The Post-War Boom in Homeownership: An Exercise in Quantitative History*

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This version: January 2011

Abstract

The objective of this paper is to understand the sources of the boom in home ownership between 1935 and 1960. In the post-depression period the government opted to intervene and regulate housing finance. The result was a change in the maturity structure of mortgage loans, lower interest rates and downpayment requirements. In addition, the economy underwent important changes in the demographic structure, the income distribution, the progressivity of taxable income. To understand the relative importance of the different driving forces we construct a quantitative general equilibrium overlapping generation model with housing. The parameterized model is consistent with key aggregate and distributional features in the U.S. in 1935. In contrast to the 1996-2005 period, income is the crucial variable in accounting for the increase in homeownership. Essentially, the level and shape of income over an age profile is a precondition for mortgage innovation to play an important role in generating an increase in the aggregate homeownership. Demographics were also an important factor in the increase in the homeownership rate between 1940 and 1960.

Keywords: Housing finance, first-time buyers, life-cycle
J.E.L.:E2, E6

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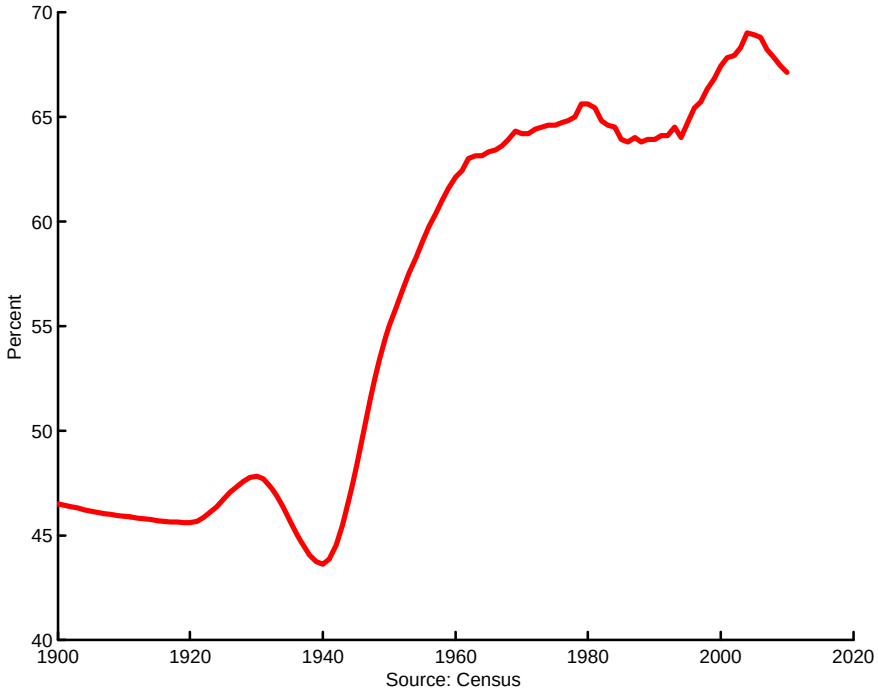
1 Introduction

Between 1965 and 1996, the homeownership rate hovered around 64.4 percent. After 1996, this rate increased to a peak of 69.0 percent in 2004. Chambers, Garriga and Schlagenhauf (2009) studied this period and found that mortgage innovation in the form of highly levered and variable interest payment mortgages were a key factor in accounting for the increase in the homeownership rate. However, the increase in this rate between 1965 and 1996 was small compared to the approximately twenty basis point increase that occurred between 1935 and 1960. This increase can be clearly seen in Figure 1 where the annual homeownership is presented between 1900 and 2009. Thus, an obvious question is what cause the homeownership to increase by this large amount? More importantly, why didn't the housing market collapse after a 20 basis point increase in the homeownership rate in 1960?

Figure 1: The U.S. Home Ownership Rate between 1900 and 2010



Source: US Census Bureau

Not surprisingly, this question has already been asked and attempted to be answered. The explanations can be segmented into two general themes: changes in population composition and economic and social policy changes. Chevan (1989) argues that changes in income and in demographic age composition explain more that half the growth in homeownership between 1940 and 1960. Kain (1983) and Katona (1964) both argue that the increase in homeownership is due to an increase in real income. Other researchers have argued that the explanation for the increase in homeownership lies in government policy. Rosen and Rosen (1980) estimate that about one-fourth of the increase in homeownership between 1949 and 1974 was a result of benefits towards housing embedded in the personal income tax code. Hendershott and Shilling (1982) support this claim by finding that the decline in the cost of owning a home relative to the cost of renting during the period 1955 to 1979 was due to income tax provisions. Yearn (1976) argues the explanation is in federal policies that made mortgage funds available with low initial payments, for longer durations, and at lower interest rates. He points to the easy monetary policy of the Federal Reserve System in the 1940 and the increase in the availability of

mortgage funds from Federal Housing Administration (FHA) and the Veterans Administration (VA). Recently, Fetters (2010) has estimated that VA's policy of making zero downpayment mortgage loans available to veterans returning from World War II and the Korean War after 1946 accounts for a ten percent increase in homeownership. Other studies have focused on other factors.

The aforementioned research has attempted to measure the importance of a factor in a regression based framework that attempts to hold other potential factors constant. We employ an alternative research strategy. In this approach, a dynamic general equilibrium model is employed that allows households and firms make optimal decisions in an environment that reflects economic and institutional environment of the relevant time period. In the moel, prices adjust to clear markets, thus allowing all factors to dynamically interact. In other words, we construct a framework that is calibrated to the period 1935-1940. The model is then used to conduct a series of counterfactual experiments to measures the relative importance of various factors. This paper follows the tradition of Amaral and MacGee (2002), Cole and Ohanian (2000,2004), Hayashi and Prescott (2002), Ohanian (2009) and Perri and Quadrini (2002), who employed quantitative techniques in the study of historical events.

The model we construct is based on the model presented in Chambers, Garriga, and Schlagenhauf (2009). Because of the role that age plays in the decision to purchase a home, an overlapping generation framework is employed. In this economy, households face uninsurable labor income, life uncertainty, and borrowing constraints. Individuals make decisions with respect to the consumption of goods, investment in housing, the consumption of housing services and savings. The decision on the consumption of housing services is intertwined with tenure and duration decisions. Housing is a lumpy and risky investment that requires a down payment, long-term mortgage financing as well as subject to preferential tax treatment. Mortgage loans are available from a financial sector that receives deposits from households and also loans capital to private firms. Households that invest in housing make a decision on the amount of housing services to consume. If consumption of services is less than the amount of services generated by the investment, any unused housing services are made available in the housing rental market. As a result, the model includes an endogenous rental market. The production sector uses a neoclassical technology with capital and labor that produces consumption/investment and housing goods. The government implements a housing policy, collects revenue with a progressive income tax system, and redistributes resources via a social security system. This model allows for changes in demographics, real wage income, interest rates, mortgage finance innovations, federal government policies toward housing, and federal income taxes to be evaluated and quantitatively measured.

The primary factors that account for the increase in the homeownership rate between 1935 and 1960 are changes in demographics and income changes. In contrast to the homeownership increased observed between 1996-2005, mortgage contract innovation is not a key factor. In contrast to the 1996-2005 period, income is the crucial variable in accounting for the increase in homeownership. Essentially, the level and shape of income over an age profile is a precondition for mortgage innovation to play an important role in generating an increase in the aggregate homeownership. Demographics were also an important factor in the increase in the homeownership rate between 1940 and 1960.

This paper is organized into five sections. The first section presents a brief economic history from 1930 to 1960 as well as some data for this period. The next section develops our model economy. In order conduct our historical decomposition analysis the model has to calibrated and estimated to 1935. This is discussed in the third section. In addition, the third section discusses data used for calibrating the model to 1960. This additional data is required for the counter-

factual decomposition analysis. The fourth section conducts and discusses the decomposition analysis. The final section concludes.

2 A Brief Economic History of the Period 1930 to 1960

The literature has suggested a number of factors that may account of the large increase in the homeownership rate. In this section, the economic and institutional environment that pertinent to the posed question are documented. We hope is that by presenting such background, the motivation for factor being offered as an explanation will be better understood. The section will consider demographic factors, economic growth and interest rate conditions, mortgage contract changes, government policy changes toward housing, and government tax policy changes.

Demographers suggest social norms towards housing changed over this period. We take a narrow view of demographic factors and ask whether demographic structure of the population changed in a way that favored homeownership. Certain age cohorts tend to have higher homeownership rates than other cohorts. Did the size of age-specific cohorts that are correlated with high homeownership rates increase over this period? In Table 1, data on home ownership rates by age from 1930, 1940 and 1960, as well as cohort size in 1940 and 1960 are presented. The important age cohorts for increasing the homeownership rate is the age 25-35 cohort which are the "first-time" buyer and the age 46-75 cohorts where ownership rates tend to be higher. The fraction of the population in the 25-35 age cohort is smaller in 1960. More importantly, in 1940 52 percent of the population, (defined over the age 20-86 population), was between age 36 and age 65, while in 1960 53 percent of the population was in this cohort. Yet, in 1960 the ownership rate increased substantially for households in the 36-65 age cohort. At firts glance, this data does not appear to present a strong case of for demographic factors accounting for the increase in homeownership.

