Did Housing Policies Cause the Postwar Boom in Homeownership?*

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Abstract

After the collapse of housing markets during the Great Depression, the U.S. government played a large role in shaping the future of housing finance and policy. Soon thereafter, housing markets witnessed the largest boom in recent history. The objective in this paper is to quantify the contribution of government interventions in housing markets in the expansion of U.S. homeownership using an equilibrium model of tenure choice. In the model, home buyers have access to a menu of mortgage choices to finance the acquisition of a house. The government also provides special programs through provisions of the tax code. The parameterized model is consistent with key aggregate and distributional features observed in the 1940 U.S. economy and is capable of accounting for the boom in homeownership in 1960. The decomposition suggests that government policies have significant importance. For example, the expansion in maturity of the fixed-rate mortgage to 30 years can account for 12 percent of the increase. Housing policies, such as the introduction of the mortgage interest deduction ot the taxation of housing services can have significant effects in homeownership.

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

1   Introduction

From a historical perspective, the recent expansion homeownership is small compared with the one that started in 1940. Before the Great Depression there was little federal involvement in U.S. housing except for land grants and the regulation of commercial banks. As a result of the foreclosure problem that coincided with the depression, the role of government in residential housing expanded.[1] The government played a large role in shaping the future of U.S. housing finance and housing policy.

Before the Great Depression many mortgages were short term (5-7 years), balloon-type (non-amortizing) with large down payment requirements (50-60 percent). As a result of New Deal policies, government agencies began to offer standard fixed-rate mortgage (FRM) contracts with longer maturities (20-30 years) and a higher loan-to-value ratio (80 percent and above). A government agency was established to create a secondary market to provide liquidity and expand credit by buying primarily FHA-insured loans.

During this period the government also changed the treatment of owner-occupied housing in the federal income tax system. This policy changed the effective price of owner-occupied housing services because of the deductibility of local property taxes, mortgage interest payments, and by the omission of imputed rents from adjusted gross income. All of these interventions coincided with a significant expansion in homeownership (Figure 1). Between 1940 and 1960, the percentage of owner-occupied households increased from 44 to 62 percent.

Insert Figure 1 here

It is important to determine the contribution of government intervention in the expansion in the homeownership rate. An extensive empirical literature shows the important contribution of various government programs. Yearns (1976) argues that the increase in homeownership can be explained by the increased availability of mortgage funds from Federal Housing Administration (FHA) and the Veterans Administration (VA), and the easy monetary policy of the Federal Reserve System. Housing provisions in the tax code have also contributed to increased ownership. Rosen and Rosen (1980) estimate that between 1949 and 1974 about one-fourth of the increase in homeownership was a result of implicit subsidies toward housing embedded in the personal income tax code. Hendershott and Shilling (1982) support this claim by their 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.

Some historians have credited passage of the Serviceman's Readjustment Act of 1994 (the GI bill) with playing a vital role in opening the doors of higher education to millions and helping set the stage for the decades of widely shared prosperity that followed WWII. Almost 70 percent of men who turned 21 between 1940 and 1955 were guaranteed an essentially free college education under one of the two GI Bills.[2] Fetter (2010) has estimated

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[1] For example, the Home Owners Loan Act of 1933 and the National Housing Act of 1934 were designed to stabilize the financial system. The National Housing Act established the Federal Housing Administration (FHA) with the objective of regulating the terms of mortgages.

[2] The 70% estimate is based on self-reported military service during WWII or the Korean War among males in the 1970 census.

that the VA policy of making zero down payment mortgage loans available to World War II and the Korean War veterans after 1946 accounts for a 10 percent increase in homeownership. The aforementioned research has attempted to measure the importance of a particular factor using a regression-based framework that attempts to hold other potential factors constant. As is known, the results from this empirical approach depend on the availability of data and the degree of interaction between the various factors.

This study employs a different empirical approach; we use a dynamic general equilibrium model and focus on the contributions of government interventions in housing markets to the expansion of U.S. homeownership. The interventions include the role in housing financing as well as subsidies toward housing embedded in the federal income tax code. The framework is a modification of the life-cycle mortgage choice framework developed by Chambers, Garriga, and Schlagenhauf (2009a). This approach allows the different factors to dynamically interact and thus provides a laboratory to study the effects of changes in government regulation on individual incentives and relative prices. It also allows us to perform counterfactual experiments.[3]

The model includes ex-ante households that differ in education status and income risk. These households purchase consumption goods and housing services and invest in capital and/or housing. The purchase of housing services is intertwined with tenure and duration decisions. Housing is a lumpy investment that requires a down payment and long-term mortgage financing, and receives preferential tax treatment. The model allows economic agents to make optimal decisions in an environment that reflects the economic and institutional environment of the relevant time period. Home buyers have access to multiple types of mortgage loans. These loans are provided by a centralized financial sector that receives deposits from households and lends capital to private firms. The model has a homeowner-based rental market that allows the house price-to-rental price ratio to be endogenous. The production sector uses a neoclassical technology with capital and labor that produces consumption/investment goods and residential investment. In the model, a government implements a housing policy through various programs and collects revenue via a progressive income tax system. The baseline model is (1) parameterized to match the key features of the U.S. economy during the late 1930s, and then (2) used to determine the contribution of various government policies for the expansion of homeownership.

In the early 1940s, government-sponsored mortgages tended to be 20-year duration contracts. By 1960, the duration of government-sponsored contracts increased to 30 years. The model suggests that the change in the length of the mortgage contract sponsored by the FHA can account for roughly 12 percent of the total increase in homeownership. When combined with a narrowing mortgage interest rate wedge, the total impact of mortgage innovation is approximately 21 percent. Given our assessment of the role of housing finance for homeownership, the implications of even longer-maturity mortgage contracts are examined with through a set of counterfactual experiments. The model indicates that increasing the maturity beyond 30 years has only a marginal (negative) effect on ownership. These results raise the question: "Why was the FRM not more effective in increasing homeownership in the 1940s?" The model suggests that the slow income growth

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[3]This paper follows the tradition of Amaral and MacGee (2002), Cole and Ohanian (2002,2004), Hayashi and Prescott (2002), Ohanian (1997), and Perri and Quadrini (2002), who used quantitative techniques in the study of historical events.

made this contract less attractive.[4]

Housing policies in the tax code have significant impact in the incentives to own a house, but the magnitude depends on the size of the general equilibrium effects. In particular, the elimination of the mortgage deduction only reduces ownership when prices are fixed and the tax surplus is not rebated back to the household sector. The taxation of housing services always reduces the ownership.

This paper is organized into five sections. Section 2 presents a brief economic history from 1930 to 1960 as well as some data for this period. Section 3 develops our model economy. In order to conduct a historical decomposition analysis the model must be calibrated and estimated to the late 1930s. This is discussed in Section 4 which also discusses data used to calibrate the model to 1960 in order to conduct our decomposition analysis. Section 5 conducts and discusses the results of the decomposition analysis.

2 Government Programs and Housing Markets

In the late 1930s, and early 1940s, the economy was recovering from the Great Depression. Not surprisingly, the economic environment substantially changed in the following years. This section describes some of the policy changes that occurred between 1930 and 1960.

2.1 The FHA and the Regulation of Housing Finance

In 1900, mortgage lenders consisted of mutual savings banks, life insurance companies, savings and loan associations(S&Ls), and commercial banks. Mutual savings banks were the dominant lenders, whereas commercial banks played a small role. After 1900 the importance of mutual saving banks declined while life insurance companies and savings and S&Ls substantially increased their market shares. Commercial banks did not become dominant mortgage lenders until after World War II. The reason commercial banks were a relatively unimportance source of mortgage funds is the National Banking Act, which severely limited real estate loans. Hence, any commercial bank mortgage loans were restricted to state-chartered banks. In 1913, the Federal Reserve Act liberalized restrictions that limited participation in the mortgage market for 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. LTV ratios, length of contract, and contract structure as related to amortization were changing. For the period 1920 to 1940, mortgage loans were typically non-amortizing and characterized by a short-term balloon payment with a high LTV ratio. Grebler, Blank, and Winnick (1956) examine data from life insurance companies, commercial banks, and S&Ls and find that partially amortizing loans did exist during this period. Between 1920 and 1940, approximately 50 percent of mortgage loans issued by commercial banks were non-amortized contracts. For life insurance companies, approximately 20 percent of mortgage contracts in the period 1920-1934 were non-amortizing. For the same period,

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[4]The role of housing prices may be a factor. Conventional wisdom is that housing prices started to increase in the early 1930's and continued an upward trend through the 1950's. In thus volume, Fishback and Kollman (2013) argue that housing prices were not increasing in the 1930's and were actually lower in 1940 compared to 1930.

the percent of this type of loans issued by saving and loan associations did not exceed 7 percent. However, by the early 1940s, 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 Edwards (1950) finds 99.7 percent of saving and loan association contracts were fully amortized.

