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# Did Housing Policies Cause the Post-War Boom in Homeownership? A General Equilibrium Analysis

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# Did Housing Policies Cause the Post-War Boom in Homeownership? A General Equilibrium Analysis*

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**Abstract**

The objective of this paper is to understand the sources of the boom in home ownership between 1940 and 1960. The increase over this period was five times larger than the recent episode 1996-2004. In the post-depression period the government opted to intervene and regulate housing finance, provide assistance programs (i.e. through the Veteran Administration), and change tax provision towards housing. The result was a change in the maturity structure of mortgage loans, downpayment requirements and increase of credit. In addition, the economy underwent important changes in the demographic structure, the income distribution. The relative importance of these different driving forces is analyzed using 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 1940. In contrast to the recent episode, income and demographics are the crucial variables in accounting for the increase in homeownership. Essentially, the level and shape of income over the life-cycle are a precondition for the government reforms in housing markets and housing finance to play an important role in generating an increase in the aggregate home ownership. The increase in life expectancy and the shift in the distribution of age cohort also had a significant effect in the demand for housing.

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

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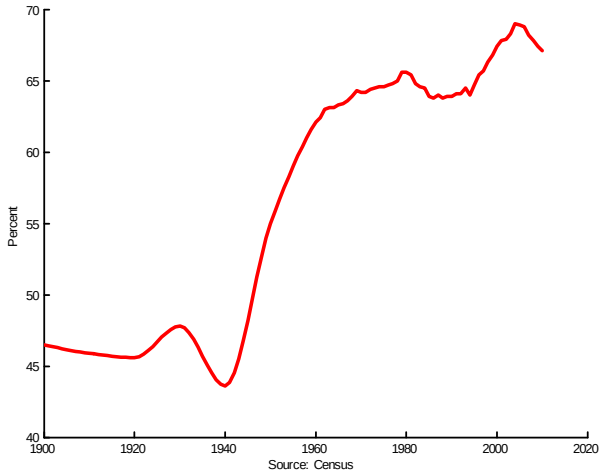
# 1 Introduction

The collapse of housing markets in the United States has been central in the recent financial crisis. One needs to go back to the Great Depression to find a similar impact from the housing sector in the economy. The housing boom had been fueled by substantial innovations in housing finance that modified central features of mortgage loans (i.e. repayment structure and downpayment) resulting in a sizeable expansion of credit and home ownership. Since 1965 the home ownership rate hovered around 64 percent, but during the boom it peak at 69.0 percent.[1]

From a historical perspective, the recent expansion ownership is small compared to the one starting in 1940. Prior to the Great Depression there was little federal involvement housing except for land grants and the regulation of commercial banks. As a result of the foreclosure problem that coincident with the 1929 collapse, the role of government in residential housing changed.[2] The government played a large role shaping the future of the housing market and the mortgage industry. For example, before the Great Depression a large fraction of mortgages were short term (5-7 years), balloons (non-amortizing), and with large downpayment requirements (50-60 percent). The intervention of the government changed those terms in favor of the standard fixed-rate mortgage (FRM) with longer maturities (20-30 years) and higher loan-to-value ratio (80 percent and above). A government agency was established to create a secondary market providing liquidity and expand credit buying primarily FHA insured loans. This intervention coincided with the most significant increase in home ownership in the recent history (see Figure 1). Between 1940 and 1960, the fraction of households that own the home they occupy increased from 44 to 62 percent, with significant contribution from younger homeowners.

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




Thus, an obvious question is what caused the home ownership to increase during this years? This paper quantifies the contribution of the economic and non-economic forces behind this boom, with particular attention to the role of government intervention in housing markets. Some proponents argue that these policies successfully increased the rates of home ownership. For example, Rosen and Rosen (1980) estimate that about one-fourth of the increase in home

[1] 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.

[2] For example, the Home Owners Loan Act Bank 1933 and the 1934 National Housing Act 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.

ownership 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 home ownership. Others attribute the increase to economic forces such as productivity growth or non economic forces such as the change in the demographic structure. For example, Chevan (1989) argues that changes in income and demographic age composition explain more than half of the growth in home ownership between 1940 and 1960. Kain (1983) and Katona (1964) both argue that the increase in home ownership is due to an increase in real income.

There are currently proposals to reform America's housing finance market by regulating loans and reducing the role of government intervention.[3] The lessons learn from this historical episode could provide guidance on reforming housing markets and housing finance. The aforementioned research has attempted to measure the importance of a factor in a regression based framework that holds other potential factors constant. Therefore the extrapolation of the findings to the whole economy could be challenging because most of these factors interact with each other.