Table 1: Historical Age Cohort and Home Ownership Data

		Homeownership by Age					
	Total	**25-35**	**36-45**	**46-55**	**56-65**	**66-75**	**76-82**
1900	47.7	39.2	47.6	55.4	62.7	67.2	68.5
1910	46.6	37.5	46.7	55.9	61.9	66.8	68.5
1920	46.9	37.7	46.5	55.5	62.6	66.1	68.8
1930	48.1	37.5	48.5	57.7	65.1	69.7	70.1
1940	42.7	33.5	42.1	51.0	57.5	60.3	62.3
1960	62.5	56.2	68.1	69.5	69.3	69.8	67.2
		Relative Size of Age Cohort[1]					
1940		0.24	0.21	0.19	0.12	0.07	0.01
1960		0.20	0.21	0.18	0.14	0.10	0.03

[1]The relative size is based on age 20 through age 86

Source: U.S. Life Cycle tables. and US. Census Bureau

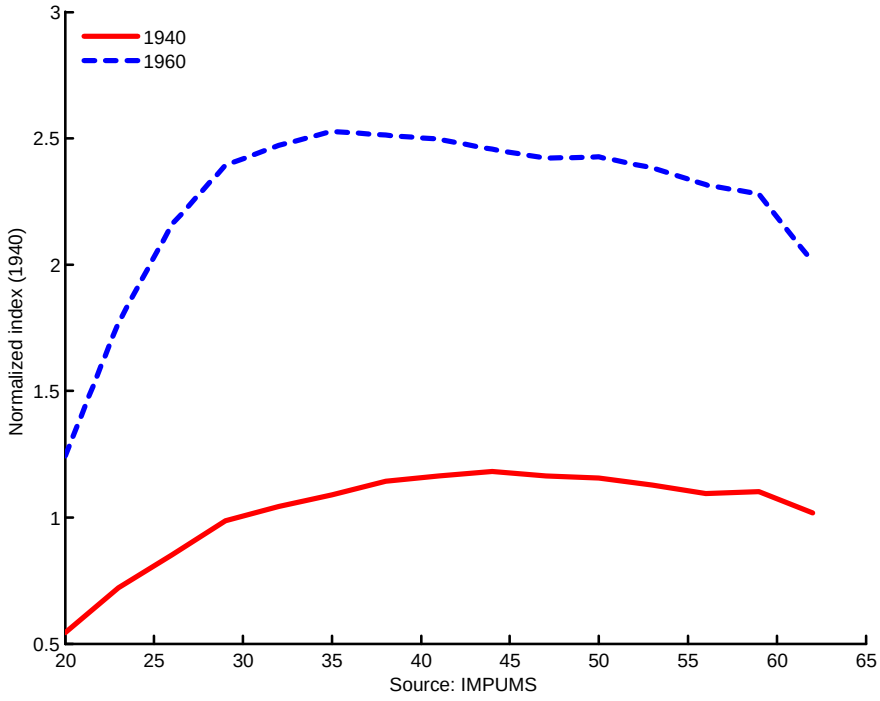
2.1 The Economic Environment

Not surprising, the economic environment changed substantially between 1935 and 1960. In the late 1930s and early years of the 1940 decade, the economy was recovering from the Great Depression. In addition, the economic environment changed due to a number of institutional changes that occurred in response to the Great Depression. Some of these institutional changes

will be discussed when the mortgage market is described for this time period. Before examining the institutional enviroment, we will focus on changes income, interest rates, and home prices.

In 1940 real GDP (in 1940 prices) was 101.4 billion (in 1940 prices). By 1960, real GDP increased to 243.3 billion (1940 prices) or an increase by a factor of 2.4. If real per capita GDP is examined so that population growth is considered, per capita real GDP increases by a factor of 1.77. A third way so measure the change in come between these two time period is to examine the change in per capita income. For this same period, wage income per capita increased by a factor of 2.6.[1] While an increase in real income is important, it equally to see how wage income changed by age cohort. We use 1940 and 1960 census data on (real) wage income to construct wage efficiency indices by age cohort. In Figure 2 we present these indices for 1940 and 1960. As can be seen, the wage efficiency indices for 1960 are much higher for all age groups in 1960. More importantly for homeownership, a steep increase in the wage efficiency index occurs between age 20 and 35. In addition, the peak in wage efficiency seems to have shifted toward younger cohorts in 1960 compared to 1940. These wage developments suggest workers could acquire funds needed invest in housing earlier in their life cycle in 1960 than 1940. These facts suggest that income could certainly be an important factor in the explanation of the increase in homeownership.

Figure 2: Wage Efficiency Indices for 1940 and 1960

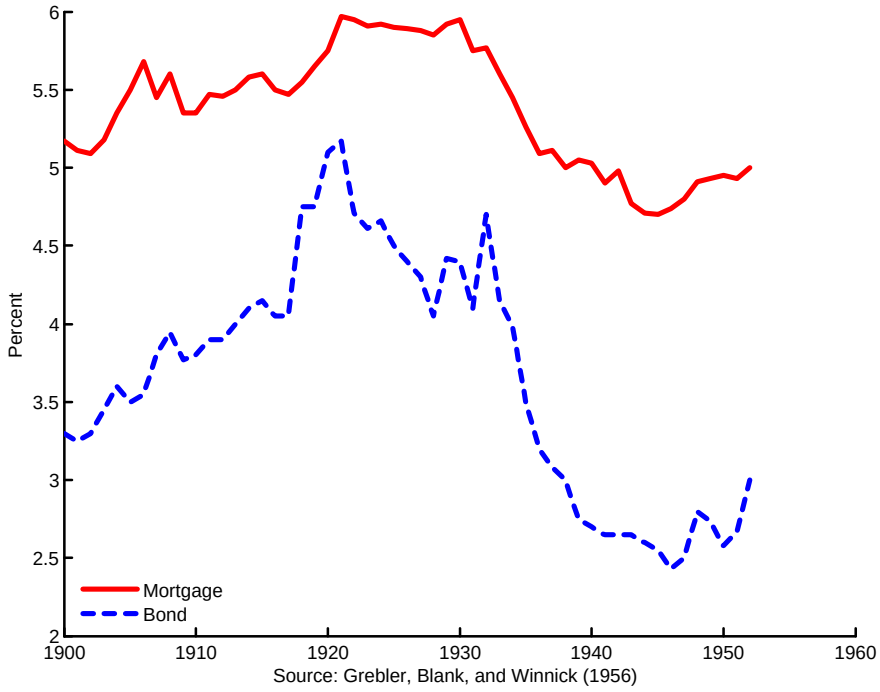


An increase in workers income does not necessarily translate into an increase in home participation. The cost of funding the home purchase as well as the cost of the home are equally important factors. Case-Shiller has constructed home price indices for the period 1935 to 1960. Their data suggests that home prices increased 41.4 percent over this 20 year period. This increase is less than the increase in real income. Mortgage interest rate are more difficult to find for this period. Grebler, Blank, and Winnick (1956, Table O-1, p. 496) report a mortgage rate series for Manhattan between 1900 and 1953 as well as a bond yield. The important changes in the mortgage market that occurred over this period of time could have implications

[1] Wage income is defined as total compensation of employees plus .65 of proprietors'income. Wage income is expessed in 1940 prices. To convert this into a per capita value, we divide by total employment.

for mortgage interest rates, the structure of mortgage contracts,or government policy. As can be seen in Figure 3, the mortgage interest rate was 5.11 percent in 1900, while the bond yield was 3.25. Between 1900 and 1930, both interest rates had an increasing trends. After 1930 mortgage interest rates declined from the 1930 peak if 5.95 percent to around 4.9 percent. This parially reflected an easy money policy. This can be clearly seen in the large decline in bond yields over this period. This figure illustrates why some economic historians believe an easy money policy played a large role in the increase in homeownership.

Figure 3: Bond and Mortgage Rates: 1900-1953



2.2 Mortgage Market Changes

Over this period, a number of changes occurred in the mortgage market that could account for the rising homeownership rate. In 1900, mortgage lenders consisted of mutual savings banks, life insurance companies, savings and loan associations and commercial banks. Mutual savings banks were the dominate lender, while commercial banks played a small role. The importance of mutual saving banks declined while life insurance companies and savings and loans associations substantially increased their market shares. Commercial banks become important mortgage lenders after World War II. In the early 1900, principles embodied in the National Banking Act made real estate loans inconsistent with sound banking practise. Hence, any commercial bank that issued mortgage loans were likely to be state chartered. In 1913, the Federal Reserve Act liberalized restrictions that limited participation in the mortgage market on national banks. As a result, the importance of commercial banks in this market steadily increased.

