505	8.809	0.873	3.912	10.820
Household size	44,449	2.820	1.547	1	29	279,505	3.316	1.785	1	26
Veteran	44,449	0.091	—	—	—	279,505	0.463	—	—	—
Veteran eligible for VA mortgage	44,449	0.000	—	—	—	279,505	0.452	—	—	—
ln(owner-occupied housing unit value)	66,050	8.046	0.918	0.000	11.362	192,581	9.844	0.584	7.824	10.820
ln(median rent)	137	2.923	0.315	2.079	3.689	124	4.446	0.235	3.912	4.942
Veterans' share	137	0.080	0.026	0.017	0.170	124	0.416	0.033	0.283	0.508