This paper employs an alternative strategy by using a dynamic general equilibrium model that allows households and firms to make optimal decisions in an environment that reflects the economic and institutional environment of the relevant time period. In the model, changes in government regulation change relative prices, and further affect decisions. The approach permits the different factors to dynamically interact by studying the simultaneous effects of changing the demographic structure, real wage income, mortgage rates, innovations in housing finance, federal government policies toward housing, and federal income taxes. The advantage of the framework is that it can also be used to assess the contribution of the various factors and to conduct a series of counter factual experiments. 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 is an modification of the life-cycle framework used in Chambers, Garriga, and Schlagenhauf (2009). In the economy, households face uninsurable labor income risk, life uncertainty, and borrowing constraints. Individuals purchase consumption of goods and housing services, and investment 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, long-term mortgage financing, and receives preferential tax treatment. Mortgage loans are available from a financial sector that receives deposits from households and also loans capital to private firms. The model uses a homeowners-based rental market, hence the house price to rental price ratio is an endogenous variable. The production sector uses a neoclassical technology with capital and labor to produces consumption/investment goods and residential investment. The government implements a housing policy, collects revenue with a progressive income tax

[3]The Administration's plan is based a reduction of the role of the government housing finance (mainly the Government Sponsored Enterprises), an increased consumer protection and transparency for investors, improved underwriting standards, and other critical measures. The plan also calls for targeted and transparent support to creditworthy but underserved families that want to own their own home, as well as affordable rental options.

system. The baseline model is parameterized to match the key features of the U.S. economy during the 1935-1940.

The primary factors that account for the increase in the home ownership rate between 1940 and 1960 are income and demographics. Mortgage market innovation played an important role in the 1994-2005, but in this episode is not a key factor. 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 home ownership. If a household faces a low income level (relative to house prices) and low growth, mortgage innovation in terms of lower downpayments or the introduction of amortization become irrelevant as the household can not afford to take advantage of this type of innovation. There are two important demographic changes during this period. One is a significant increase in the fraction of middle age households relative to the young cohorts, and the other is an increase in life expectancy that expands the benefits of owning a house.

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. Additionally, the third section discusses data used for calibrating the model to 1960 in order to conduct our decomposition analysis. The fourth section conducts and discusses the results of the decomposition analysis. The final section concludes.

# 2 A Brief Economic History of the Period 1930 to 1960

Not surprising, the economic environment changed substantially between 1935 and 1960. In the late 1930s and early 1940s, the economy was recovering from the Great Depression. Beyond the economic recovery, the economic environment changed due to a number of institutional changes that occurred in as policy responses to the Great Depression. The literature has suggested a number of factors that may account for the large increase in the home ownership rate. This section describes the economic and institutional environment between 1930 and 1960. The presentation of this historical background should provide the motivation for factors being offered as an explanation. These are divided by factors related to government intervention in housing markets and the expansion of assistance programs with other economic factor and demographic changes.

## 2.1 Regulation of Housing Finance, Assistance Programs, and Tax Provisions

Over this period, a number of changes occurred in the mortgage market that could account for the rising home ownership 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.

After 1900 the importance of mutual saving banks declined while life insurance companies and savings and loans associations substantially increased their market shares. Commercial banks did not become a dominant lenders until after World War II. The real that commercial banks were a relatively unimportance source of mortgage funds is a result if the National banking Act. This Act made real estate loans inconsistent with sound banking practise. 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 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 non-amoritizing 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 non-amoritizing while the percent of non-amoritizing 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** | | |
|---|---|---|---|---|---|---|
| Period | Life Insurance Companies | Commercial Bank | S & L Associations | Life Insurance Companies | Commercial Bank | 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 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.[4] 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 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 home ownership, 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."[5] 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. 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 home ownership and seem to support Fetters(2010) claim

[4] 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.

[5] 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.

that the VA program lead to a 10 percent increase in the home ownership rate.

**Table 3: The Role of Government Mortgage Debt for Home Mortgages: 1935 to 1953 (in millions)**

| | FHA | VA | Combined | Total Home Mortg. | FHA and VA Home Mortg. (% 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: Grebler, Blank, and Winnick (1956), p243.