Perhaps a more important change occurred in the structure of the mortgage contract. Loan-to-value ratios, length of contract, and contract structure as related to amortization were changing. A common belief is that mortgage interest loans were nonamoritizing in the period 1920 to 1940. In other words, the mortgage contract can be characterized as a short term balloon type contract with high down payment. Grebler, Blank, and Winnick (1956) examine data from life insurance companies, commercial banks, and savings and loans and find that partially amortizing loans did exist in the period 1920-1950. Between 1920 and 1940, approximately fifty percent

of mortgage loans issued by commercial banks were unamortized contracts. For life insurance companies, approximately 20 percent in the period 1920-1934 were nonamoritizing while the percent of nonamoritizing loans for saving and loans associations did not exceed 7 percent of this same period. However, over the period 1940-1946, Saulnier (1950) reports that 95 percent of mortgage loans issued by saving and loan associations were fully amortizing. Over approximately the same period, Behrens (1952) claims 73 percent of loans issued by commercial banks were fully amortized and Edward (1950) finds 99.7 if saving and loan association contracts were fully amortized.

However, the belief that mortgage contracts in the early years were of short duration and with low loan-to-value ratio is accurate. In Table 2, mortgage durations are presented for loans originated by saving and loan associations, commercial banks, and saving and loan associations. As can be seen, for the period 1920 to 1930, the average duration was between 6 and 11 years. After 1934, the length of mortgages increased and started to approach 20 year mortgages. This was especially true for mortgages offered by life insurance companies. Loan-to-value ratios also changed over this period. For the 1920-34 subsample, loan-to-value rations were around 50. After 1934, loan-to-value ratios began to increase, and by 1947 this ratio started to approached 80 percent.

Table 2: Properties of Mortgage Contracts between 1920 and 1950 (Yearly Average)

	Mortgage Duration			**Loan-to-Value Ratio**		
	Life Insurance	Commercial	S & L	Life Insurance	Commercial	S & L
Period	Companies	Bank	Associations	Companies	Bank	Associations
1920-24	6.4	2.8	11.1	47	50	58
1925-29	6.4	3.2	11.2	51	52	59
1930-34	7.4	2.9	11.1	51	52	60
1935-39	16.4	11.4	11.4	63	63	62
1940-44	21.1	13.1	13.1	78	69	69
1945-47	19.5	12.3	14.8	73	75	75

Source: Data for life insurance companies is from R. J. Sailnier, Urban Mortgage Lending by Life Insurance Companies, National Bureau of Economic Research, 1950, for commercial banks is from C. F. Behrens, Commercial Bank Activities in Urban Mortgage Financing, National Bureau of Economic Research, 1952, and saving and loan association is from J. E. Morton, Urban Mortgage Lending: Comparative Markets and Experience, Princeton University Press, 1956.

An obvious question is why did mortgage contracts start to change after 1934? Prior to 1930, there was little federal involvement in housing except for land grants as exemplified by the 1862 Homestead Act. The Great Depression changed government's role in residential housing. As a result of the foreclosure problem that coincided with the 1929 collapse, Congress responded initially with Home Loan Bank Act of 1932. This Act brought thrift institutions under the Federal regulation umbrella. The Home Owners Loan Act Bank (1933) and the 1934 National Housing Act were passed. These Acts were designed to stabilize the financial system. The National Housing Act established the Federal Housing Administration(FHA) which introduced a government guarantee in hopes of spurring construction. [2] The FHA home mortgage was initially a 20-year, fully amortizing loan with a maximum loan-to-value ratio of 80 percent. Carliner (1989) argues that the introduction of this loan contract influenced the behavior of

[2] Marriner Eccles (1951), who was a central figure in the development of the FHA made it clear the the main intent of the program was "pump-priming" and not reform of the mortgage market.

existing lenders, thus partially explaining the data trends presented in Table 2. The contract took time to be implemented as state laws limiting loan-to-value ratios had to be modified. The FHA also added restricted design, construction and underwriting standards. These government programs, that were part of "New Deal" legislation, are thought to have increased homeowner participation.

A second government policy that could impact homeownership, especially after 1950, was federal guarantees for individual mortgage loans. Because of the treatment of veterans after World War I, Congress passed the Servicemen's Readjustment Act of 1944, or the "GI Bill."[3] This program was a benefit to veterans. Initially no downpayments were required on the theory that soldiers were not paid enough to accumulate savings and did not have an opportunity to establish a credit rating. Here are the relevant aspects of this program. Under the original VA loan guarantee program, the maximum amount of guarantee was limited to 50% of the loan, and not to exceed $2000. Loan durations were limited to 20 years, with a maximum interest rate of 4%. These ceilings were eliminated when market interest rates greatly exceeded this ceiling. The VA also set the price of the home. Because of rising house prices in 1945 the maximum amount of the guarantee to lenders was increased to $4,000 for home loans. The maximum maturity for real estate loans was extended to 25 years for residential homes. In 1950, the maximum amount of guarantee was increased to 60% of the amount of the loan with a cap of $7,500. The maximum length of a loan was lengthened to 20 years.

Were these programs quantitatively significant? In Table 3, the value of FHA and VA mortgage are reported as well as the relative importance of these mortgages in the total home mortgage market. These statistics come from Grebler, Blank, and Winnick (1956,p. 243). While these government mortgage programs took a while to have an impact, by 1940, FHA and VA mortgages accounted for 13.5 percent of mortgages, and by 1945 these mortgages accounted for nearly a quarter of mortgages. In 1950 the home mortgage share of FHA and VA mortgages was 41.9 percent. The increased role of these government programs is due to the growth of VA mortgage contracts. Between 1949 and 1953, VA mortgage loans averaged 24.0 percent of the market. Clearly, these statistics suggest the VA mortgage program may have had a significant effect on homeownership and seem to support Fetters(2010) claim that the VA program lead

[3] A "veteran" mean an individual served at least 90 days on active duty and was discharged or released under conditions other than dishonorable. Service time was much higher some an individual who was in the military, but not on active duty. For World War II active duty was between September,1940 to July 1947. The Korean conflict was the period June, 1950 to January 1955.

to a 10 percent increase in the homeownership rate.

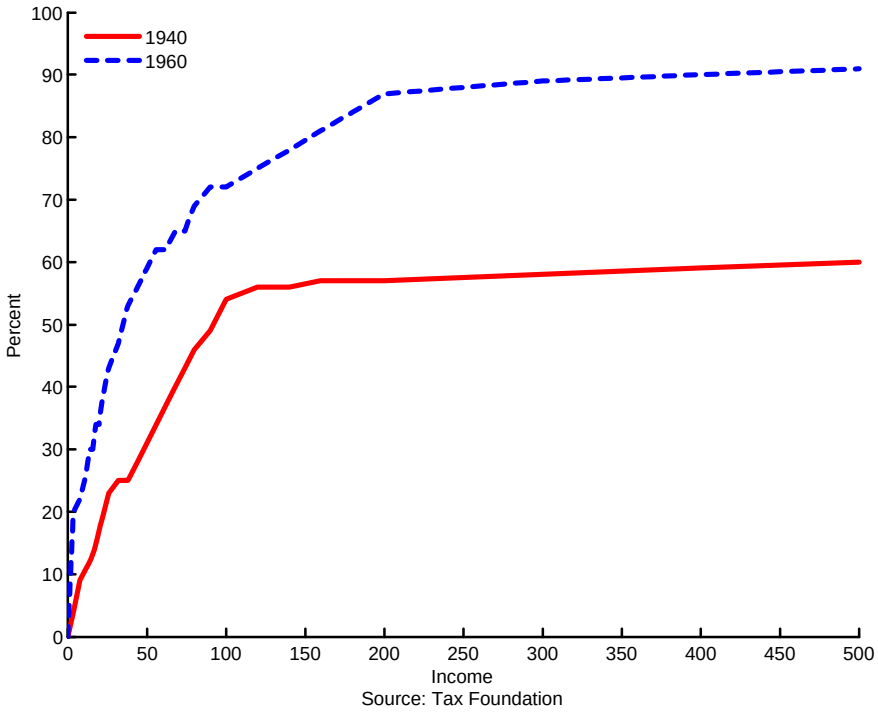
Table 3: The Role of Government Mortgage Debt for Home Mortgages:1935 to 1953

	FHA (in millions)	VA (in millions)	Combined (in millions)	Total Home Mort. (in millions)	FHA and VA Home Mortgages as a percent of total
1936	$12		12		
1936	203		203	15,615	1.3
1937	594		594	15,673	3.8
1938	967		967	15,852	6.1
1939	1755		1755	16,402	10.7
1940	2349		2349	17,400	13.5
1941	3030		3030	18,364	16.5
1942	3742		3742	18,254	20.5
1943	4060		4060	17,807	22.8
1944	4190		4190	17,983	23.3
1945	4078	$500	4578	18,534	24.7
1946	3692	2,600	6292	23,048	27.3
1947	3781	5,800	9581	28,179	34.0
1948	5269	7,200	12469	33,251	37.5
1949	6906	8,100	15006	37,515	40.0
1950	8563	10,300	18863	45,019	41.9
1951	9677	13,200	22877	51,875	44.1
1952	10770	14,600	25370	58,188	43.6
1953	11990	16,100	28090		

Source: , p243.

Rosen and Rosen (1980) have argued that tax policy changes introduced an incentive to purchase homes. The Tax Foundation has constructed marginal tax rates by income level for 1935 and 1960. In Figure 4, the marginal taxes for each year is presented. As can be seen, marginal tax rate were substantially lower in 1935. In fact, the highest marginal tax rate in 1935 was 63 percent for tax households earning $2 million or more. In 1960, the top marginal rate was 91 percent for households over $200,000. The evidence is suggestive that fiscal policy code have fostered an increase in the homeownership rate.

