

# Housing Economics and Public Policy

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# INTRODUCTION

- Real estate is the land and any permanent structures on the land, natural and man-made.
  - Buildings
  - Trees
  - Water
- There are five main types of real estate
  1. **Residential real estate**
    - Any property used for residential purposes. Examples include single-family homes, condos, cooperatives, duplexes, townhouses, and multifamily residences with fewer than five individual units.
  2. **Commercial real estate**
    - Any property used exclusively for business purposes, such as apartment complexes, gas stations, grocery stores, hospitals, hotels, offices, parking facilities, restaurants, shopping centers, stores, and theaters.
  3. **Industrial real estate**
    - Any property used for manufacturing, production, distribution, storage, and research and development. Examples include factories, power plants, and warehouses.
  4. **Land**
    - Includes undeveloped property, vacant land, and agricultural land (farms, orchards, ranches, and timberland).
  5. **Special purpose**
    - Property used by the public, such as cemeteries, government buildings, libraries, parks, places of worship, and schools.
- Real estate has distinct economic characteristics that influence its value.
  1. **Scarcity**
    - The total supply of land is fixed, and in some regions and cities, it is hard to find undeveloped land.
  2. **Improvements**
    - An improvement is any change to the land or structures that impacts its value.

- Building, renovating, or expanding a home.
- Cutting down a tree.
- Building a fence.

### 3. Permanent investment

- Many of the improvements to a property, like sewage, electricity, water, etc. tend to be permanent, even if the structures are removed.

### 4. Location preference

- People have preferences regarding a specific location based on convenience, reputation, and history.
- Location is often the most important economic characteristic to people and thus has a huge influence on the value.

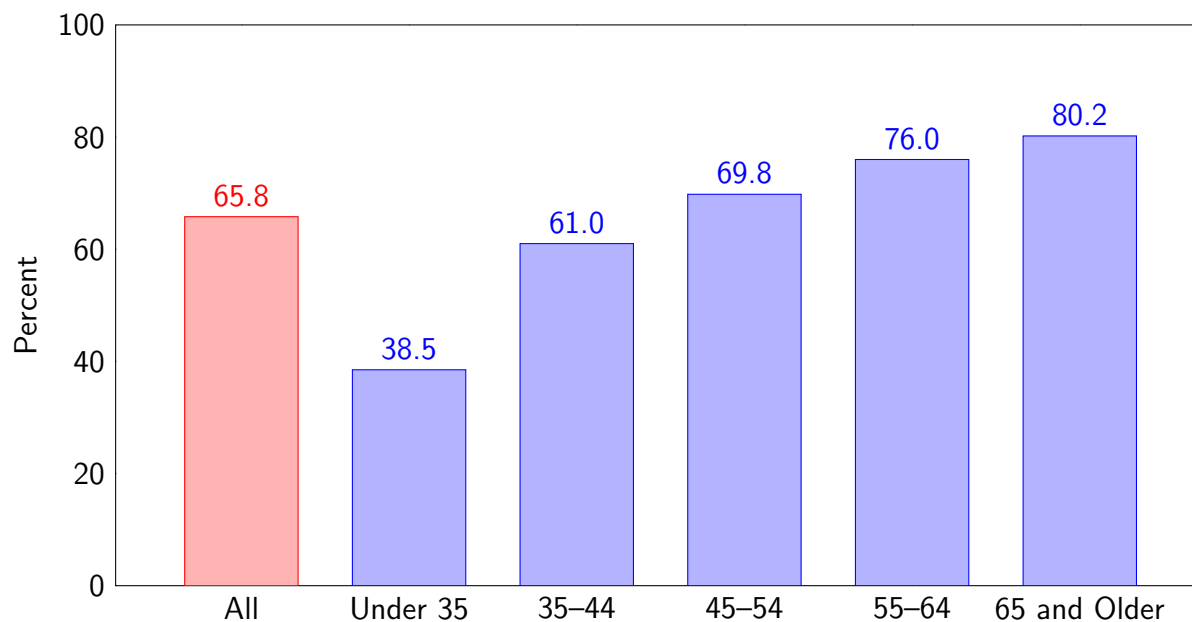
- In this class, we are going to primarily talk about residential real estate and commercial real estate in the form of apartments and rental property.