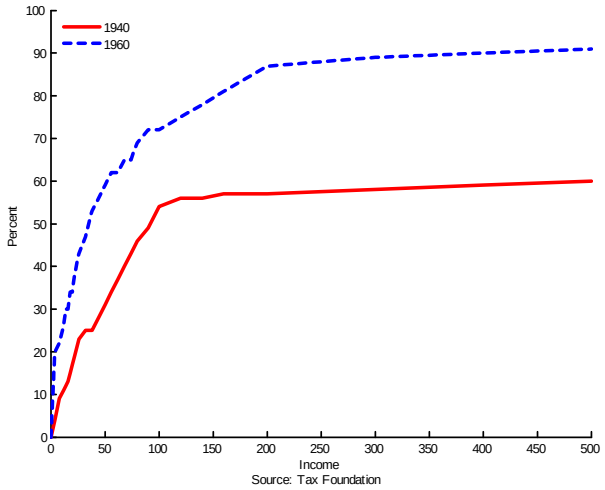
The important changes in the mortgage market could have implications for mortgage interest rates. Unfortunately, mortgage interest rate are more difficult to find for this period. Grebler, Blank, and Winnick (1956, Table O-1, p. 496) report a mortgage rate series for Manhattan between 1900 and 1953 as well as a bond yield. As can be seen in Figure 3, the mortgage interest rate was 5.11 percent in 1900, while the bond yield was 3.25.

**Figure 2: Bond and Mortgage Rates: 1900-1953**

Between 1900 and 1930, both interest rates had an increasing trends (see Figure 2). After 1930 mortgage interest rates declined from 5.95 percent down 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 home ownership., but it could also be due to the elimination of regional lending and a more homogeneous credit market.

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 3, the marginal taxes for each year is presented. As can be seen, marginal tax rate were substantially lower in 1935.

**Figure 3: Marginal Tax Rates in 1935 and 1960**




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

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. Figure 3 shows evidence that fiscal policy code have fostered an increase in the home ownership rate. On the margin, the increased tax rates give home ownership a greater preference in the tax code give the deductibility of mortgage interest.

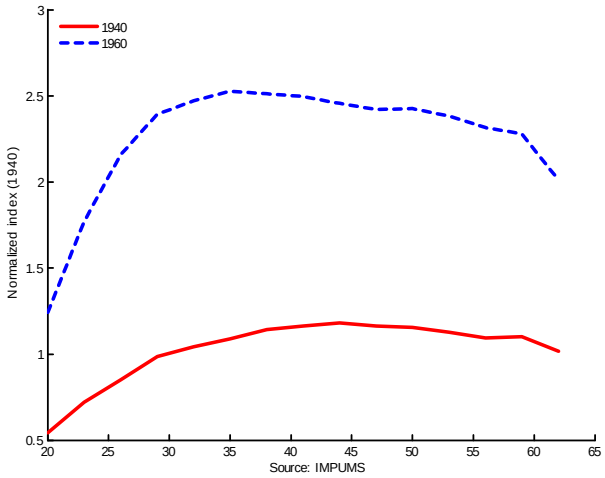
## 2.2 Economic and Demographic Factors

**Income:** In 1940 real GDP was 101.4 billion (in 1940 prices). By 1960, real GDP increased by a factor of 2.4 to 243.3 billion (1940 prices). 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 to measure the change in income between these two time period is to examine the change in per capita wage income. For this same period, wage income per capita increased by a factor of 2.6.[6] While an increase in real income is important, it is equally important to see how wage income changed over the life cycle. We use 1940 and 1960 census data on (real) wage income to construct wage efficiency indices by age cohort. Figure 4 presents 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 home ownership, a steep increase in the wage efficiency index occurs between ages 20 and 35. In addition, the peak in wage efficiency seems to have shifted toward

[6] 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.

younger cohorts in 1960 when compared to 1940. These wage developments suggest workers could acquire the funds needed to invest in housing earlier in their life cycle in 1960 than in 1940. These facts suggest that income could certainly be an important factor in the explanation of the increase in home ownership.

**Figure 4: Wage Efficiency Indices: 1940 and 1960**




An increase in labor 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 25 year period. This increase is less than the increase in real income which suggests that there was an increase in the affordability of housing over this time frame.

**Demographics:** Demographers, such as Chevan (1989), suggest social norms towards housing changed over this period . In the context of the model framework, the demographic factors are restricted to changes in the cohort size and survival rates. These changes have the potential to favored home ownership. Certain age cohorts tend to have higher home ownership rates than other cohorts. Did the size of age-specific cohorts that are correlated with high home ownership 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.