This evidence supports the belief that mortgage contracts before 1950 were of shorter duration and with lower LTV ratios compared with the postwar period. Table 1 presents mortgage durations for loans originated life insurance companies, commercial banks, and S&Ls. For the period 1920 to 1930, the average duration was between 6 and 11 years. After 1934, mortgage lengths (terms) increased and started to approach 20 year mortgages; this was especially true for mortgages offered by life insurance companies. LTV ratios also changed over this period and were around 50. After 1934, LTV ratios began to increase, and by 1947 approached 80 percent.

Table 1: Properties of Mortgage Contracts between 1920 and 1950

	Mortgage Duration (Years)			Loan-to-Value Ratio (Percent)		
Period	Life Insurance Companies	Commercial Banks	S & L Associations	Life Insurance Companies	Commercial Banks	S & L 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 are from Sailnier,(1950), for commercial banks from Behrens (1952), and S&Ls from Morton (1956)

An obvious question is why did mortgage contracts start to change after 1934? Before 1930, there was little federal involvement in housing except and grants as exemplified by the 1862 Homestead Act. The Great Depression changed government's role in residential housing. As a result of the wave of foreclosures, Congress responded initially with Home Loan Bank Act of 1932. This act brought thrift institutions under the federal regulation umbrella. The Home Owners Bank Act and the National Housing Act of 1934 followed. These acts were designed to stabilize the financial system. The National Housing Act established the FHA which introduced a government guarantee in hopes of spurring construction.[5] The FHA home mortgage was initially a 20-year, fully amortizing loan with a maximum LTV ratio of 80 percent. Carliner (1998) argues that the introduction of this loan contract influenced the behavior of existing lenders, thus partially explaining the data trends in Table 1. The changes in contract structuring took time to be implemented as state laws limiting LTV ratios had to be modified. The FHA also added restricted design, construction, and underwriting standards. These government programs, part of

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

the "New Deal" legislation, are thought to have increased homeowner participation.[6]

A second government policy with the potential to affect homeownership, especially after 1950, was the federal guarantee for individual mortgage loans. Because of the public view that World War I veterans received few benefits except the promise of a delayed bonus payment,[7] Congress passed the Servicemen's Readjustment Act of 1944, or the "GI Bill."[8] The new program included a housing benefit to veterans. Initially no down payments were required, based on the theory that soldiers were not paid enough to accumulate savings and did not have an opportunity to establish a credit rating. Under the original VA loan guarantee program, the maximum amount of guarantee was limited to 50% of the loan and was not to exceed $2,000. 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 a limit on 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 again lengthened to 30 years.

Were these programs quantitatively significant? In Table 2, the values of FHA and VA mortgages are reported as well as the relative importance of these mortgages in the total home mortgage market. While the impact of government mortgage programs was not immediate, by 1940 FHA and VA mortgages accounted for 13.5 percent of mortgages, and by 1945 these mortgages accounted for nearly 25 percent 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 Fetter's (2010) claim that the VA program led to a 10 percent increase

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[6]The role that government policies played in influencing loan duration has been recently called into question. Rose and Snowden (2013) argue that the adoption of longer-term amortization was underway in the Building and Loan Associations by the 1930's.

[7]The 1920 Fordney Bill, a broader benefits program that would have allowed WWI veterans to choose among a cash bonus, education grants, or payments toward buying a home or farm, was defeated by the Senate. In 1924 Congress passed the Adjusted Compensation Act (the Bonus Bill), which promised World War I veterans a bonus. The plan was intended to compensate veterans for wages lost while serving in the military during the war, but the bonus (paid as a bond) was to be deferred until 1945. In 1932, thousands of veterans (the "Bonus Army") marched on Washington and set up an encampment to urge the government to pay the bonus earlier. The Bonus Army was forced by the military to leave Washington, and the early payments (averaging about $800 per veteran) were not authorized by Congress for another four years.

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

in the homeownership rate.

Table 2: The Role of Government Mortgage Debt
for Home Mortgages: 1936 to 1953[*]

	FHA	VA	Combined	Total Home Mortgages	FHA and VA Home Mortgages (% total)
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		

[*]Values expressed in millions of dollars. Source: Grebler, Blank, and Winnick (1956), p243.

The important changes in the mortgage market could have implications for mortgage interest rates. Unfortunately, mortgage interest rates 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. Figure 2 shows the mortgage interest rate was 5.11 percent in 1900, while the bond yield was 3.25.

Insert Figure 2 here

Between 1900 and 1920, both interest rates had increasing trends. In the 1920s mortgage rates fell a little, while bond rates declined by a bit more. After 1930 mortgage interest rates declined from 5.95 percent to around 4.9 percent. This partially reflected an easy money policy clearly seen in the large decline in bond yields over this period. Some economic historians have used this information to argue that an easy money policy played a large role in the increase in homeownership, but it could also be due to the elimination of regional lending and a more homogeneous credit market.

2.2   Tax Treatment of Owner-Occupied Housing

During this period the U.S. government used the tax code to promote owner-occupied housing. The most prominent provisions were the deductibility from taxable income of

mortgage interest payments and property taxes, and the exclusion of the imputed rental value of owner-occupied housing from taxable income. A large body of empirical and quantitative research evaluates the tax treatment of housing. This literature indicates that the elimination of the prominent provisions would have significant effects for tenure and housing consumption. These provisions introduce a wedge into the decision to invest in housing relative to real capital, as well as the tenure (owner vs. renter) decision. Laidler (1969), Aaron (1972), and Rosen and Rosen (1980) estimate that the elimination of these tax provisions has sizable effects on the homeownership rate. There is also a growing literature that uses equilibrium models to assess the impact of changing such provisions and estimate significant effects. For example, Berkovec and Fullerton (1992) use a static disaggregated general equilibrium model and find that eliminating these provisions generates a decline of owner-occupied housing consumption ranging between 3 and 6 percent. Chambers, Garriga, and Schlagenhauf (2009c) find that the elimination of these provisions could increase the ownership rate if the resulting increase in government revenue is rebated to households. However, most of the empirical research on the implications of the tax treatment of owner-occupied housing are either estimated or calibrated to the postwar period. In addition, these studies in general ignore the implications of mortgage choice.

The progressivity of the income tax code changed significantly between 1940 and 1960. The Tax Foundation has constructed marginal tax rates by income level for 1940 and 1960. As Figure 3 shows the marginal tax rates were substantially lower in 1940 than in the immediate post-war period.

<center>Insert Figure 3 here</center>

The highest marginal tax rate in 1940 was 63 percent for tax households earning $2 million or more. In contrast, the top marginal rate was 91 percent for households earning over $200,000 in 1960. During this period, income also changed significantly. Chambers, Garriga, and Schlagenhauf (2011) document the importance of education and income in ownership. The basic idea is that conditional on a certain level of income, a higher marginal tax rate increases the benefit for homeownership due to the tax break from the deductibility of mortgage interest payments and property taxes. This distortion not only provides an additional benefit of owning, but also an incentive to own larger homes.

3   Model

The model is based on the overlapping-generations economy with housing and long-term mortgages developed in Chambers, Garriga, and Schlagenhauf (2009a). A more detailed version for the pre-World War II period can be found in Chambers, Garriga, and Schlagenhauf (2011). The economy consists of households, a final goods-producing sector, a rental property sector, a mortgage lending sector, and the government.