## 1.1 Housing

- Housing influences many aspects of life.
  - It is a private space for relaxation where people raise families.
  - The location of housing is important for access to schools, transportation, and shopping.
  - The neighborhood or apartment complex where people live provides access to social networks.
- There are also many benefits to owning houses:
  - Education.
  - Health.
  - Economic outcomes .
- Housing is also an investment good.
  - A house is also an asset and often appreciates in value over time
  - For most people/families, the house is the largest part of their net wealth.

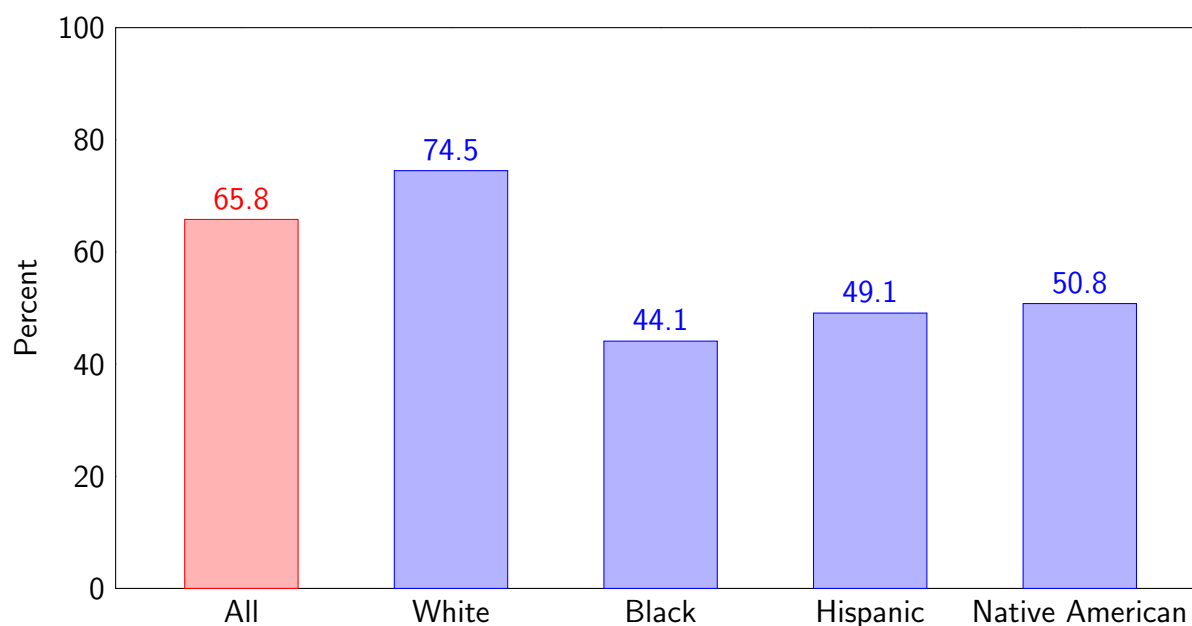
### 1.1.1 Data on Housing

Figure 1.1: Homeownership Rates by Age, 2020



Source: U.S. Census Bureau, Current Population Survey/Housing Vacancy Survey.