Figure 4: Marginal Tax Rates in 1935 and 1960



Source: Tax Foundation (http://www.taxfoundation.org)

This section suggest a number factors could been important in constructing an explanation for the increase in homeownership between 1935 and 1960. We next construct a model that will allow us to quantify the relative importance of these factors.

3 Model

The model is based on the overlapping generations economy with housing and long-term mortgages developed in Chambers, Garriga, and Schlagenhauf (2009). The economy consists of households, a final goods producing sector, a rental property sector, a mortgage lending sector and a government that engages in a number of activities.

3.1 Households

Age Structure. We develop a life-cycle model with *ex-ante* heterogeneous individuals. Let j denote the age of an individual and let J represent the maximum number of periods an individual can live. At every period, an individual faces mortality risk and uninsurable labor earning uncertainty. The survival probability, conditional on being alive at age j, is denoted by $\psi_{j+1} \in [0,1]$, with $\psi_1 = 1$, and $\psi_{J+1} = 0$. Earning uncertainty implies that the individual is subject to income shocks that cannot be insured via private contracts. In addition, we assume that annuity markets for mortality risk are absent. The lack of these insurance markets creates a demand for precautionary savings to minimize fluctuations in consumption goods, c, and in the consumption of housing services, d, over the life-cycle.

Preferences. Individual preferences rank goods (consumption and housing) according to a momentary utility function $u(c, d)$.

Asset Structure. Individuals have access to a portfolio of assets to mitigate income and mortality risk. We consider two distinct assets : a riskless financial asset denoted by a' with a net return r and a risky housing durable good denoted by h' with a market price p where the prime is used to denote future variables. This assumption simplifies the problem because households do not need to anticipate changes in house prices. A housing investment of size h' can be thought of as the number of square feet in the house. A house of size h' yields s services.[4] If a household does not invest in housing, $h = 0$, the household is a renter and must purchase housing services from a rental market. The rental price of a unit of housing services is R.

Mortgage Contracts. Housing investment is financed through long-term mortgage contracts. These contracts have a general recursive representation. Consider the expenditure associated with purchase of a house of size h (i.e. square feet) with a unit price p (per square feet). In general, a mortgage loan requires a downpayment equal to χ percent of the value of the house. The amount χph represents the amount of equity in the house at the time of purchase, and $D_0 = (1-\chi)ph$ represents the initial amount of the loan. In a particular period, denoted by n, the borrower faces a payment amount m_n (i.e., monthly or yearly payment) that depends on the size of the original loan D_0, the length of the mortgage, N, and the mortgage interest rate, r^m. This payment can be subdivided into an amortization, (or principal) component, A_n, which is determined by the amortization schedule, and an interest component I_n, which depends on the payment schedule. That is,

$$m_n = A_n + I_n, \qquad \forall n. \tag{1}$$

where the interest payments are calculated by $I_n = r^m D_n$.[5] An expression that determines how the remaining debt, D_n, changes over time can be written as

$$D_{n+1} = D_n - A_n, \qquad \forall n. \tag{2}$$

This formula shows that the level of outstanding debt at the start of period n is reduced by the amount of any principal payment. A principal payment increases the level of equity in the home. If the amount of equity in a home at the start of period n is defined as H_n, a payment of principal equal to A_n increases equity in the house available in the next period to H_{n+1}. Formally,

$$H_{n+1} = H_n + A_n, \qquad \forall n, \tag{3}$$

where $H_0 = \chi ph$ denotes the home equity in the initial period.[6]

Prior to the Great Depression the typical mortgage contract was characterized by no amortization and a balloon payment at termination. A balloon loan is a very simple contract in which the entire principal borrowed is paid in full in last period, N. The amortization schedule for this contract can be written as:

$$A_n = \begin{cases} 0 & \forall n < N \\ (1-\chi)ph & n = N \end{cases} .$$

[4] For the sake of simplicity, we assume a linear relationship between house and services generated. In other words, $s = h'$.

[5] The calculation of the mortgage payment depends on the characteristics of the contract, but for all contracts the present value of the payments must be equal to the total amount borrowed,

$$D_0 \equiv \chi ph = \frac{m_1}{1+r} + \frac{m_2}{(1+r)^2} + ... + \frac{m_N}{(1+r)^N}.$$

[6] It is important to state that this framework assumes no changes in house prices for the sake of simplicity. If house prices are allowed to change, then the equity equation would have to allow for capital gains and losses.

This means that the mortgage payment in all periods, except the last period, is equal to the interest rate payment, $I_n = r^m D_0$. Hence, the mortgage payment for this contract can be specified as:

$$m_n = \begin{cases} I_n & \forall n < N \\ (1 + r^m) D_0 & n = N \end{cases},$$

where $D_0 = (1 - \chi)ph$. The evolution of the outstanding level of debt can be written as

$$D_{n+1} = \begin{cases} D_n, & \forall n < N \\ 0, & n = N. \end{cases}.$$

With an interest-only loan and no changes in house prices, the homeowner never accrues equity beyond the initial downpayment. Hence, $A_n = 0$ and $m_n = I_n = r^m D_0$ for all n. In essence, the homeowner effectively rents the property from the lender and the mortgage (interest) payments are the effective rental cost. As a result, the monthly mortgage payment is minimized because no periodic payments toward equity are made. A homeowner is fully leveraged with the bank with this type of contract. If capital gains are realized, the return on the housing investment is maximized. If the homeowner itemizes tax deductions, a large interest deduction is an attractive by-product of this contract.

After the Great Depression, FHA sponsored a new mortgage contract characterized by a longer duration, lower downpayment requirements (i.e., higher loan-to-value ratios), and self-amortizing with a mortgage payment comprised of both interest and principal. This loan product is characterized by a constant mortgage payment over the term of the mortgage, $m \equiv m_1 = ... = m_N$. This value, m, must be consistent with the condition that the present value of mortgage payments repays the initial loan. That is,

$$D_0 \equiv \chi ph = \frac{m}{1 + r} + ... + \frac{m}{(1 + r)^{N-1}} + \frac{m}{(1 + r)^N}.$$

If this equation is solved for m, we can write

$$m = \lambda D_0,$$

where $\lambda = r^m[1 - (1 + r^m)^{-N}]^{-1}$. Because the mortgage payment is constant each period, and $m = A_t + I_t$, the outstanding debt decreases over time $D_0 > ... > D_N$. This means the fixed payment contract front loads interest rate payments,

$$D_{n+1} = (1 + r^m) D_n - m, \qquad \forall n,$$

and, thus, back-loads principal payments,

$$A_n = m - r^m D_n.$$

The equity in the house increases each period by the mortgage payment net of the interest payment component.

$$H_{n+1} = H_n + [m - r^m D_n], \qquad \forall n.$$

Household Income. Household income varies over the buyer's life-cycle and depends on whether the individual is a worker or a retiree, the return from savings and transfer programs, and the income generated from the decision to rent property when a homeowner. Households supply there time endowment inelastically to the labor market and earn wage income, w, per effective unit of labor. Household's productivity depends on an age component, v_j, and a

transitory age-dependent idiosyncratic component ϵ_j drawn from a age-specific probability distribution $\Pi(\epsilon_j)$. For an individual younger than j^*, labor earnings are then $w\epsilon_j \upsilon_j$. Households of age j^* or older receive a social security transfer that is proportional to average labor income, and is defined as θ. Pretax labor earnings are defined as y_w, where

$$y_w(\epsilon, j) = \begin{cases} w\epsilon_j \upsilon_j, \text{ if } j < j^* \\ \theta, \qquad \text{if } j \geq j^* \end{cases} .$$

A second source of income is available to households who invest in housing and decide to rent part of their investment. A household that does not to consumes all housing services, $h' > d$, can pay a fixed cost $\varpi > 0$ is paid, and receive rental income $y_R(h', d)$

$$y_R(h', d) = \begin{cases} R(h' - d) - \varpi, \text{ if } h' > d \\ 0, \qquad\qquad\qquad \text{if } h' = d \end{cases}$$

Saving and transfers provide an additional sources of income. Households with positive savings receive $(1 + r)a$. The transfers are derived from the households that die with positive wealth The value of all these assets is uniformly distributed to the households that remain alive in an equal lump sum amount of tr. The (pre-tax) income of a household, y, is simply

$$y(h', a, \epsilon, d, j) = y_w(\epsilon, j) + y_R(h', d) + (1 + r)a + tr$$

The various income sources generate a tax obligation of T, which depends on labor income, y_w , net interest earnings from savings, ra, rental income, y_R, less deductions that are available in the tax code, Ω. Examples of deductions could be the interest payment deduction on mortgage loans or maintenance expenses associated with tenant-occupied housing. Total tax obligations are denoted as

$$T = T(y_w(\epsilon, j) + ra + y_R(h', d) - \Omega).$$

A household budget constraint can not be written for this problem. The reason is that the households makes tenure decisions. In each period a renter could purchase a home, or a homeowner could change the size of their house or even become a renter. Hence, the household's budget constraint depends on the value of the current state variables. The relevant information at the start of the period is the level of asset holding, a, the housing investment, h, the mortgage counter, n, and age, j. To simplify notation, let $x = (a, h, n, j)$ summarize the household's state vector. A household could face a number of budget constraints depending on the tenure decision.