3.1   Households

Age Structure. The economy is populated by life-cycle households that are *ex ante* heterogeneous. The heterogeneity is due to different education levels. Let i denote the

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education level of an individual and j represent the age. The term J represents the maximum number of periods a household can live. At every period, a household faces mortality risk and uninsurable wage 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 $\psi_{J+1} = 0$. For simplicity, all individuals living in the household are subject to the same mortality risk. Earnings uncertainty implies that the household is subject to income shocks that cannot be insured via private contracts. As is usual in this class of models, annuity markets for mortality risk are absent. The lack of these insurance markets creates a demand for precautionary savings.

Preferences. Household preferences rank goods according to a momentary utility function $u(c, d)$, where c represents the effective consumption of goods, c, and d represents effective housing services over the life-cycle. This function satisfies the usual properties of differentiability and Inada conditions. A comment is required to define effective consumption and effective housing services. At a particular age j, a household is composed of adults and children. A household is consists of up to two adults and children. Because of economies of scale in consumption (housing services), effective consumption (housing services) is simply household consumption divided by a household consumption aggregator.[9]

Asset Structure. Households have access to a portfolio of two assets to mitigate income and mortality risk. A financial asset is denoted by a' with a net return r, and a housing durable good is 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.[10] 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 foot). In general, a mortgage loan requires a down payment equal to χ percent of the value of the house. The amount $\chi p h$ 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, 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,

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[9]The aggregator used is the old OECD household aggregator. That is, if f_j is the average family size of an age j household, then effective consumption is

$$c_j = \frac{C_j}{[1.7 + 0.3(f_j - 2)]},$$

where the denominator adjusts for economies of scale in household size. The term 1.7 indicates that the second adult accounts for 0.7 of the consumption of the first adult. The term $0.3(f_j - 2)$ indicates that each child consumes 30 percent of the first adult. This formulation is a simple way to introduce changes in family structure into the model.

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

(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 $I_n = r^m D_n$.[11] 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.

Before 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 the last period, N. The amortization schedule for this contract can be written as

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

This means that the mortgage payment in all periods except the last one, 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 additional equity beyond the initial down payment until the final mortgage payment is made. 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 the homeowner itemizes tax deductions, a large interest deduction is an attractive by-product of this contract.

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[11] 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, $D_0 \equiv \chi ph = \sum_n^N m_n/(1+r)^n$.

After the Great Depression, the FHA sponsored a new mortgage contract characterized by a longer duration, lower down payment requirements (i.e., higher LTV ratios), and self-amortization 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,

$$D_0 \equiv \chi p h = \sum_n^N \frac{m}{(1+r)^n}.$$

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: $H_{n+1} = H_n + [m - r^m D_n]$ every period.

Household Income. Household income varies over the life-cycle and depends on (1) whether the household is a worker or a retiree, (2) the return from savings and transfer programs, and (3) the income generated from the decision to rent property when a home-owner. Households supply their time endowment inelastically to the labor market and earn wage income, w, per effective unit of labor. The effective units of labor depend on the education level and the age of the household. The deterministic component of income is denoted by v_{ij} and a transitory type-dependent idiosyncratic component, ϵ_{ij}, drawn from a probability distribution, $\Pi_{ij}(\epsilon_{ij})$. The expectations about income uncertainty are drawn from this distribution. For an individual younger than j^*, labor earnings are then $w \epsilon_{ij} v_{ij}$. 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

$$y_w(\epsilon, i, j) = \begin{cases} w\epsilon_{ij}v_{ij}, & \text{if } j < j^* \\ \theta, & \text{if } j \geq j^* \end{cases}.$$

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

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

Savings and transfers provide 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 (pretax) income of a household, y, is simply

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

The various income sources generate a tax obligation of T, which depends on labor income, y_w , net interest earnings from savings, ra, and rental income, y_R, less deductions 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

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

The Household Decision Problem. A single household's budget constraint cannot be easily written for this problem because such households make discrete tenure decisions. In each period, a renter could purchase a home or a homeowner could change the size of the 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 education level (i.e., no education, high school, and college), i, household's age, j, the level of asset holding, a, the housing investment, h, the mortgage choice, z, the mortgage balance with the bank, n, and the income shock $\epsilon(i, j)$,which is contingent on age and education, written as ϵ. To simplify notation, let $x = (i, a, h, z, n, j, \epsilon)$ summarize the household's state vector. A household could face a number of budget constraints depending on the tenure decision. Individuals make decisions over consumption goods, c, housing services, d, and investment in assets, a', and housing, h'. Table 3 summarizes the five distinct decision problems that a household must solve with respect to shelter.

Table 3: Choice Diagram for the Household

Current renter: $h = 0$ $\left[\begin{array}{l}\text{Continues renting: } h' = 0 \\ \\ \text{Purchases a house: } h' > 0\end{array}\right.$

Current owner: $h > 0$ $\left[\begin{array}{l}\text{Stays in house: } h' = h \\ \\ \text{Change house size (upsize or downsize): } h' \neq h \\ \\ \text{Sell house and rent: } h' = 0\end{array}\right.$

The starting point is the problem of a household that starts as a renter and then the decision problem of a household that starts as a homeowner is considered.

- **Renters:** A household that 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 $x = (i, j, a, 0, 0, 0, \epsilon)$, the individual chooses the option with the higher value, which can be expressed as

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

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The value associated with continued renting is determined by solving

$$v^r(x) = \max u(c, d) + \beta_{j+1} E_{ij} v(x'),$$ (4)

$$s.t. \quad c + a' + Rd = y(x) - T.$$

The household is subject to non-negativity constraints on c, d, and a'. These constraints are present in all possible cases and are not explicitly stated in the other cases.[12] The current decisions determine the state vector tomorrow $x' = (i, j + 1, a, 0, 0, 0, \epsilon')$.

A household that purchases a house solves a different problem as choices must now be made over $h' > 0$. This decision problem can be written as

$$v^o(x) = \max u(c, d) + \beta_{j+1} E_{ij} v(x'),$$ (5)

$$s.t. \quad c + a' + (\phi_b(z, x) + \chi(z, x))ph' + m(h', n; p) = y(x) - T.$$

The purchase of a home requires use of a long-term FRM loan. The mortgage contract is a function that specifies the length of the contract, N, the down payment fraction, $\chi(z, x) \in [0, 1]$, and the payment schedule, m. The decision to buy a house of value ph' implies total borrowing must equal $D_N = (1 - \chi(z, x))ph'$. The payment structure depends on the mortgage available in any given period. The purchase of a house requires only an expenditure of the down payment and associated transaction costs, $\phi_b(z, x)$. The model formulation is fairly general and allows for downpayment and transaction costs to depend on the mortgage choice, and potentially education status. The relevant continuation state is $x' = (i, j + 1, a', h, z, N - 1, \epsilon')$

- **Owners:** The decision problem for a household that 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 state x, 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.

1. If the homeowner decides to stay in the current house the optimization problem can be written as

$$v^s(x) = \max u(c, h') + \beta_{j+1} E_{ij} v(x')$$ (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 off (i.e., $n = 0$), then $m(h, n; p) = 0$. Otherwise, the mortgage payment is positive. The next period state is given by $x' = (i, j + 1, a', h, z, n', \epsilon')$, where $n' = \max\{n - 1, 0\}$.

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[12] 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.

2. The homeowner could continue to be a homeowner but with a different housing position. This means the household must sell its housing position, h. The sale of the house generates revenue, $\pi = (1-\phi_s)ph - D(h, n; p)$, from which transaction costs, $\phi_s ph$, and any remaining principal on the mortgage loan, $D(h, n; p)$, must be paid. The new house that is purchased, h', requires paying transaction costs and down payment costs, $(\phi_b(x) + \chi(x))ph'$, as well as making a mortgage payment on the new house, which depends on the type of mortgage selected to finance the new housing position, $m(h, n; p)$. For this case, the consumer problem is

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

This household 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 $x' = (i, j+1, a', h, z', N-1, \epsilon')$.

3. The final option is for the homeowner to sell the current house, $h > 0$, and become a renter, $h' = 0$, which means the household must make a rental expenditure of Rd [13]

The consumer's optimization problem for this situation is

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

and the future state vector is $x' = (i, j + 1, a', 0, 0, 0, \epsilon')$.

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.