**Table 1: Historical Age Cohort, Survival Rates, and Home Ownership**

| | | Home ownership by Age | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Total** | **20-25** | **26-35** | **36-45** | **46-55** | **56-65** | **66-75** | **76-82** |
| 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 | | 0.13 | 0.27 | 0.21 | 0.19 | 0.12 | 0.07 | 0.02 |
| 1960 | | 0.10 | 0.21 | 0.21 | 0.18 | 0.14 | 0.10 | 0.04 |
| | | **Conditional Survival Probabilities** | | | | | | |
| 1940 | | 0.986 | 0.969 | 0.949 | 0.898 | 0.798 | 0.609 | 0.4828 |
| 1960 | | 0.993 | 0.986 | 0.971 | 0.927 | 0.840 | 0.677 | 0.568 |

[1] The relative size is based on age 20 through age 82

Source: U.S. Life Cycle Tables. and U.S. Census Bureau

The highest home ownership rates occur in age cohorts older than age 36. The fraction of the population in the 20-25 and 26-35 age cohorts is smaller in 1960. More importantly, in 1940 57.5 percent of the population was between age 36 and 65, while in 1960 62.6 percent of the population was accounted for by this cohort. Since the age 36-65 age cohorts tend to have higher home ownership rates, this evidence suggest that demographic trends could be a factor in an explanation for the large increase in the home ownership rate in 1960. A simple way to test this conjecture is to perform a decomposition of the home ownership rate. The aggregate ownership rate for a given year $t$ can be expresses as $\Pi_t = \sum_{i \in I} \mu_t^i \pi_t^i$, where $\mu_t^i$ is population weight for households of type $i$ in period $t$, and $\pi_t^i$ denotes the ownership rate for individuals of type $i$ in period $t$. The contribution of a factor can be roughly estimated by appropriately holding the other factors constant, and then calculating a hypothetical aggregate rate. The data from *Public Use Microdata Samples* (PUMS) for 1940 and 1960 provide the complete information to perform the decomposition. For example, the effect of demographic changes on the home ownership rate can be estimated by holding the participation behavior of year 1940 constant and using the population weights of 1960. Table 2 summarizes the implied homeownership rates for different combinations of population structures and individual participation behavior.

**Table 2: United States: Actual and Hypothetical Ownership Rate with respect to 1940**

| | **Expression** | **Ownership Rate** | **Total Change** |
|---|---|---|---|
| Participation (1940) and Population (1940) | $\sum_{i \in I} \mu_{1940}^i \pi_{1940}^i$ | 44.53 | |
| Participation (1960) and Population (1960) | $\sum_{i \in I} \mu_{1960}^i \pi_{1960}^i$ | 65.57 | 21.04 |
| Participation (1940) and Population (1960) | $\sum_{i \in I} \mu_{1960}^i \pi_{1940}^i$ | 47.47 | 2.94 |
| Participation (1960) and Population (1940) | $\sum_{i \in I} \mu_{1940}^i \pi_{1960}^i$ | 62.13 | 17.60 |

Data Source: United States Public Use Microdata Samples (PUMS)

The simple decomposition shows that when the participation rates for the different cohorts remain at their 1940 level but the cohort sizes are changed to 1960, the implied ownership rate

increases from 44.5 to 47.5 percent. This implies that demographic changes alone account for 14 percent of the total increase of the observed home ownership. This type of demographic changes, as reflected in the population cohort weights, do not seem to be a primary factor. To estimate the effect of changes in participation rates, the population structure observed in 1940 can be held constant and the participation rates set to their 1960 values. Under this set of assumptions the implied ownership rate is 65.6 percent and account for 84 percent of the increase in the observed aggregate. The total effect also includes a small positive covariance term that amounts to 2.4 percent.

A second demographic consideration is the survival rates of households in the two periods. The idea is that if survival rates are higher in one period than a previous period, a household may be more likely to invest in housing. In Table 1, we present survival rates for the designated cohorts. These survival rates measure the probability of being alive at beginning age in the next cohort given you are alive at the beginning of the current cohort. Clearly, life expectancy increased significantly between 1940 and 1960. This is a possible channel for demographic considerations to impact home ownership that has not been stressed in the empirical literature

The section suggests that a number of factors could been important in constructing an explanation for the increase in home ownership between 1935 and 1960. The next section details presents a model that will used 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.** The economy is populated by life-cycle households that are *ex-ante* heterogeneous. 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 $\psi_{J+1} = 0$. Earnings uncertainty implies that the individual is subject to income shocks that cannot be insured via private contracts. As 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 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 $u(c,d)$. This function satisfies the usual properties of differentiability and Inada conditions.