The Household Decision Problem. Individuals make decisions over consumption goods, c, housing services, s, a mortgage contract type, z, and investment in assets , a', and housing, h'. The household's current-period budget constraint depends on the household's asset holdings, the current housing investment, the remaining length of the mortgage, labor income shock, and

age. We can isolate five possible decision problems that a household must solve.

Table 4: Basic Structure of the Model

Current renter: $h = 0$	Continues renting $h' = 0$
	Purchases a house $h' > 0$
Current owner: $h > 0$	Stays in house: $h' = h$
	Change size (Upsize or downsize): $h' \neq h$
	Sell and rent: $h' = 0$

We now detail the various decisions problems. First, we consider an individual who starts as a renter, and then we consider the decision problem of an individual who starts as a homeowner.

- **Renters:** An individual who is currently renting, $(h = 0)$, has two options: continue renting, $(h' = 0)$, or purchase a house, $(h^{'} > 0)$. This is a discrete choice in ownership that can easily be captured by the value function v (present and future utility) associated with these two options. Given the relevant information vector $x = (a, 0, 0, j)$, the individual chooses the option with the higher value, which can be expressed as

$$v(x) = \max\{v^r, v^o\}.$$

The value associated with continued renting is determined by the choice of goods consumption, c, housing services, s, and a', which solves the problem

$$v^r(x) = \max u(c, s) + \beta_{j+1} Ev(x'), \tag{4}$$
$$s.t. \quad c + a' + Rd = y(x) - T.$$

The household is subject to nonnegativity constraints on c and d, as well as the restriction that $a' \geq 0$. These constraints are present in all possible cases and are not explicitly stated in the other cases. [7] The evolution of the state vector summarizing future information is $x' = (a', 0, 0, j + 1)$.

The individual who purchases a house solves a different problem as choices must now be made over $h^{'} > 0$, as well as c, s, and a'. This decision problem can be written as:

$$v^o(x) = \max u(c, s) + \beta_{j+1} Ev(x'), \tag{5}$$
$$s.t. \quad c + a' + (\phi_b + \chi)ph' + m(h', n; p) = y(x) - T,$$

The purchase of a home requires use of a long-term fixed-rate mortgage loan.[8] The mortgage contract is a function that specifies the length of the contract, N, the down payment

[7] The change in the size of rental property (flow) is not subject to transaction costs; only the change in housing investment (stock) is subject to frictions.

[8] According to the American Housing Survey (AHS) and POMS, 91 percent of homeowners and 87 percent of landlords use fixed rate mortgages.

fraction, $\chi \in [0,1]$, and the payment schedule, m. The decision to buy a house of value ph' implies total borrowing must equal $D_N = (1-\chi)ph'$. The payment structure depends on the mortgage available at any given time period. The purchase of a house only requires an expenditure of the downpayment and associated transaction costs, ϕ_b.

- **Owners:** The decision problem for an individual who currently owns a house, $(h > 0)$, has a similar structure. However, a homeowner faces a different set of options: stay in the same house, $(h' = h)$, purchase a different house, $(h' \neq h)$, or sell the house and acquire housing services through the rental market, $(h' = 0)$. Given the relevant information $x = (a, h, n, j)$ the individual solves.

$$v(x) = \max\{v^s, v^c, v^r\},$$

Each of these three different values is calculated by solving three different decision problems. If the homeowner decides to stay in the current house the optimization problem can be written as:

$$v^s(x) = \max u(c, h') + \beta_{j+1} Ev(x') \tag{6}$$
$$s.t. \quad c + a' + m(h, n; p) = y(x) - T.$$

This problem is very simple, because the homeowner must make decisions only on consumption and saving after making the mortgage payment. If the mortgage has been paid, $n = 0$ and $m(h, n; p) = 0$. Otherwise, the mortgage payment is positive. Next period's state is given by $x' = (a', h, n', j+1)$ where $n' = \max\{n-1, 0\}$. The sale of the house generates revenue, $\Pi = (1-\phi_s)p\xi h - D(h, n; p)$, that nets selling costs, ϕ_s, and any remaining principal on the mortgage loan, $D(p, h)$.[9] The consumer problem is

$$v^c(x) = \max u(c, h') + \beta_{j+1} Ev(x')$$
$$s.t. \quad c + a' + (\phi_b + \chi)ph' + m(h, n; p) = y(x) + \Pi - T.$$

This individual must sell the existing property to purchase a new one. The choices depend on the income received from selling the property, ph, net of transactions costs from selling, ϕ_s, and the remaining principal $D(n)$ owed to the lender. The relevant future information is given by $x' = (a', h', N-1, j+1)$.

Finally, we solve the problem of a homeowner who sells the house $h > 0$ and becomes a renter $h' = 0$. [10] The optimization problem is very similar to the previous one. However, in this case the individual must sell the home and rent Rs. Formally,

$$v^r(x) = \max u(c, s) + \beta_{j+1} Ev(x'), \tag{7}$$
$$s.t. \quad c + a' + Rd = y(x) + \Pi - T.,$$

the future state vector is $x' = (a', 0, 0, , j+1)$. Given the initial information summarized in x, the choice of whether to stay in the house, change the housing size, or sell the house and become a renter depends on the values of v^s, v^c,and v^r.

[9] Because our analysis is conducted at the steady state, other than the differences in transaction costs and idiosyncratic capital gains, there are no differences in the purchase and selling price.

[10] In the last period, all households must sell h, rent housing services and consume all their assets, a, as a bequest motive is not in the model. In the last period, $h^{'} = a' = 0$.

3.2 Mortgage Lending Sector

The financial intermediary is a zero-profit firm. This firm receives deposits from households, a', and uses these funds to make loans to firms and households. Firms acquire loans of capital to produce goods, and households use long-term mortgages to finance the housing investment. Financial intermediaries receive mortgage payments, principal payments from those individuals who sell their homes with an outstanding mortgage position, as well as the outstanding principal of individuals who unexpectedly die. The formulation of the market clearing condition derived from zero profit on the lender side is described in the Appendix.

3.3 Production of Final Goods

A representative firm produces a good in a competitive environment that can be used either for consumption, government, capital, or housing purposes. The production function has the property of constant returns to scale, $F(K, L) = K^{\alpha}L^{1-\alpha}$, where K and L denote the amount of capital and labor respectively, and the term α represents the labor share. The aggregate resource constraint is given by

$$C + C_H + I_K + I_H + G + \Upsilon = K^{\alpha}L^{1-\alpha}, \tag{8}$$

where C, I_K, I_H, G, and Υ represent aggregate consumption, capital investment, housing investment, government spending, and various transactions costs, respectively.[11]

3.4 Government Activities

In this economy, the government engages in a number of activities. First, retirement benefits are provided through a pay-as-you-go social security program. Social security contributions are used to finance a uniform transfer upon retirement that represents a fraction of average income. Second, exogenous government expenditure is financed by using a nonlinear income tax scheme. The financing of government expenditure and social security are conducted under different budgets. Finally, the government redistributes the wealth (housing and financial assets) of individuals who die unexpectedly. Both housing and financial assets are sold and any outstanding debt on housing is paid off. The remaining value of these assets, in conjunction with the profits from the corporate rental sector, are distributed to the surviving households as a lump-sum payment, tr. In the model, newborn cohorts do not receive the transfer as they start life with an initial endowment of financial assets as observed in the data.

3.5 Stationary Equilibrium

In the model a stationary equilibrium includes optimal decisions that are function of the individual state variables, $x = (a, h, n, \epsilon, j)$, prices $\{r, w, R\}$, market clearing conditions, and a distribution over the state space $\Phi(x)$ that are constant over time. A formal definition of the recursive equilibrium is presented in an appendix which is available as supplementary material.

4 Model Estimation and Calibration

In order to determine the critical factors that account for the large increase in the homeownership rate between 1935 and 1960, functional forms and parameter values must be specified.

[11] The definitions for aggregate housing investment and total transaction costs appear in the Appendix.

Some parameters can be directly specified using procedures established in the literature. Other parameters must be estimated. We will employ a (exactly identified) first method of moments approach to estimate this set of parameters based on key properties of the U.S economy observed over the period 1935-1940.[12] This period is chosen so as to minimize the potential structural effects on the housing market due to the National Housing Act. While this act was passed in 1934, the substantive effects of this legislation only began to impact housing markets late in the 1930's. We will begin by discussing the estimation of the model for the period 1935-40.