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 housing investment. This formulation does not derive the optimal mortgage contract from the model primitives. It takes the contract structure available during a period as given and imposes the mortgage structure as a constraint. Conditional on the legal lending arrangements, lenders provide credit and receive flows of payments to maximize profits. In addition, financial intermediaries receive 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.[14]

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[13]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, $h' = a' = 0$.

[14]The formulation of the market clearing condition derived from zero profit on the lender side is available in an appendix available from the authors upon request.

3.3 Construction Sector

The stock of new homes is produced by a competitive real estate construction sector. Producers manufacture housing units using a linear technology, $I_H = C_H/\theta$, where I_H represents the output of new homes, C_H is the input of the consumption good, and θ is a technology constant used to transform consumption goods into new housing units. Technology is reversible; hence, homes can be transformed into consumption goods. The optimization problem of the representative real estate firm is given by

$$\max_{H,C_H} pI_H - C_H,$$

$$s.t. \quad I_H = C_H/\theta.$$

The first-order condition of the housing sector determines that the equilibrium house price must satisfy $p = \theta$. The homes produced are added to the existing housing stock as either new units or as repairs of the existing stock. The aggregate law of motion for housing investment is

$$I_H = (1 + \rho_n)H' - H + \varkappa(H, \delta_o, \delta_r),$$

where $\rho_n \geq 0$ represents the population growth rate. The depreciation of the housing stock $\varkappa(H, \delta_o, \delta_r)$ depends on utilization (i.e., owner- vs. tenant-occupied housing). The larger the size of the rental market, the larger the investment in housing repairs. If the depreciation rate is the same for owner-occupied and rental housing, $\delta_o = \delta_r$, then residential investment is linear in the stock, or $\varkappa(H, \delta_o, \delta_r) = \delta H$. All the aspects of the supply side of the market can be controlled by changing the technological parameter θ. For example, shortages of materials can be capture by a decline in θ, whereas innovations in the process of producing homes (i.e., Levittown on the East Coast) would be an increase in θ.

3.4 Production of Final Goods

A representative firm produces a good in a competitive environment that can be used 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.[15]

3.5 Government Activities

In this economy, the government regulates markets by imposing particular lending arrangements on the mortgage loan market. It also provides tax provisions toward housing. In

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

addition to these passive regulatory roles, the government plays a more active role through other programs. 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 is 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 is distributed to the surviving households as a lump-sum payment, tr.

3.6 Stationary Equilibrium

In the model, a stationary equilibrium includes optimal decisions that are a function of the individual state variables, $x = (i, j, a, h, z, n, \epsilon)$, prices $\{r, w, R\}$, market clearing conditions, and a distribution over the state space $\Phi(x)$ that are constant over time.[16]

4 Quantitative Analysis

4.1 Parameterization

The objective of the paper is to quantify the role of government policy in housing markets during 1940-1960. During this period many other important changes occurred that could account for the large increase in the homeownership rate. In order to measure the role of government policy toward housing, other important factors must be incorporated into the model. Otherwise, the model could mismeasure the role of government policy. The methodology used in this paper incorporates the key factors that have been mentioned in the literature but focuses on counterfactual experiments pertaining to government housing policy. The change in ownership rates that occurs in these experiments allows us to quantify the importance of government housing policies over this period.[17]

The parameterization technique is based on moment estimation to replicate key properties of the U.S. economy between 1935 and 1940. This period is chosen 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 did not begin to impact housing markets until late in the1930s. Some of the parameters are taken directly from data or other empirical work.

Population Structure: A period in the model corresponds to five years. An individual enters the labor force at age 20 (model period 1) and lives a maximum of 83 years (model period 14). Mandatory retirement occurs at age 65 (model period 11). The survival probabilities $\{\psi_{j+1}\}$ are from the National Center for Health Statistics, *United States Life Tables* (1935, 1940). The initial size of a cohort, μ_{ij}, is endogenously determined by the share of these individuals at age 25 or younger and the population growth rate.

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[16] A formal definition of the recursive equilibrium is available from the authors.

[17] The details of the full decomposition overall factors for the ownership rate are provided in a companion paper (see Chambers, Garriga, and Schlagenhauf , 2011).

Functional Forms: The utility functions is CES specified as

$$u(c,d) = \frac{\left[\gamma c^{-\rho} + (1-\gamma)d^{-\rho}\right]^{-\frac{1-\sigma}{\rho}}}{1-\sigma},$$

where the parameters γ, σ, and ρ need to be determined. The parameter σ is set to 2, and the intertemporal elasticity of substitution is taken from the range of estimates in the literature and set to 1. The parameters γ, which measures the relative importance of consumption to housing services, and the discount rate β are estimated. The first parameter, γ, is estimated to be consistent with a housing-to-consumption ratio of 0.180. The individual discount rate is determined to match a capital-output ratio for 1935 which was 2.54. 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 (GDP) plus an estimate of the service flow from consumer durables less the service flow from housing.

Goods outputs are produced with a Cobb-Douglas function. The capital share parameter, α, is set to 0.24 based on National Income and Product Accounts (NIPA) data for 1935. Total factor productivity is normalized to unity. The depreciation rate of the firm's capital capital stock, δ, is estimated to be consistent with the observed ratio of fixed capital investment to GDP (as previously defined) for 1935.

Income Endowments: A household's income depends on its education level, i. Four exogenous education levels are available: (1) fewer than 8 years of education, (2) 8 years of education, (3) fewer than 12 years of education, and (4) 12 or more years of education. For each education level, a household's income has two components; one is deterministic and the other is stochastic. These values of these components are constructed from Public Use Microdata Samples (PUMS) for the 1940 and 1960 Censuses. The deterministic, or life-cycle component, υ_{ij}, is generated using the average salary and wage income by age and education. A polynomial is fit to age-specific averages per education to smooth this component. The determination of the uncertain component hinges on the available data. The reliance on Census data (which restricts data availability to once every ten years) does not allow the estimation of a serially correlated income process.[18] Our strategy is to assume the stochastic component, ϵ_{ij}, is independent and identically distributed over education and age. This component of income, along with the associated probabilities, is estimated using a kernel density estimation for every age cohort, $\Pi_{ij}(\epsilon_{ij})$, for the cross section of individuals. Since the unit in the model is the household, the estimation considers only households that work full-time. Therefore, the model captures the dispersion of labor income for a given education. This approach has the attractive property that it reproduces, by construction, the coefficient of labor income dispersion observed in the data for both periods.

Family Size: The size of the average household family is constructed using Census data for the relevant years. Since the baby boom takes place during this period, the goal

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[18]Storesletten, Telmer, and Yaron (2004) find that income shocks have a persistent component even when you condition on all the observables. Their finding is based on a sample of household data over many periods from the Panel Survey on Income Dynamics. Other recent works (e.g., Castaneda, Diaz-Giminez, and Rios-Rull(2003) find that a smaller persistent component is needed once ex-ante heterogeneity is considered. Their model is constructed to generate the observed income and wealth differences.

is to allow for the effects of changing household family size in the demand for owner-occupied housing. In a more detailed theory, changes in institutional arrangements could affect fertility decisions. In the model, the demographic structure is taken as exogenously determined and does not depend on education types.

Government and the Income Tax Function: In 1940, the U.S. Social Security program was in its infancy. The payroll tax rate for a worker was 1 percent of wage income. In addition, wage income for payroll tax purposes was capped at $3,000. The model uses 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 long as net income is less than $3,000. If net income exceeds $3,000, the credit is calculated as 10 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, each household received a personal exemption of $800. If these two credits are subtracted from total net taxable income, adjusted taxable income is determined. The actual tax schedules for 1940 and 1960 are programed to determine a household's tax obligation. The tax functions for 1940 and 1960 are summarized in Figure 3. For the 1940 tax code, the marginal tax rate is 0.79 which is applicable to income levels exceeding $500,000. In 1940, an income tax surcharge is equal to an additional 10 percent must be included in the income tax obligation. The documentation for the 1940 tax code is the Internal Revenue Service and the Tax Foundation. 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 considered as adding an intercept to the tax function. If too much revenue is generated, this parameter, τ_0, can be reduced. This factor is estimated by targeting the personal income tax revenue-to-GDP ratio. In 1935, this ratio was 0.01.