**Asset Structure.** Individuals have access to a portfolio of two assets to mitigate income and mortality risk. A financial asset denoted by $a'$ with a net return $r$ and a 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.[7] If a household does not invest in housing, $h = 0$,

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

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 $\chi$ percent of the value of the house. The amount $\chi ph$ 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, (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 $I_n = r^m D_n$.[8] 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.

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:

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

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 additional equity beyond the initial downpayment until the final mortgage payment is made.

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

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.

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,

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

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 whether the household 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 their 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, $\upsilon_j$, and a transitory age-dependent idiosyncratic component $\epsilon_j$ drawn from a age-specific probability distribution $\Pi_j(\epsilon_j)$. 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 $\theta$. Pretax labor earnings are defined as $y_w$, where

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

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 $y_R(h', d)$

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

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, $\Omega$. 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

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

**The Household Decision Problem.** A single household budget constraint can not be easily 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. 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.

**Table 3: 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: $h' = 0$ |

The starting point is the problem of an individual that starts as a renter, and then 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 solving

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

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

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. [9] 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 $h^{'} > 0$. This decision problem can be written as:

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

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

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

- **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, $\phi_s$, and any remaining principal on the mortgage loan, $D(p, h)$.[10] 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, $\phi_s$, and the remaining principal $D(n)$ owed to the lender. The relevant future information is given by $x' = (a', h', N-1, j+1)$.

[9] 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.

[10] 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.

Finally, we solve the problem of a homeowner who sells the house $h > 0$ and becomes a renter $h' = 0$. [11] The optimization problem is very similar to the previous one. However, in this case the individual must sell the home and rent $Rd$. Formally,

$$v^r(x) = \max u(c, d) + \beta_{j+1} E v(x'), \tag{7}$$

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

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 $v^r$.

### 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 $\alpha$ 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 $\Upsilon$ represent aggregate consumption, capital investment, housing investment, government spending, and various transactions costs, respectively.[12]

### 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, $tr$.

[11] 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, $h^{'} = a' = 0$.

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

### 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 Parameterization and Baseline Results

In order to determine the critical factors that account for the large increase in the home ownership rate between 1940 and 1960 it is necessary to specify functional forms and parameter values. Some parameters can be directly specified using procedures established in the literature, but other parameters need to be estimated. The parametrization technique is based on moment estimation to replicate key properties of the U.S. economy. 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.

**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, $\mu_j$. 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. The normal convention is to calculate an equilibrium under an assumption of a demographic steady state. Because of the argument that the increase in the home ownership was due to demographic factors, 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 $\beta, \gamma, \sigma_c$, and $\sigma_d$ are required. The parameter $\sigma_d$ is normalized to 1 and the value of $\sigma_c$ is set at 3 to match the growth rate of housing over the consumption over the life-cycle. The parameters $\gamma$, which measures the relative importance if consumption in the momentary utility function, and $\beta$ 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, $\alpha$, 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, $\delta$, is estimated to the ratio 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, $\upsilon_j$. This component is generated using the average salary and wage income by age from Public Use Microdata Samples (PUMS) for 1940. Similarly, the data for 1960 is used to calculate the age-earnings component in that period. 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. The micro evidence from PUMS is restricted to Census years 1940 and 1960 being 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. The alternative is to consider the stochastic component to be an independent and identically distributed age dependent income shock, $\epsilon_j$. This income process can be estimated using a Kernel density estimation for every age cohort, $\Pi_{jt}(\epsilon_j)$ 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. The model considers 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 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, $\tau_0$, can be reduced. This factor is estimated by targeting the personal income tax revenue to GDP ratio. In 1935, this ratio was 0.01.

**Wealth endowments:** Bequests appeared to be an important source of home ownership for young households in 1940. Table 4 presents IRS data on real estate bequests in both 1940 and

1960.[13]

**Table 4: Real Estate Bequests in the U.S. (1940-1960)**

| 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

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 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. 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 one households who receive a bequest of a minimum size home. The percentage is adjusted so that the model generates a home ownership for young households that is similar to that found in the data. The value of transfers from accidental death is adjusted to equate to the amount of housing bequests to individuals.