4.1 The Specification of the 1935-40 Model

Population Structure: A period in the model corresponds to three years. An individual enters the labor force at age 20 (model period 1), and lives a maximum of 83 years (model period 23). Mandatory retirement occurs at age 65 (model period 16). Demographic parameters that need to be specified are the survival probabilities, $\{\psi_{j+1}\}$, as well as the relative size of each age cohort, μ_j. The survival probabilities are from the National Center for Health Statistics, *United States Life Tables* (1935,1940). Usually a population growth rate is specified and the corresponding steady state size if each cohort is generated. In this paper, the actual age cohorts are specified using data from the 1940 US Census. We recognize the normal convention is to calculate an equilibrium with under an assumption of a demographic steady state. Because of the argument that the increase in the homeownership was due to demographic factors, we think it is important to have an accurate representation of the 1935-40 period.

Functional Forms: The expected value of the discounted sum of momentary utility functions is specified as:

$$E\sum_{j=1}^{J}\beta^{j-1}\psi_j\left[\gamma\frac{c_j^{1-\sigma_c}}{1-\sigma_c}+(1-\gamma)\frac{d_j^{1-\sigma_d}}{1-\sigma_d}\right]$$

This means that parameter values for β, γ, σ_c, and σ_d are required. The parameter σ_d is normalized to 1 and the value of σ_c is set at 3 to match the growth rate of housing over the consumption over the life-cycle. Unfortunately, we have to use relatively recent data as data for the 1935-40 period is not available. The parameters γ, which measures the relative importance if consumption in the momentary utility function, and β are estimated. The first parameter estimated to the housing-to-consumption ratio 0.180. The individual discount rate is determined to match a wealth-to-output ratio of 2.54. The ratio for 1935, where the capital stock is defined as private fixed assets plus the stock of consumer durables less the stock of residential structures (to be consistent with the capital stock in the model). Output is gross domestic product plus an estimate of the service flow from consumer durables less the service flow from housing.

Goods outputs is assumed to be produced by a production function with a Cobb-Douglas form. The capital share parameter, α, is set at 0.24 which is based on NIPA data for 1935. Since the model does not consider aggregate shocks, total factor productivity in this production function is normalize to equal unity. The depreciation rate of the firm's capital capital stock, δ, is estimated to the ration of fixed capital investment to GDP.

Income endowments: According to the model, two components of the household income process must be measured. One component is the age specific earnings component, υ_j.In order to generate this component, we average salary and wage income by age from Public Use Microdata Samples (PUMS) 1940. (We use the 1960 PUMS to calculate the age-earnings component for

[12] In principal, all parameter could be estimated if a equal number of targets were specified. We are restricted to estimating a subset of parameter due to the computational complexity of the joint estimation and model solution problem.

1960). In Figure 2, we present the resulting age specific earnings component. The other earnings component is the stochastic component. Storesletten, Telmer, and Yaron (2004) find persistence. This finding is based on a sample of household data over many periods drawn from the Panel Survey on Income Dynamics (PSID). Obviously, this survey did not exist for the periods focused on in this paper. Our income data is restricted to the PUMS data set for 1940 and then 1960. The PUMS data contains wage income information for 1 percent of the sample of housing units. Unfortunately, the data is only available every 10 years. The availability of data once every ten years does not allow us to estimate a serially correlated income process. This may not be a severe problem given the longer run focus of this study. As a result, we consider the stochastic component to be an independent and identically distributed age dependent income shock, ϵ_j.

This income process can be estimated using a Kernel density estimation for every age cohort, $\Pi_t(\epsilon_j)$ for each time period. Since the model period is 3 years, the income process is estimated in the same time frame across cohorts. Although the approach does not capture the persistence of income shock, it captures the dispersion of labor income across age cohorts and reproduces the Gini coefficient for income in both time periods.

Government and the Income Tax Function: In 1940, the social security program was in its infancy. The payroll tax rate for a work was one percent of wage income. In addition, wage income for payroll tax purposes was capped at $3,000. We use a 30 percent replacement rate.

The income tax code in 1940 differentiated wage income from total net taxable income, which is equal to wage and interest income less interest payments such as mortgage interest payments. Each household receives an earned income credit. This credit is equal to 10 percent of wage income as as long as net income is less that $3,000. If net income exceeds $3000, the credit is calculated as ten percent of the minimum of wage income or total taxable income. The tax credit is capped at $1,400. In addition to the earned income credit, a household received a personal exemption of $800. If these two credit are subtracted from total net taxable income, adjusted taxable income is determined. A tax schedule is used to determine part of the tax obligation. In Figure 4, the marginal tax rates are plotted for the 1940 tax code. The highest marginal tax rate is 0.79 which applicable to income level exceeding $500,000. In 1940, a income tax surcharge equal to an additional 10 percent of the income tax obligation. The documentation for the 1940 tax code is the Internal Revenue Service and the Tax Foundation. In order to ensure that the income tax function generates the proper amount of revenue for 1940, an adjustment factor must be added to the tax code. This parameter can be thought of adding an intercept to the tax function. If too much revenue is generated, this parameter, τ_0, can be reduced. We estimate this adjustment factor by targeting the personal income tax revenue to GDP ratio. In 1935, this ratio was 0.01.

Wealth endowments: Bequests appeared to be an important source of homeownership for young households in 1940. Table 5 presents IRS data on real estate bequests in both 1940 and 1960.[13]

Table 5: 1940 and 1960 Real Estate Bequests

Year	Returns	Gross Bequest Value	Mortages and Debts	Net Bequest Value
1940	16,156	2,649,492,000	229,866,000	2,419,626,000
1960	52,070	2,857,330,000	690,038,000	1,867,292,000

Source: Internal Revenue Service, Historical Data

[13]The data in Table 5 are from U. S. Treasury Department, Bureau of Internal Revenue, Statistics on Income for 1940, Part 1. This data is compiles from individual income tax returns, taxable fiduciary income and defense tax returns, estate tax returns prepares under the direction of the Commissioner of Revenue by the statistics section, income tax unit. A similar document is used for 1960.

Although the number of returns tripled between 1940 and 1960, the total gross value of realestate bequests grew by less that 10 percent. However, the amount of outstanding debts on bequested real estate more than tripled in the same 20 year period. As a result, the net value of real estate bequests actually dropped by 23 percent between 1940 and 1960. Given the apparent importance of real estate bequests in 1940, we introduce an additional parameter W_0 to the model. This parameter represents the percentage of age one households who receive a bequest of a minimum size home. By using this percentage, the model generates the value of the bequest required for an age one households to match the homeownership rate for this age cohort. The value of transfers from accidental death is adjusted given the amounts of housing bequests to individuals.

Housing: The housing market introduces a number of parameters that must be specified. We have already pointed out amortizing loans were available in the 1930's. In our baseline model, we assume that homeowners could finance their home purchases with short duration balloon type contracts. We assume the balloon contract was for 12 years (or 4 model periods). A 50 percent is required. This means $N = 4$ and $\chi = 0.5$. The transaction costs from buying and selling property are set as follows: $\phi_s = 0$ and $\phi_b = 0.06$. The minimum house size, $\underline{h}$, is estimated to be consistent with the set of specified targets. The value of minimum size house determines the second housing grid point. The values δ_o and δ_r are crucial for the supply of rental property. Data is not available for readily available that allows estimation of these parameters. As a result were are forced to use the parameter values estimated in Chambers, Garriga, and Schlagenhauf (2009). We assume the annual depreciation rate of owner occupied homes, δ_0, is 0.0106. The depreciation rate for rental housing in annual terms, δ_r, is 0.0135.

4.2 Estimation and Evaluation of the 1935-1940 Model

The estimation of the set structural parameters $(\delta, \gamma, \beta, \underline{h}, \tau_0, W_0)$ is based on an exactly-identified Method of Moments approach along with the computation of market clearing (capital market, and rental market) under the restriction that government budgets balance. Table 5 reports the parameter values that generate aggregate statistics that are consistent with the U.S. economy. Parameters are estimated within one percent error for all the observed targets.

Table 6: Estimation of Model

Statistic	**Target**	**Model**	%**Error**
Ratio of wealth to gross domestic product (K/Y)	2.541	2.547	0.224
Ratio housing services to consumption of goods (Rs_c/c)	0.180	0.1799	-0.083
Ratio fixed capital investment to GDP ($\delta K/Y$)	0.1120	0.1123	0.224
Homeownership Ratio	0.454	0.4564	0.529
Personal Income Tax Revenue to output ($T(ay)/Y$)	0.01	0.0099	-0.07
Balanced bequests	0.00	0.0003	

Variable	**Parameter**	**Value**
Individual Discount Rate	β	0.91775
Share of consumption goods in the utility function	γ	0.9401
Depreciation rate of capital	δ	0.111
Minimum Housing Size	$\underline{h}$	4.1726
Lump sum tax transfer	τ_0	0.00079
Intital period bequested homes	W $_0$	0.2525

The model can be evaluated from various perspectives. In order to judge how the model performs, we focus on the homeownership rate. Homeownership rate statistics are only available for the census years 1930 and 1940. As can be seen in Table 7, the homeownership rate was 48.1 percent in 1930. In 1940 homeownership rate was only 42.7. Since the baseline model attempts to focus on the homeownership rate prior to the impact of the National Housing Act. We use the average of the of the homeownership rate in 1930 and 1940 - 45.4 percent - to be the target homeownership rate for 1935. Since we use the aggregate homeownership rate as an estimation target, it not surprising that the baseline model generates a homeonership close to this statistic. However, the age specific homeownership rates are not estimated. These rates can be evaluated with respect to the corresponding homeownership rates in 1930 and 1940. The pattern of the homeownership by age cohort is relatively similar. The lowest homeownership rate occurs in the youngest age cohort. The homeownership rate is increasing in age cohort. This

pattern is apparent in 1930 and 1940. The difference is that homeownership rates are higher in 1930. The model does generate this pattern by age chort, but does overstate the age specific homeownership rate starting with the age 46-55 cohort. The model generates a homeownership rate for the 76-82 cohort that is understated. This is explained by the end point constraints in an OLG model, as well as the restriction that bequest are only allowed in the form of accidental bequests so a household must sell their housing position at the beginning of last period of life and rent. Beyond these differences, the pattern between the data and the model is very similar.