Housing: In the baseline model, homeowners have two mortgages choices: a short-duration balloon loan restricted to 10 years with a 50 percent down payment and a 20-year FRM with a 20 percent down payment. Formally, $\chi(1) = 0.5$ and $\chi(2) = 0.2$. The transaction costs from buying and selling property are $\phi_s = 0$ and $\phi_b = 0.06$. The minimum house size, $\underline{h}$, is estimated to be consistent with the set of specified targets. The values δ_o and δ_r are from Chambers, Garriga, and Schlagenhauf (2009), where the annual depreciation rates for owner and tenant-occupied housing are $\delta_o = 0.0106$ and $\delta_r = 0.0135$, respectively.

Wealth Endowments: Bequests appear to have been an important source of homeownership for young households in 1940. Table 4 presents IRS data on real estate bequests in

both 1940 and 1960.[19]

Table 4: Real Estate Bequests in the United States (1940-1960)

Year	Returns	Gross Bequest Value($)	Mortgages and Debts($)	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

Although the number of returns tripled between 1940 and 1960, the total gross value of real estate bequests grew by less that 10 percent. However, the amount of outstanding debt on bequeathed 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. The apparent importance of real estate bequests in 1940 requires the introduction of an additional parameter W_0 to the model. This parameter represents the percentage of age 1 households that receive a bequest of a minimum size home. The percentage is adjusted so that the model generates a homeownership rate for young households is similar to that found in the data. The value of transfers from accidental death is adjusted to equal the amount of housing bequests to individuals.

The estimation of the set structural parameters $(\delta, \gamma, \beta, \underline{h}, \tau_0, W_0)$ for 1940 is based on an exactly identified method of moments approach plus the computation of market clearing (capital market and rental market) under the restriction that the government budget constraint is balanced. Table 5 reports the parameter values that generate aggregate statistics consistent with the U.S. economy. Parameters are estimated within 1 percent error for all the observed targets.

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

Table 5: Parameterization of Model

Statistic	Target	Model
Ratio of wealth to gross domestic product (K/Y)	2.540	2.5470
Ratio of housing services to consumption of goods (Rs_c/c)	0.180	0.1800
Ratio of fixed capital investment to GDP $(\delta K/Y)$	0.112	0.1120
Homeownership Rate	0.436	0.4350
Ratio of personal income tax revenue to output $(T(ay)/Y)$	0.010	0.0099
Balanced bequests	0.000	0.0003

Variable	Parameter	Value
Individual discount rate	β	0.928
Share of consumption goods in the utility function	γ	0.947
Depreciation rate on capital	δ	0.197
Minimum housing size	$\underline{h}$	0.637
Lump-sum tax transfer	τ_0	0.081
Initial-period bequested homes	W_0	0.565

4.2   Baseline Economy: 1940

The model can be evaluated from various perspectives. The objective is to measure the performance by considering the homeownership rate statistics for the various years and age groups. As Table 6 shows, the homeownership rate in 1930 was 48.1 percent, whereas after the Great Depression it ranged between 42.7 and 45.5 percent. Since the baseline model attempts to focus on the home ownership rate prior to the impact of the National Housing Act, the targeted homeownership rate is 45.5 percent.

Table 6: Homeownership (%) by Age

Age	Data		Model
	1930	1940-43	1940
Under 35 years	20.0	19.1	22.7
36-45 years	48.5	42.1	49.5
46-55 years	57.7	51.0	61.8
56-65 years	65.1	57.5	69.5
65 years and over	69.7	60.3	69.4
Total	48.1	42.7-45.5	45.7

Source: US. Census Bureau

Since the aggregate homeownership rate is an estimation target, it not surprising that the baseline model generates a number close to the selected moment. The age-specific homeownership rates also can be used to evaluate the model. The model captures the hump-shaped behavior observed in the data. The lowest homeownership rate is for the youngest age cohort; this pattern is apparent in 1930 and 1940 with the difference that

homeownership rates are higher in 1930. The model does generate a pattern by age cohort consistent with the Census estimates. The model also makes predictions about mortgage holdings. Table 7 summarizes some aggregate statistics about housing finance.

Table 7: Housing Finance

Statistics	Model 1940
Homeownership rate	45.7
No Mortgage (%)	83.5
Mortgage loan (%)	16.5
Share balloon (5 year)	100.0
Share FRM (20 year)	0.0

It is difficult to find micro data for specific mortgage contracts, but given the short duration and the predominance of balloon, this contract would be the expected to be the dominant in the model. In the model the majority of homeowners (83.5 percent) do not have a mortgage. In the model all the homeowners purcahse the housing using the balloon loan. The share of FRMs predicted by the model for 1940 is zero.

4.3 Baseline Economy: 1960

Many factors could have been important in the determination of the ownership boom. The objective of this section is to isolate the contribution of government programs from other relevant factors that could influence the increase in ownership. Government programs potentially affect homeownership through policies that have an impact on financing of housing, changes in the federal income tax structure, the role of the mortgage interest rate deduction, and the reduction of transaction costs in mortgage rates. To measure the contribution of these government policies, the model must account for other factors that have been argued as critical.[20] The relevant factors that changed between 1940 and 1960 are summarized as follows:

1. **Demographic factors:** Include changes in the survival probabilities, education composition, and family structure.

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[20]The federal income tax code changed significantly by 1960. Using data from the Tax Foundation and the the U.S. Treasury Department Internal Revenue Service publication No. 17, it is possible to construct a representative tax function. This tax function had to account for the fact that renters were not likely to itemize their deductions. A model assumption is that in 1960 all renters did not itemize deductions. As a result, these individuals used tax tables different from the households that did itemize. In fact, non-itemizing households with income levels under $5,000 were able to use a tax table that differed from non-itemizers 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 because of 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 tax adjustment coefficient, τ_0, is set to be consistent with a federal income tax-to-GDP ratio of 7.73 percent. Income tax obligations were much higher in 1960 and marginal tax rates were higher (See Figure 3). 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.

2. **Endowments:** Include a change in the distribution of the i.i.d. idiosyncratic income component, the efficiency units by age and education, and the fact tha real wage income increased by a factor of 2.25.

3. **House prices:** According to Case-Shiller price data, real house prices increased by 41.5 percent. Since house prices in the model are determined by the productivity parameter in the construction sector, this parameter must be adjusted to generate the increased cost of housing per unit.

4. **Housing finance:** Changes include the extension of the FRM maturity from 20 to 30 years and a decline in the spread between the mortgage interest rate and the risk-free rate from 2.53 to 1.63 percent annualized.

5. **Taxation:** Include the relevant changes in the tax code.

Table 8 summarizes the implications of allowing all factors to change in the model.[21] The model accounts for a significant amount of the total change in ownership (level) as well as the compositional differences across age groups. It is important to note that these are endogenous variables, not a result of estimating the parameters for 1960

Table 8: Model Prediction for Homeownership Rate 1940-60

Age Cohort	Data(%)			Model(%)		
	1940	1960	Difference	1940	1960	Difference
Under 35 years	19.1	56.2	37.1	22.7	53.5	30.8
36-45 years	42.1	68.1	26.0	49.5	80.0	30.5
46-55 years	51.0	69.5	18.5	61.8	86.5	24.7
56-65 years	57.5	69.3	11.8	69.5	85.4	15.9
65-72 years	60.3	69.8	9.5	69.4	73.3	3.9
Total	45.5	62.5	18.9	45.7	63.5	17.8

For example, the actual aggregate housing participation rate in 1960 was 62.5 percent and the model predicts a similar magnitude. The model-generated age-cohort ownership rates have a more pronounced hump compared with actual 1960 data, but this is likely due to the fact that homeowners do not face mobility or health shocks that could require them to sell their house and rent. Despite the small differences in levels, the change between both periods in the model and data is quite similar, suggesting that this dynamic model of tenure and mortgage choice provides a useful laboratory to assess the importance of government interventions in housing finance and housing policy.

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[21]In 1960, households have mortgage choice (30-year FRM mortgage and a balloon contract). In equilibrium, households do not hold a balloon- type contract. In other words, the 20-year (or 30-year) fixed-rate contract is a dominant contract.