**Housing:** In the baseline model, homeowners can only finance home purchases with short duration balloon type contracts. The balloon loan is restricted to 12 years (or 4 model periods), and a 50 percent downpayment is required. Formally, this means setting $N = 4$ and $\chi = 0.5$. 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 value of minimum size house determines the second housing grid point. The values $\delta_o$ and $\delta_r$ are crucial for the supply of rental property. Data is not available for readily available that allows estimation of these parameters. The parameter values are taken 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.

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.

[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.

**Table 5: Estimation of Model**

| **Statistic** | **Target** | **Model** |
|---|---|---|
| Ratio of wealth to gross domestic product $(K/Y)$ | 2.54 | 2.547 |
| Ratio housing services to consumption of goods $(Rs_c/c)$ | 0.18 | 0.18 |
| Ratio fixed capital investment to GDP $(\delta K/Y)$ | 0.112 | 0.112 |
| home ownership Ratio | 0.454 | 0.4564 |
| Personal Income Tax Revenue to output $(T(ay)/Y)$ | 0.01 | 0.01 |
| Balanced bequests | 0.00 | 0.0003 |

| **Variable** | **Parameter** | **Value** |
|---|---|---|
| Individual Discount Rate | $\beta$ | 0.918 |
| Share of consumption goods in the utility function | $\gamma$ | 0.940 |
| Depreciation rate of capital | $\delta$ | 0.111 |
| Minimum Housing Size | $\underline{h}$ | 4.173 |
| Lump sum tax transfer | $\tau_0$ | 0.001 |
| Initial period bequested homes | $W_0$ | 0.253 |

The model can be evaluated from various perspectives. The objective is to measure the performance by looking at the home ownership rate statistics for the various years and age groups. As can be seen in Table 6, the home ownership rate was 48.1 percent in 1930. In 1940 home ownership rate was only 42.7. Since the baseline model attempts to focus on the home ownership rate prior to the impact of the National Housing Act. The average of the of the home ownership rate between 1930 and 1940 - 45.4 percent - is used as a target.

**Table 6: home ownership Rates: 1935-40**

| | | **home ownership by Age** | | | | | |
|---|---|---|---|---|---|---|---|
| **Actual Data** | **Total** | **25-35** | **36-45** | **46-55** | **56-65** | **66-75** | **76-82** |
| 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 |

Since the aggregate home ownership rate is an estimation target, it not surprising that the baseline model generates a number close to selected moment. The age specific home ownership rates can be used to evaluate the model. The model captures the hump-shaped behavior observed in the data. The lowest home ownership rate occurs in the youngest age cohort. The home ownership rate is increasing by age cohort. This pattern is apparent in 1930 and 1940. The difference is that home ownership rates are higher in 1930. The model does generate this pattern by age cohort, but does overstate the age specific home ownership rate starting with the age 46-55 cohort. The model generates a home ownership 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 similar.

# 5 Contributive Factors to Home Ownership Growth in 1960

In this section, the model is used to quantify the contribution of the economic and non-economic forces behind this boom, with particular attention to the role of government intervention in housing markets. The parameter values are maintained at their respective baseline levels.

## 5.1 Baseline Model with Institutions and Economic Conditions of the 1960s

The starting point tests the model ability to capture the total increase in home ownership between 1940 and 1960. That includes government related factors: housing financed sponsored policies such as the introduction of the FRM, a mortgage market innovation, mortgage interest rate deduction, a change in the federal income tax structure, and the reduction of transaction costs in mortgage rates. The additional factors considered are an increase in real income and change in the demographic structure

A starting point is to ask if all six of these changes occurred at the same time, what would the model predict home ownership would like in 1960? The 1940 survival and age cohort population shares are replaced with their 1960 counterparts. The distribution of i.i.d. idiosyncratic factor is adjusted to replicate the income distribution of 1960. 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 is normalize to equal one, the 1960 values are rescaled upwards by the 2.25. 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, 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 those households who 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 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 tax adjustment coefficient, $\tau_0$, is set to be 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.

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 balloon contract with a fixed payment amortizing contract. Another 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 from 2.53 to 1.63 percent.[14] Despite the income increase, house prices also increase according to Case-Shiller by 41.5. The model captures the increased cost of housing by adjusting the cost per unit of housing.

Table 7 presents the model's prediction on the effect on home ownership if the various factors

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

are jointly introduced.

**Table 7: home ownership Rates 1960**

| | | home ownership by Age | | | | | |
|---|---|---|---|---|---|---|---|
| **Actual Data** | **Total** | **25-35** | **36-45** | **46-55** | **56-65** | **66-75** | **76-82** |
| 1960 | 62.5 | 56.2 | 68.1 | 69.5 | 69.3 | 69.8 | 67.2 |
| **Model Data** | | | | | | | |
| 1960 | 68.5 | 43.7 | 72.4 | 85.0 | 89.7 | 92.3 | 46.7 |

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 home ownership 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 home ownership rates in the 46-55, 56-65 and 66-75 age cohorts which again is due to the lack of housing price risk.