Table 7: Homeownership Rates: 1935-40

		Homeownership by Age					
	Total	**25-35**	**36-45**	**46-55**	**56-65**	**66-75**	**76-82**
				Actual Data			
1930	48.1	37.5	48.5	57.7	65.1	69.7	70.1
1940	42.7	33.5	42.1	51.0	57.5	60.3	62.3
		Model Data					
1935-40	45.6	28.3	41.7	64.4	70.4	71.3	38.8

5 Evaluation of the 1935-40 and 1960 periods

In this section, we use our model, calibrated to the 1935-40 period, to conduct a series of counterfactual experiments in order to measure the relative importance of a proposed explanation for the changes in the homeownership rate between 1940 and 1960. In this section, we will examine the relative importance of six possible explanations: a change in the demographic structure of economy, an increase in real income, a change in the federal income tax structure, a change in the real price of housing, a mortgage market innovation, and a decline the spread between the overall interest rate and the mortgage interest rate spreads.

A starting point is to ask if all six of these changes occurred at the same time, what would the model predict homeownership would like in 1960? In order to answer this question, we maintain the calibrated parameters and five of the estimated parameters, $\beta, \gamma, \delta, \underline{h}$, and W_0 at their respective 1935-40 values. The 1940 survival and age cohort population shares are replaced with their 1960 counterparts. In the 1935-40 version of the model, wage income depended on an age-specfic productivity factor and an i.i.d. idiosyncratic factor. We use the PUMS data from the 1960 census to construct age-specific and idiosyncratic values for 1960. These factors were constructed in the same manner that the 1940 factors were constructed. In addition, real wage income per person in the labor force in 1960 was 2.25 times larger than the corresponding number for 1940. Since the age-specific productivity factors in 1940 and 1960 are normalize to equal one, we rescaled the 1960 values upwards by the 2.25 number. The federal income tax code changed significantly by 1960. Using data from the Tax Foundation and the The US Treasury Department Internal Revenue Service publication No. 17, we constructed a tax function faced by any household, (i.e., individual). This tax function had to account for the fact that renters were not likely to itemize their deductions. We assume all renters did not itemize deductions. As a result, these individuals used tax tables different from those households who itemize. In fact, nonitemizing households with income levels under $5,000 were able to use a tax table that differed from nonitemizers with income over $5,000. Individuals were allowed an individual deduction worth $600 that could be used to minimize the tax obligation. If a

household itemized expenses due to the mortgage interest rate deduction, another tax table was to be used to calculate the income tax obligation where taxable income excluded the mortgage deduction and the individual exemption. The various tax schedules were programmed so that the tax environment facing a household in 1960 is accurately reflected in the model. The tax adjustment coefficient, τ_0, was not held at the 1940 value. We estimated this parameter so that aggregate income tax obligation was consistent with a federal income tax-GDP ratio of 7.73 percent. Income tax obligations were much higher in 1960, and marginal tax rates were higher. This fact was clearly displayed in Figure 4. The top marginal tax rate in 1960 was 91 percent for income over $2 million. The payroll tax increased to 1.5 percent of wage income up to a cap of $4,800.

The mortgage contract employed in 1960 was substantially different from the mortgage contract of 1940. By 1960, the dominant mortgage was a fixed payment amortizing contract. This contract increases the loan-to-value constraint to eighty percent, (i.e., $\psi = 0.20$) and lengthened the duration of the contract to 30 years, (i.e., N = 10). Hence, we replaced the ballon contract with a fixed payment amortizing contract. An change that occurred between 1940 and 1960 was the size of the spread between the mortgage interest rate and risk free rate. In 1960, this spread was substantially smaller. Hence, we replaced the 1940 spread of 2.53 percent with the 1960 spread of 1.63 percent.[14] The last change in the 1940 baseline model dealt with house prices. The Case-Shiller data indicates that house prices increased by 41.5 percent between 1935 and 1960. We reset the housing price to the 1960 to reflect this price level.

Table 8 presents the model's prediction on the effect on homeownership if the various factors are jointly introduced. The actual aggregate housing participation rate in 1960 was 62.5 percent. The model indicates that the introduction of the 1960 values of these key factors would result in an aggregate ownership rate of 68.5 percent. The model has a bias toward homeownership as housing is not a risky investment. The model generated age-cohort ownership rates have a more pronounced hump as compared to actual 1960 data. The age 25-36 participation rate is lower than actual data. The 56.2 percent rate for households in the 25-36 age cohort may reflect the benefits from the VA program. This program has not been considered in the model. The model has the unattractive feature of very high homeownership rates in the 46-55, 56-65 and 66-75 age cohorts which again is due to the lack of housing price risk.

Table 8: Homeownership Rates 1960

		Homeownership by Age					
	Total	**25-35**	**36-45**	**46-55**	**56-65**	**66-75**	**76-82**
				Actual Data			
1960	62.5	56.2	68.1	69.5	69.3	69.8	67.2
				Model Data			
1960	67.6	43.7	72.4	85.0	89.7	92.3	46.7

Demographers, such as Chevan (1989), argue that demographic factors are the key to understanding the large increase the participation in housing. In order to examine this argument, we replace the 1940 survival rates and the relative age cohort sizes with their counterparts in 1960. The cohort sizes are normalized to sum to one. Table 9 presents the results of this experiment. Recall that the 1935-40 homeownership rate was 45.4 percent. The model suggests that the 1960 demographics would have resulted in an aggregate participation rate of 59.3 percent. Given that a preliminary examination by cohorts did not suggest large changes in cohort sizes, this may be

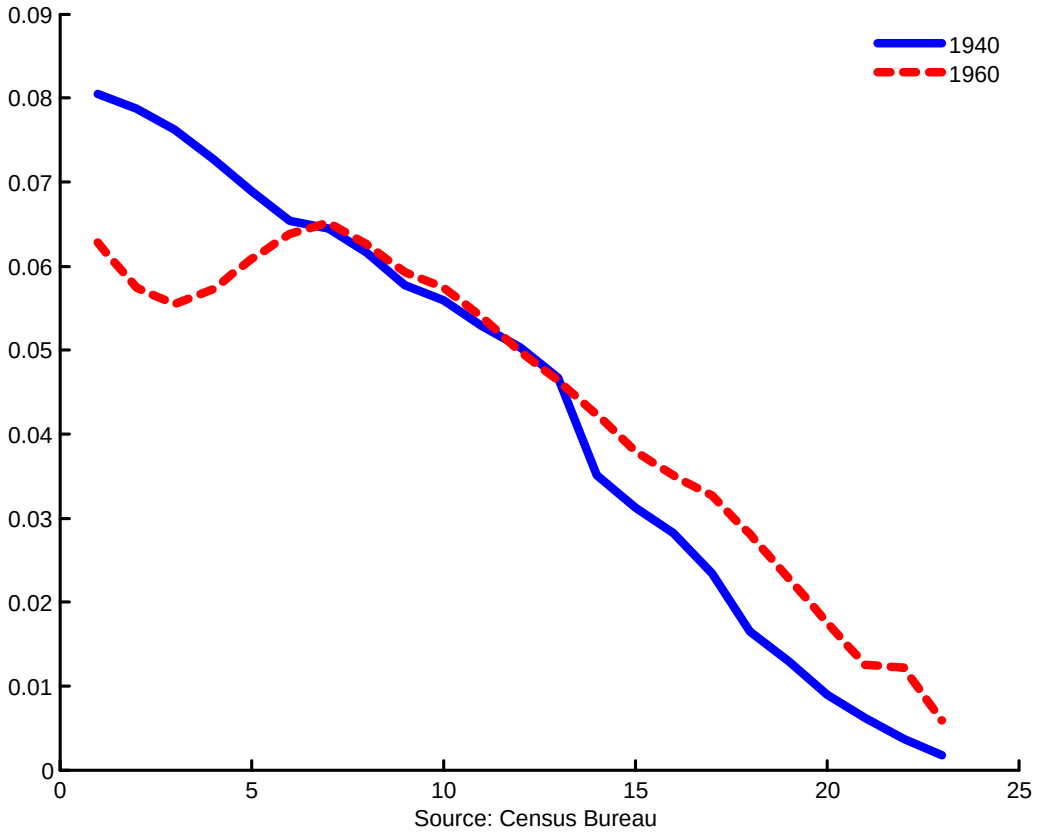
[14] The size of the spreads reflects the fact that a period in the model is three years.

viewed as a surprising result. In Figure 5, we present the relative cohort sizes for 1940 and 1960, holding population size constant. A closer examination of the data indicates why demographic changes seem to be important. The horization axis measures age in model periods. In 1960, the relative size of age cohorts under model age 5, (i.e., under age 35) were smaller. These are the cohorts where the age-cohort homeownership rates are the smallest. However, after model age 5, the relative size of the remaining cohorts are larger that the size of those same cohorts in 1940. As can be seen, this especially true after age 56. The 56-65 and 66-75 age cohorts have relatively large participation rates. The net effect is dominated by the older cohorts.