4.4 Policy Intervention in Housing Finance

In this section, the model is used to measure the contribution of federal housing policies to the increased homeownership rate.[22] The focus is on the importance of amortizing contracts, mortgage duration, and mortgage interest rate costs. Chambers, Garriga, Schlagenhauf (2009a,b) found that mortgage market innovation was the key factor in explaining the increase in the homeownership rate between 1996 and 2005. More precisely, the introduction of highly leveraged loans with graduated mortgage payments was found important as this type of contract attracted first-time buyers to the housing market, while more established households still had the availability of the standard 30-year FRM contract. Significant mortgage contract innovation also occurred in the mortgage market between 1930 and 1960. As discussed previously, stimulating the flow of mortgage funds to residential construction was a goal of federal housing policies since the early 1930s. Grebler, Blank, and Winnick, (1956, p238) state:

> Stimulating the flow of mortgage funds to residential construction has been the principal aim of federal housing policies since the early and middle thirties. ..[T]hese policies in fact have operated almost exclusively through the use of various devices influencing the flow of private institutional mortgages funds, that is, mortgage insurance or guarantee and improved marketability of loans through the Federal National Mortgage Association. ... Another major objective of federal housing policies has been to reduce the periodic payments of mortgage borrowers, by lowering interest rates and lengthening contract terms. Policy makers looked to easier borrowing as a way to increase demand for new residential construction.

As noted in the previous section, the starting point is the benchmark model where the 1940 estimated parameters are used with all factors at their 1960 values. Households have access to a 30-year FRM mortgage with a 20 percent down payment requirement as well as a 10-year balloon contract with a 50 percent down payment. As documented earlier, the homeownership rate would be at 63.5 percent. Since the baseline model captures the magnitude of the increase in ownership, one way to measure the contribution of the 30-year FRM is to replace this contract with a 20-year FRM contract. This latter contract corresponds to the initial offering of FRMs in the 1940s.

As Table 9 shows, the model predicts that the aggregate homeownership rate should fall from 63.5 percent to 61.6 percent. The model suggests that the extension of the FRM contract from 20 to 30 years can explain around 12 percent of the increase in ownership. The effect is more dramatic by age cohorts, particular in young and middle-aged buyers. For these groups, the access of a more leveraged contract reduces the magnitude of the mortgage payments and makes housing more attractive. In both economies, the fraction of individuals who use the balloon loan with 50 percent down payment is zero.

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[22]It is interesting to note that Gebler, Blank, and Winnick (1956, p. 238) stated that the "precise effects of the Federal Housing Administration and Veterans Administration programs on the volume of residential mortgage lending are as indeterminable as their impact on residential building activity."

Table 9: Contribution of 30- year FRM in 1960

Age	Data			Model Predictions (1960)	
Cohort	1940	1960	1940	FRM=20 year	FRM=30 year
Under 35 years	19.1	56.2	22.7	50.7	53.5
36-45 years	42.1	68.1	49.5	78.7	80.0
46-55 years	51.0	69.5	61.8	86.2	86.5
56-65 years	57.5	69.3	69.5	84.0	85.4
65-72 years	60.3	69.8	69.4	64.7	73.3
Total	45.5	62.5	45.7	61.6	63.5

All households use the FRM but the change in duration, combined with the general equilibrium effects, makes this contract more attractive to a larger percentage of the population. The higher aggregate LTV ratio implies that the percentage of homeowners with no mortgage is substantially reduced from the 1940s' figure. In the economy with a 20-year FRM, only 6.3 percent of homeowners do not have a mortgage and when the maturity is extended the number does not change. The lesson learned is that mortgage innovation did make a significant contribution to the increase in homeownership between 1940 and 1960.

The 10-year increase in loan maturity had a positive effect on the aggregate home-ownership rate. One could ask whether additional extensions in the maturity would have resulted in even larger increases effects in homeownership. The model can be used to examine implications of increasing the maturity beyond 30 years. Table 10 summarizes the finds of extending maturity of FRM to 35 and 40 years.

Table 10: Loan Maturity of FRM and Ownership

Age(yr)		Model Predictions (1960)		
Cohort	1940(%)	30-year(%)	35-year(%)	40-year(%)
25-35	22.7	53.5	54.1	54.3
36-45	49.5	80.0	77.4	77.2
46-55	61.8	86.5	84.7	84.4
56-65	69.5	85.4	84.7	84.0
66-82	69.4	73.3	52.7	52.6
Total	45.7	63.5	63.0	62.5

The model suggests that extending the loan maturity beyond 30 years has only a very marginal (negative) effect in the aggregate ownership rate. The aggregate effects mask some interesting distributional implications. As the maturity increases, the mortgage payments for an equivalent home are reduced and housing becomes more attractive for the young working cohorts. The decline in the older cohorts is mainly due to the terminal condition that forces individuals to sell the home before they die. Given the extended loan maturity, the fraction of retired homeowners carrying a mortgage increases and properties are sold earlier.

Overall, the introduction of the 30-year FRM can account for roughly 12 percent of the total change in ownership. The model suggests that the length of the mortgage contract sponsored by FHA had a significant effect on ownership; however, increasing the maturity beyond 30 years seems to have a small negative effect in ownership. Since FRM contracts already existed in the 1940s and 1950s, an obvious question is why the FRM contracts were not more popular in the 1940s when this type contract first became available? As documented in Chambers, Garriga, and Schlagenhauf (2013), given that average household income was lower in 1940 than 1960 by a significant factor, the 1940 household might not have been financially able to take advantage of the leverage features available in a FRM contract.

In addition to federal policies that impacted homeownership through mortgage contract structure, Grebler, Blank, and Winnick (1956) argue that a policy of lower mortgage interest rates and increased mortgage market efficiencies were important in the increase in homeownership. Data for 1940 and 1960 suggest the spread between the mortgage interest rate and risk-free rate declined 85 basis points. The model can be used to quantify the importance of the decline in the spread that resulted from an improved mortgage market. The test maintains the baseline model for 1960 but assumes the 1940 spread. If the interest spread is increased to the 1940 value, while maintaining the other factors at their 1960 values, the model-predicted ownership rate would be 62.1 percent as summarized in Table 11. The decrease in the spread accounts for a 8.5 percent change in homeownership.

Table 11: The Importance of the Interest Rate Spread

Experimental Factors	Ownership(%)
1. Baseline: 1960 factors, 1940 parameters, 30-year FRM, 1960 spread	63.5
2. Model: 1960 factors, 1940 parameters, 30-year FRM, 1940 spread	62.1

4.5 Housing Policy: The Tax Treatment of Housing

This section explores the direct role of housing policy, taking as given the innovations in housing finance. The purpose is to use the model to understand how housing tenure and investment decisions can be affected by housing policy embedded in the tax code. Part of the analysis is based on Chambers, Garriga, and Schlagenhauf (2009c). The key difference is that the model abstracts from mortgage choice, and in the current framework mortgage choice is an important consideration.

Understanding how this type of housing policy affects a household's tenure and duration decisions requires examination of the household's budget constraint. Some additional notation is required. Let κ_o and κ_r represent the taxable fraction of housing services consumed by owner- and tenant-occupied housing, respectively. The terms ι_o and ι_r represent the fraction of maintenance expenses from owner- and tenant-occupied housing that is deductible. Given these definitions, taxable income can be defined in the model as

$$y = \omega + ra + \kappa_r R(h' - d) + \kappa_o Rd - \iota_r \delta_r p(h' - d) - \iota_o \delta_0 pd - \Omega, \tag{9}$$

where Ω represents other type of deductions. The mortgage interest rate deduction would

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enter through this variable as it obviously reduces taxable income.[23] For homeowners who do not pay the fixed entry cost ($\varpi > 0$), the definition of taxable income is reduced to

$$y = \omega + ra + \kappa_o R d - \iota_o \delta_0 p d - \Omega, \tag{10}$$

as $h' = d$.