### 5.2 Mortgage Market Innovation: Introduction FRM

Chambers, Garriga, Schlagenhauf (2009) found that mortgage market innovation was the key factor in explaining the increase in the home ownership 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 home ownership rate change is presented in Table 8.

**Table 8: The Mortgage Contract Innovation**

| | | home ownership by Age | | | | | |
|---|---|---|---|---|---|---|---|
| **Actual Data** | **Total** | **25-35** | **36-45** | **46-55** | **56-65** | **66-75** | **76-82** |
| 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** | | | | | | | |
| 1940 with balloon | 45.4 | 7.7 | 47.5 | 74.8 | 83.4 | 85.2 | 55.8 |
| 1940 with FRM | 41.0 | 17.5 | 38.8 | 59.7 | 65.9 | 64.7 | 31.5 |

In contrast to the 1996-2005 period, mortgage innovation, ceteris paribus, resulted in a decrease in home ownership 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 efficiency 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]

### 5.3 Tax Provision Towards Housing

Rosen and Rosen (1980) argue that twenty-five percent of the increase in home ownership 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 is a result of 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. The results of this counter factual experiment are presented in Table 9.

**Table 9: The Importance of Tax Policy Changes**

| | | **home ownership by Age** | | | | | |
|---|---|---|---|---|---|---|---|
| **Actual Data** | **Total** | **25-35** | **36-45** | **46-55** | **56-65** | **66-75** | **76-82** |
| 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** | | | | | | | |
| 1940 Tax structure | 45.6 | 26.4 | 50.5 | 51.0 | 69.6 | 64.7 | 27.5 |
| 1960 Tax structure | 27.7 | 19.8 | 18.2 | 23.7 | 31.4 | 78.7 | 49.9 |

If the 1960 tax structure existed in 1940, home ownership rates would have declined to 27.7 percent. This result is contrary to the Rosen and Rosen result. Why? We will show that real income in 1940 was substantially smaller and more uniform. When the 1960 tax code is imposed in 1940, income is sufficiently 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.

### 5.4 Income

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 lead to a slight increase in variance. Holding everything else at 1940 levels, when the 1960 wage income structure is introduced into the model, the aggregate home ownership rate increases to 74.3 percent.

[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

**Table 10: The Importance of Income Changes**

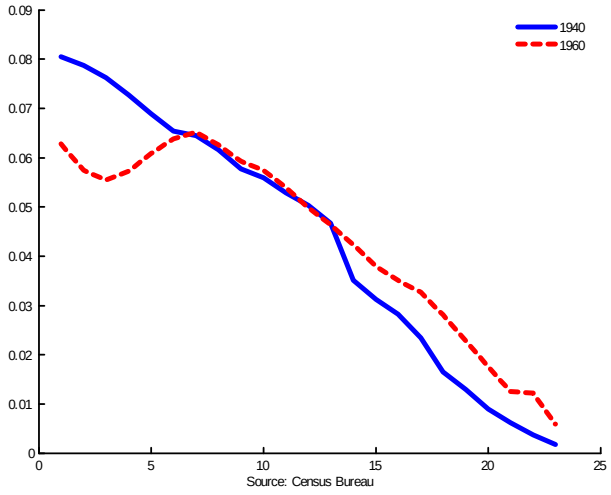
| | | home ownership by Age | | | | | |
|---|---|---|---|---|---|---|---|
| **Actual Data** | **Total** | **25-35** | **36-45** | **46-55** | **56-65** | **66-75** | **76-82** |
| 1940 | 42.7 | 33.5 | 42.1 | 51.0 | 57.5 | 60.3 | 62.3 |
| 1960 | 62.5 | 56.2 | 68.1 | 69.5 | 69.3 | 69.8 | 67.2 |
| **Model Data** | | | | | | | |
| 1940 with income | 45.6 | 26.4 | 50.5 | 51.0 | 69.6 | 64.7 | 27.5 |
| 1960 with income | 74.3 | 52.2 | 86.1 | 97.4 | 98.9 | 98.7 | 54.9 |

The change in income dominates all other possible factors. 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 steepness of the wage efficiency measures between age 20 and 35 are much more pronounced in 1960. This means more first time households are likely to find home ownership a viable alternative to renting as they able to accumulated wealth at a faster pace.