Table 9: The Importance of Demographic Factors

		Homeownership by Age					
	Total	**25-35**	**36-45**	**46-55**	**56-65**	**66-75**	**76-82**
				Actual Data			
1940	42.7	33.5	42.1	51.0	57.5	60.3	62.3
1960	62.5	56.2	68.1	69.5	69.3	69.8	67.2
				Model Data			
Benchmark (1940 pop.)	45.6	28.3	41.7	64.4	70.3	71.3	38.7
Benchmark(1960 pop.)	59.3	20.8	49.5	75.5	80.8	81.7	47.3

Figure 5



Rosen and Rosen (1980) argue that twenty-five percent of the increase in homeownership between 1949 and 1974 was a result of the benefits to housing that were included in the tax

code. We have documented that the tax code is more progressive in 1960 than the code in 1940. This change reflected the need for increased revenue to finance World War II and the Korean War. The benefits from the mortgage interest deduction are enhanced when the tax rates became more progressive. We examine the role of the changing tax structure by replacing the 1935 tax structure with the 1960 tax structure in Table 10. The 1960 tax structure resulted in a **decline** in the aggregate rate to 27.7 percent. This result is contrary to the Rosen and Rosen result. Why? Real income in 1940 was substantially smaller and more uniform. When the 1960 tax code is imposed in 1940, income is suffiently low to keep households from reaping the benefits in the tax code. In fact, the higher tax obligations resulted in less saving, which is reflected in an increase in the interest rate. The movement toward rental housing lead to a 11.9 percent increase in the rental price.

Table 10: The Importance of Tax Policy Changes

		Homeownership by Age					
	Total	**25-35**	**36-45**	**46-55**	**56-65**	**66-75**	**76-82**
				Actual Data			
1940	42.7	33.5	42.1	51.0	57.5	60.3	62.3
1960	62.5	56.2	68.1	69.5	69.3	69.8	67.2
				Model Data			
Benchmark (1940)	45.6	26.4	50.5	51.0	69.6	64.7	27.5
Benchmark (1960 Taxes)	27.7	19.8	18.2	23.7	31.4	78.7	49.9

Between 1935 and 1960 wage income changed significantly. Over this period wage income increase by a factor of 2.25. The pattern of the age-specific earning effect changes and the idiosyncratic age-specific shocks increase slightly in variance. Holding everything else at 1940 levels, when the 1960 wage income structure is introduced into the model, the aggregate homeownership rate increased to 74.3 percent. The change in income effect dominates all other possible facts. In Figure 2, the wage efficiencies for 1940 and 1960 are presented. The level change clearly indicates that more households can afford housing. In addition, the growth if income, reflected in the steepness of the wage efficiency between age 20 and 35 is much more pronounced in 1960. This means more first time households are likely to find home ownership a viable alternative to renting.

Table 11: The Importance of Income Changes

		Homeownership by Age					
	Total	**25-35**	**36-45**	**46-55**	**56-65**	**66-75**	**76-82**
				Actual Data			
1940	42.7	33.5	42.1	51.0	57.5	60.3	62.3
1960	62.5	56.2	68.1	69.5	69.3	69.8	67.2
				Model Data			
Benchmark (1940)	45.6	26.4	50.5	51.0	69.6	64.7	27.5
Benchmark (1960 Income)	74.3	52.2	86.1	97.4	98.9	98.7	54. 9

An easy monetary policy seemed to exist from the 1940s through the early 1950s. In addition, increase competition in the mortgage industry lead to a decline in the spread between mortgage

interest rates and bond yields. In 1935, the spread between these two assets in annual terms was 2.5 percent. In 1960, the spread in annual terms was approximately 1.6 percent. In Table 12, we examine whether the narrowing of this spread was a significant factor in the ownership rate. The decline in the spread resulted in an increase in the aggregate participation rate to 56.1 percent.

Table 12: The Importance of a Decrease in the Bond-Mortgage Rate Spread

		Homeownership by Age					
	Total	**25-35**	**36-45**	**46-55**	**56-65**	**66-75**	**76-82**
				Actual Data			
1940	45.4	33.5	42.1	51.0	57.5	60.3	62.3
1960	62.5	56.2	68.1	69.5	69.3	69.8	67.2
				Model Data			
Benchmark(1940)	45.6	26.4	50.5	51.0	69.6	64.7	27.5
Benchmark(1960 spread)	42.0	17.0	34.9	59.7	75.8	72.3	33.5

Chambers, Garriga, Schlagenhauf (2009) found that mortgage market innovation was the key factor in explaining the increase in the homeownership rate between 1996 and 2005. The introduction of highly leverage loans with graduated mortgage payments were found to be important as these contracts attracted first-time buyers into the housing market. By 1960, fixed mortgage contracts had become more levered as the loan-to-value ratio increased and the duration of the mortgage contract lengthened. It seems that the mortgage contact innovation between 1935 and 1960 could be a key factor. To investigate this possibility, we replaced the 1935 balloon contract with a 1960 mortgage type contract. The homeownership rate change is presented in Table 13. In contrast to the 1996-2005 period, mortgage innovation, ceteris paribus, resulted in a decrease in homeownership rate to 41.0 percent from 45.4 percent. This is a very different result that was found in the United States from after 1994. Why? If everyone was forced to use a fixed rate contract with 20% down, the mortgage payment would increase as principal payments are included in the monthly payment. Given the wage effciency index in 1940 was lower and more uniform than in 1960, household could not afford to take advantage of the leverage features available in a fixed rate mortgage.[15]

Table 13: The Mortgage Contract Innovation

		Homeownership by Age					
	Total	**25-35**	**36-45**	**46-55**	**56-65**	**66-75**	**76-82**
				Actual Data			
1940	42.7	33.5	42.1	51.0	57.5	60.3	62.3
1960	62.5	56.2	68.1	69.5	69.3	69.8	67.2
				Model Data			
Benchmark (1940)	45.4	7.7	47.5	74.8	83.4	85.2	55.8
Benchmark(FRM)	41.0	17.5	38.8	59.7	65.9	64.7	31.5

[15] We also experiment with the effect of lower the downpayment requirement to 5 percent. A move leveraged mortgage contract would result in a higher homeownership rate. However, the homeownership rate would only increase to 43.5 percent

On final influence on homeownership between 1940 and 1960 was the increase in the real price of housing. Case-Shiller data indicates that house prices increased by 41.5 percent between 1935 and 1960. We reset the housing price for 1960 to reflect this price increase. The experiment shows that, holding all parameters constant, the homeowner actually increases 46.2 percent. This occurs because of a large increase in the equilibrium rental price increases 45.9 percent from 0.2022 to 0.2951. Thus, ownership was actually slightly cheaper when compared to renting. This slight drop in the relative price of ownership accounts for the slight increase in ownership.

Table 14: The Increase in the Real Price of Housing

		Homeownership by Age					
	Total	**25-35**	**36-45**	**46-55**	**56-65**	**66-75**	**76-82**
				Actual Data			
1940	42.7	33.5	42.1	51.0	57.5	60.3	62.3
1960	62.5	56.2	68.1	69.5	69.3	69.8	67.2
				Model Data			
Benchmark (1940)	45.4	7.7	47.5	74.8	83.4	85.2	55.8
	46.2	26.9	51.1	67.1	71.3	65.6	9.7

6 Conclusions

Between 1935 and 1960, the aggregate homeownership rate increased 46.4 percent, from 45.4 to 62.5 percent. A number of explanations have been offered to explain this increase. In this paper, we employed a heterogenous general equilibrium model to measure the relative importance of prominently mentioned factors. In contrast, to the homeownership increased observed between 1996-2005, income is the crucial variable in accounting for the increase in homeownership. Essentially, the level and shape of income over an age profile is a precondition for mortgage innovation to play an important role in generating an increase in the aggregate homeownership rate. Demographics were also an important factor in the increase in the homeownership rate between 1940 and 1960. A conjecture is that a collapse in the housing market did not occur after this housing boom despite a 41 percent increase in housing prices was because the income growth allowed the increased homeownership rate to be supported.

The results presented in the paper need to be considered preliminary. The model seems to overstate homeownership. We feel this has to do with housing not being a risky asset. We are looking for disaggregated historical data on sales price variability. In addition, the model ignores the potentially important role of the VA housing programs. In order to analyze this program, a new state variable must be introduced into the model to identify veterans of World War II and the Korean War. A veteran had a choice of the normal fixed rate mortgage contract and a mortgage contract where the government pays the cost of the downpayment and subsidizes the mortgage interest rate. The cost of this program must be introduced into the government budget constraint. We are presently working on these modifications.

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