The first-order condition of a household that supplies rental housing services to the market can be expressed as

$$\frac{u_d}{u_c} = R - p\Delta\delta + T'(y)[p(\iota_r \delta_r - \iota_o \delta_o) - R(\kappa_r - \kappa_o)], \tag{11}$$

where u_c measures the marginal utility with respect to consumption c, and u_d represents the marginal utility with respect to housing services consumption, d. The first term on the right-hand side is the rental price of a unit of housing, R, measures the benefit to a household of forgoing a unit of housing services. This benefit is reduced the greater the spread in the depreciation rate for renter- and owner-occupied housing, $\Delta\delta = (\delta_r - \delta_o)$. Ignoring tax considerations, the effective cost of owner-occupied housing services is $R_e = R - p(\delta_r - \delta_o)$. The implicit moral hazard problem makes renting more expensive than owning as in Henderson and Ioannides (1983). The last two terms on the right-hand side of the equation reflect the asymmetric treatment of owner- and tenant-occupied housing. The benefit from supplying services to the rental market is reduced when the spread in the fraction of rental income relative to owner-occupied imputed income is larger. In addition, the benefit increases when the spread between maintenance expenses on renter- and owner-occupied housing increases. Removing the asymmetries, $\iota_r = \iota_o \delta_o / \delta_r$ and $\kappa_r = \kappa_o$, and eliminating the progressivity of income taxation, $T'(y)$, reduces the benefits from housing policy. As a result, the first-order condition without distortions is:

$$\frac{u_d}{u_c} = R - p\Delta\delta. \tag{12}$$

The U.S. tax code has explicit provisions toward housing that imply $\kappa_o = \iota_o = 0$ and $\kappa_r = \iota_r = 1$. That is, the income from the consumption of tenant-occupied housing services is taxable, whereas owner-consumed housing services are not taxable. Maintenance expenses are treated asymmetrically in the tax code. Owner-occupied maintenance expenses cannot be deducted whereas maintenance expenses incurred with respect to tenant-occupied housing are deductible. Under the U.S. code, the first-order condition becomes

$$\frac{u_d}{u_c} = R[1 - T'(y)] + p[T'(\widetilde{y})\delta_r - \triangle\delta]. \tag{13}$$

In addition to the asymmetric distortions just discussed and housing deductions, Ω, that affect adjusted gross income, y, the degree of progressivity of the marginal tax rates, $T'(y)$, affects housing decisions. For example, under a more progressive tax code, the taxation effects are large, which changes the incentives to own and supply rental property. At the aggregate level some of these incentives can disappear due to general equilibrium effects. Since the model has mortgage choice, changes in the tax code can change the incentives on when to buy and the size of the house.

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[23]These terms are relevant only for homeowners since renters are not affected because they cannot be property owners in the model.

4.5.1 The Home Mortgage Interest Deduction

One of the hallmarks of U.S. housing policy is the deductibility of mortgage interest payments for households that itemize. This deduction creates an incentive to both own and consume more homes, generating an asymmetry between housing and financial investment. The view among many economists is that the removal of the interest deduction would reduce owner-occupied housing consumption and thus result in smaller home sizes. Homeownership would be lower because the incentives to own have been reduced. Under revenue neutrality, the elimination of the deduction for mortgage interest costs results in additional revenue, thus leading to a tax reduction.[24]

The baseline model assumes complete deductibility of mortgage interest payments. Formally, the deduction on taxable income can be expressed as $\Omega = \varkappa I_n = \varkappa r^m D(h', n; p)$, where the term $\varkappa$ captures the percentage of mortgage interest costs that is deductible. If $\varkappa = 1$, then mortgage interest expenses are fully deductible. It is also important to point out that the benefits from the mortgage interest deduction are enhanced when the tax rates are more progressive.

The importance of the mortgage interest rate deduction can be determined if the model is resolved under the assumption that this deduction is eliminated, $\varkappa = 0$,. Table 12 summarizes the quantitative implications of this change in policy.

Table 12: The Importance the Mortgage Deduction

Experimental Factors	Ownership(%)
1. Baseline: 1960 factors,1940 parameters, $\varkappa = 1$	63.5
2. Removal of the mortgage deduction, $\varkappa = 0$	67.6
3. Prices fixed, revenue neutrality not imposed, $\varkappa = 0$	50.2

By comparing the baseline version of the model, (i.e, the model with estimated 1940 parameters with the various factors that existed in 1960), in which a mortgage interest rate deduction is allowed with the same model except the mortgage interest deduction is removed, the homeownership rate would increase from 63.5 percent to 67.6 percent, or a 22 percent increase.[25] The importance of general equilibrium effects can be tested by solving the model with fixed prices. In this case, ownership declines to 50.2 percent a value more in-line with Rosen and Rosen (1980) who estimate a negative effect in ownership. Their framework ignores the importance of income effects and the analysis indicates the importance of using a general equilibrium approach over a partial equilibrium approach when relative prices change significantly.

4.5.2 Taxation of Owner-Occupied Housing Service Flows

Many economists argue that the primary distortion in the current tax code is the treatment of housing services. Previous studies for the postwar period suggest that the elimination

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[24]This point is important to keep in mind in policy analysis as the lowering of tax revenue to maintain revenue neutrality can reverse the intuition implied from a partial equilibrium analysis.

[25]In this model all homeowners can choose to either use the standard deduction or itemize, picking the choice that generates the lower tax liability.

of this asymmetry should lead to the consumption of smaller homes and lower home-ownership. For example, Berkovic and Fullerton (1992) find that the taxation of housing services should reduce average housing consumption between 3 and 6 percent, whereas Gervais (2002) finds that taxing imputed rents of owner-occupied housing would increase the capital stock by more than 6 percent but decrease the housing stock by 8 percent.

Under the current tax code, income generated from rental property is subject to taxation, but the implicit income from owner-occupied housing is not taxed. As shown in Equation (13), this policy introduces an asymmetry in the tax treatment of owners and landlords that favors the consumption of owner-occupied housing services and reduces the incentive to supply rental property. The landlord supply decision when housing services are taxed at different rates is determined by

$$\frac{u_d}{u_c} = [R - p\Delta\delta] + T'(\widetilde{y})p\delta_r - T'(\widetilde{y})R(\kappa_r - \kappa_o). \tag{14}$$

The U.S. tax code for the period 1940-60 would set $\kappa_o = 0$ and $\kappa_r = 1$. In Equation (14), the term $T'(\widetilde{y})R(\kappa_r - \kappa_o)$ measures the impact of the failure to tax housing services. As can be seen, this term reduces the effective cost of owner-occupied housing and thus introduces a bias toward owner-occupied housing consumption. This asymmetry is eliminated when the fraction of imputed rental income from owner- and tenant-occupied housing is taxed at the same rate, $\kappa_r = \kappa_o$, but not necessarily zero. The analysis considers the case where the imputed rental income (measured as Rd) is fully taxed, $\kappa_o = \kappa_r = 1$. Table 13 presents these results.

Table 13: The Importance of Taxation Housing Services

Experimental Factors	Ownership(%)
1. Baseline: 1960 factors,1940 parameters, $\kappa_o = 0$ and $\kappa_r = 1$	63.5
2. Taxation of services, $\kappa_o = \kappa_r = 1$	60.4
3. Prices fixed, revenue neutrality not imposed, $\kappa_o = \kappa_r = 1$	55.9

The model suggests that the lack of taxation of housing services has an important impact in accounting for the increase in homeownership. The model suggests that if housing services were taxed, the homeownership rate would be 21 percent lower. Again, a partial equilibrium analysis would overstate the importance of the policy of not taxing owner-occupied housing services. With fixed prices, the taxation of housing services reduces the homeownership rate to 55.9.

5   Conclusions

After the collapse of housing markets during the Great Depression, the government, as part of the New Deal, played a large role in shaping the future of housing finance. By 1960, the housing market had more than recovered as the homeownership rate soared to over 60 percent. This paper quantifies the role of government intervention in housing markets in explaining the expansion in U.S. homeownership between 1940 and 1960; this

role is quantified with an equilibrium model of tenure choice. In the model, home buyers have access to a menu of mortgage choices to finance the acquisition of the house. The government also provides special programs, consistent with the provisions in the tax code. The parameterized model is consistent with key aggregate and distributional features in the U.S. in 1940. The model can account for the boom in homeownership when adjusted to a 1960 economy.