## 5.5 Demographics

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 home ownership rate was 45.4 percent. The model suggests that the 1960 demographics would have resulted in an aggregate participation rate of 59.3 percent. A closer examination of the data indicates why age-specific cohort changes increase the home ownership rate. In Figure 5 we plot age-specific age cohort data for 1940 and 1960.

**Figure 5: Age Specific Cohort Sizes in 1940-1960**




The horizontal axis measures age in model periods. In 1960, the relative size of age cohorts under model age 5, (i.e., under age 35) are smaller. These cohorts tend participate less in home ownership. However, after model age 5, the relative size of the remaining cohorts are larger

in 1960. 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. In addition, an increase in survival rates between 1940 and 1960 is likely to lead to higher housing participation rates.

**Table 11: The Importance of Demographic Factors**

| | | | home ownership by Age | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Actual Data** | | **Total** | **25-35** | **36-45** | **46-55** | **56-65** | **66-75** | **76-82** |
| 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 |
| **Population Shares** | **Survival Rates** | | | | **Model Data** | | | |
| 1940 | 1940 | 45.6 | 28.3 | 41.7 | 64.4 | 70.3 | 71.3 | 38.7 |
| 1960 | 1960 | 59.3 | 20.8 | 49.5 | 75.6 | 80.9 | 81.8 | 47.3 |
| 1960 | 1940 | 53.3 | 19.9 | 48.0 | 74.8 | 82.3 | 81.8 | 41.3 |
| 1940 | 1960 | 49.0 | 24.4 | 45.0 | 69.3 | 75.6 | 77.9 | 51.6 |

An important question is whether the increase in home ownership is due to having more households in cohorts where the participation rate is higher or having household survival rates increase? This question can be addressed by using the model to conduct a series of counter factual experiments. First, we attempt to measure the pure effect of having more households in age cohorts where the participation rate is higher. We do this by holding survival rates at their 1940 values, but assuming the 1960 survival rates exist in 1940. The model is resolved for equilibrium. If 1960 age cohorts existed in 1960, the home ownership rate would have been 53.3 percent. This factor accounts for 56 percent of the increase in home ownership. In order to examine the importance of the increase in survival rate, we replace the 1940 survival rates with the 196o survival rates, bur maintain the 1940 age cohort structure. The home ownership rate would have increased to 49.0 if 1960 survival rates existed in 1940. This factor accounts for 25 percent of increase in home ownership due to demographic changes.

### 5.6 The Role of Housing Bequests

In the calibrated model for 1940, we argued that it was important to allow for that fact that a number households entered the housing bequest via a bequest. After examining historical data on bequests of real property, we estimated that approximately 8.3 percent of households received a housing bequest. We used that number along with the assumption that the bequest was for a minimum size house to quantify the amount of the gift.. In 1960, the importance of housing bequests fell to about 5.8 percent of households. In order to examine the role of the housing bequests, we use the replace the benchmark bequest with the bequest value based on

1960 numbers.

**Table 12: The Role of Housing Bequests**

| | | home ownership by Age | | | | | |
|---|---|---|---|---|---|---|---|
| **Actual Data** | **Total** | **25-35** | **36-45** | **46-55** | **56-65** | **66-75** | **76-82** |
| 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 | | | | | | | |
| 1940 | 45.4 | 7.7 | 47.5 | 74.8 | 83.4 | 85.2 | 55.8 |
| 1960 bequest value | 31.3 | 18.6 | 26.7 | 39.5 | 45.7 | 47.1 | 23.6 |

The introduction of bequests into the model was important for matching the overall home ownership rate and the home ownership rate by age. If the number of households receiving the bequest is reduced to 1960 values while holding all other variables at 1940 values, we find the aggregate home ownership would be 31.3 percent. This value is much lower than the value actually observed in 1940. The age specific home ownership rates would be significantly lower for age cohorts except the 25-35 age cohort. The increase in the 25-35 age cohort home ownership rate is a result of general equilibrium effects resulting in higher rental prices.

# 6 Conclusions

Between 1935 and 1960, the aggregate home ownership 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 home ownership increased observed between 1996-2005, income is the crucial variable in accounting for the increase in home ownership. 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 home ownership rate. Demographics were also an important factor in the increase in the home ownership 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 home ownership rate to be supported.

The results presented in the paper need to be considered preliminary. The model seems to overstate home ownership. 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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