Government intervention via the mortgage market was a key part of the housing boom. The model suggests that moving from a 20-year to a 30-year FRM accounts for roughly 12 percent of the increase in homeownership. When combined with a narrowing mortgage interest rate wedge, the total impact of mortgage innovation is approximately 21 percent. Government intervention via tax policy was also a significant factor in the housing boom. The model suggests that housing policy can have important effects in ownership. For example, the elimination of the mortgage deduction only reduces ownership when prices are fixed and the tax surplus is not rebated back to the household sector. The taxation of housing services always reduces the ownership.

These estimates have ignored the implications of the GI Bill for U.S. housing markets. This legislation could affect housing markets in two ways. First, the GI Bill made housing markets more accessible to veterans through down payment and mortgage payment subsidies. Fetters (2010) presented some empirical findings on this question. Second, this bill provided benefits for human capital investment. The increase in number of college graduates increased substantially under this program. This means an individual with this level of human capital will operate on a higher income path in expected terms than an individual with less education, which has implications for housing investment. The quantitative implications of these policies are analyzed in more detail in Chambers, Garriga, and Schlagenhauf (2011).

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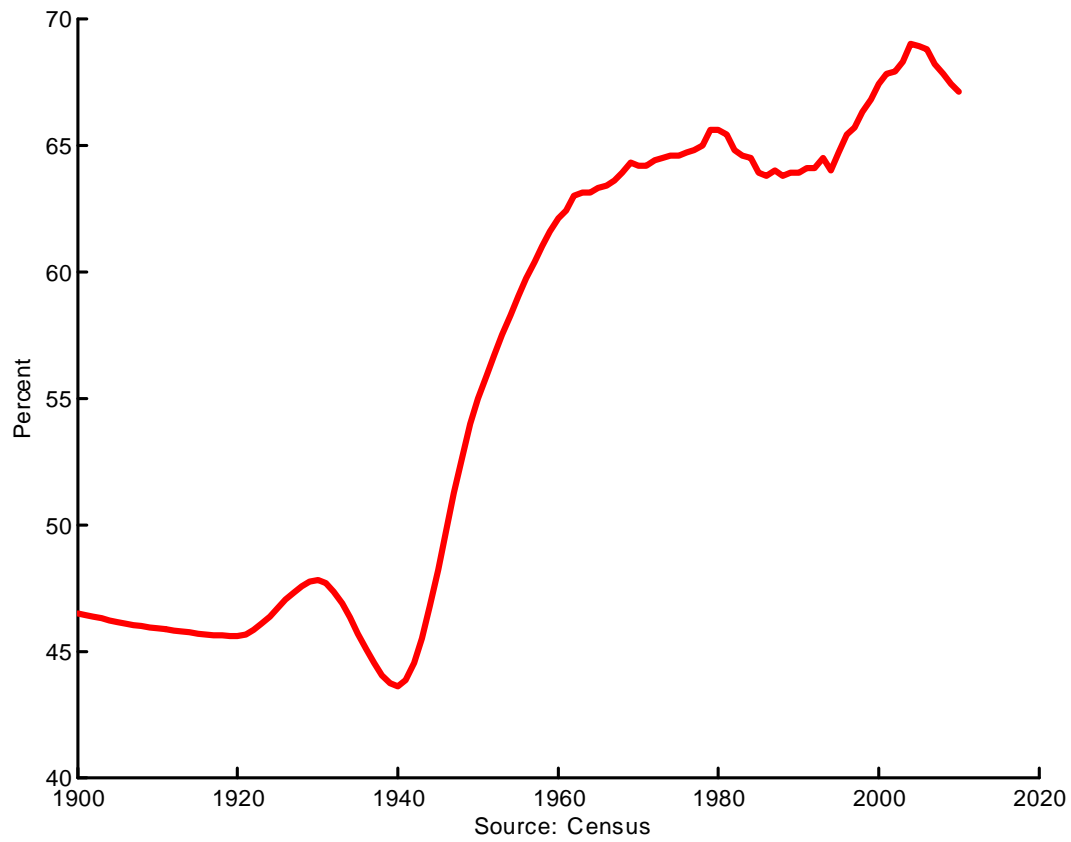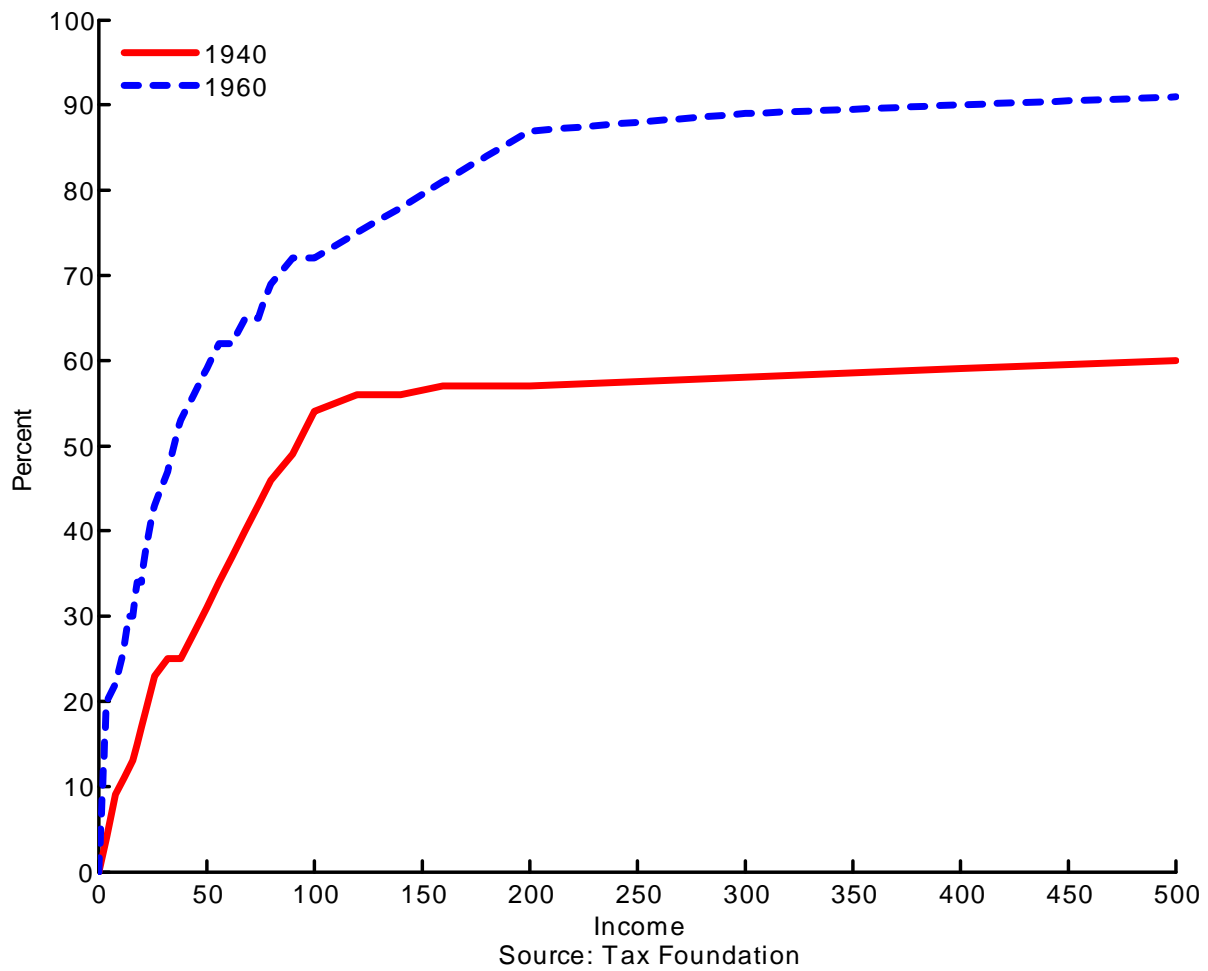**Figure 1: Homeownership Rate: United States (1900-2010)**

Source: Census

Figure 2: Bond and Mortgage Rates (1900-1953)

Source: Grebler, Blank, and Winnick (1956)

Figure 3: Marginal Tax Rates in 1940 and 1960

Source: Tax Foundation

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