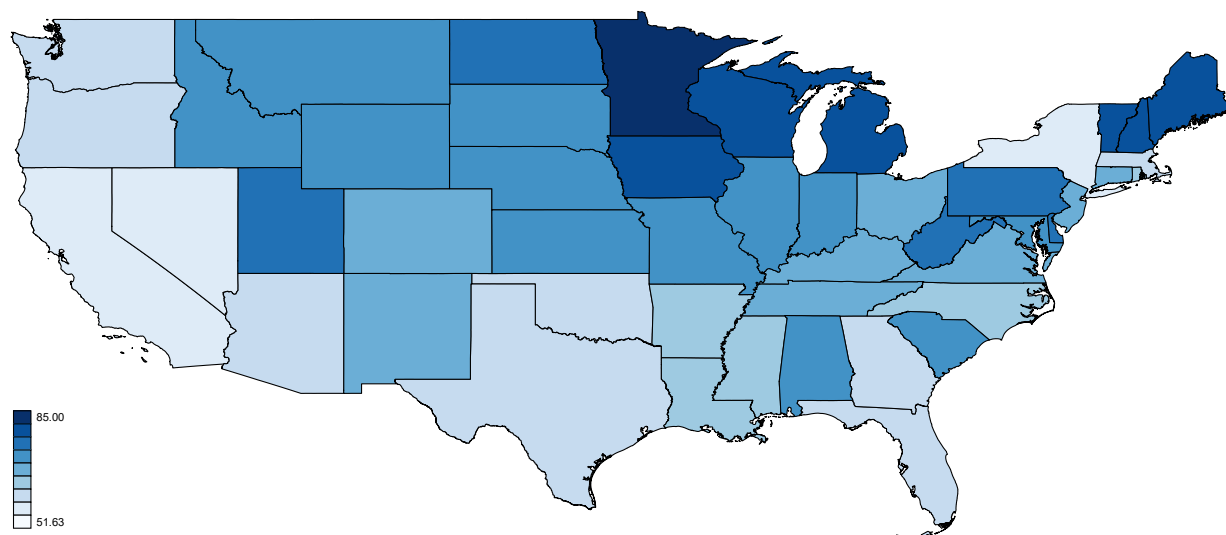
Figure 1.2: Homeownership Rates by Race and Ethnicity, 2020



Source: U.S. Census Bureau.

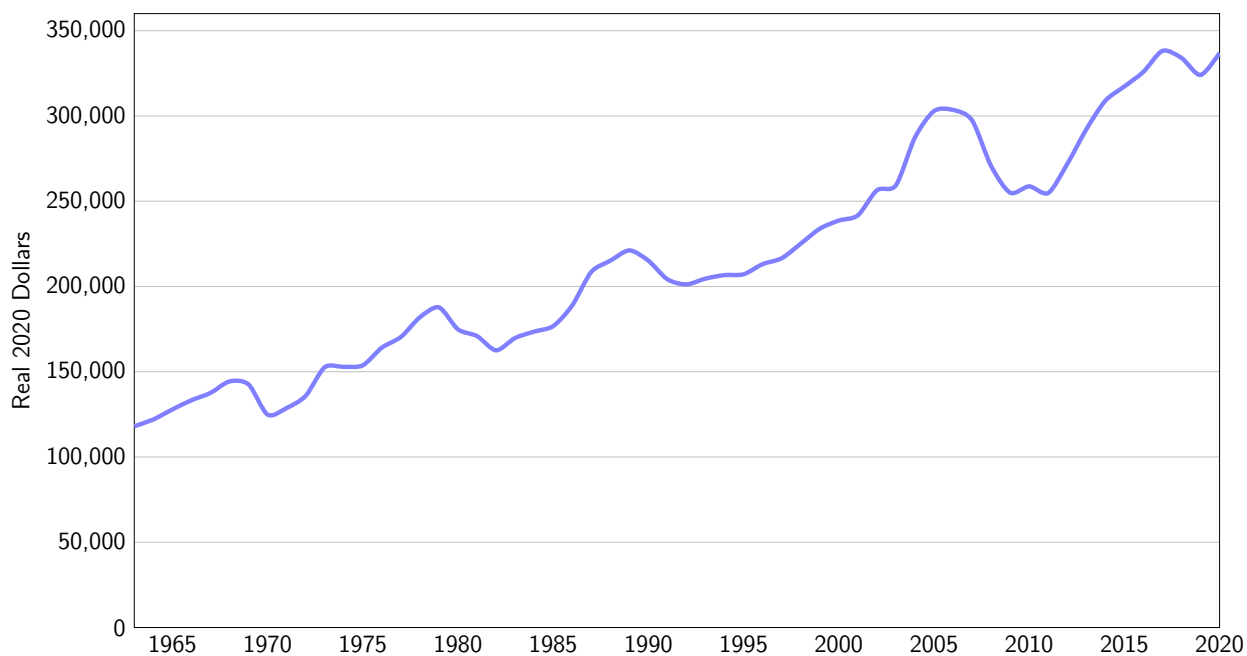
Note: Homeownership rate for Native Americans is from 2019

Figure 1.3: Homeownership Rates by State, 2019



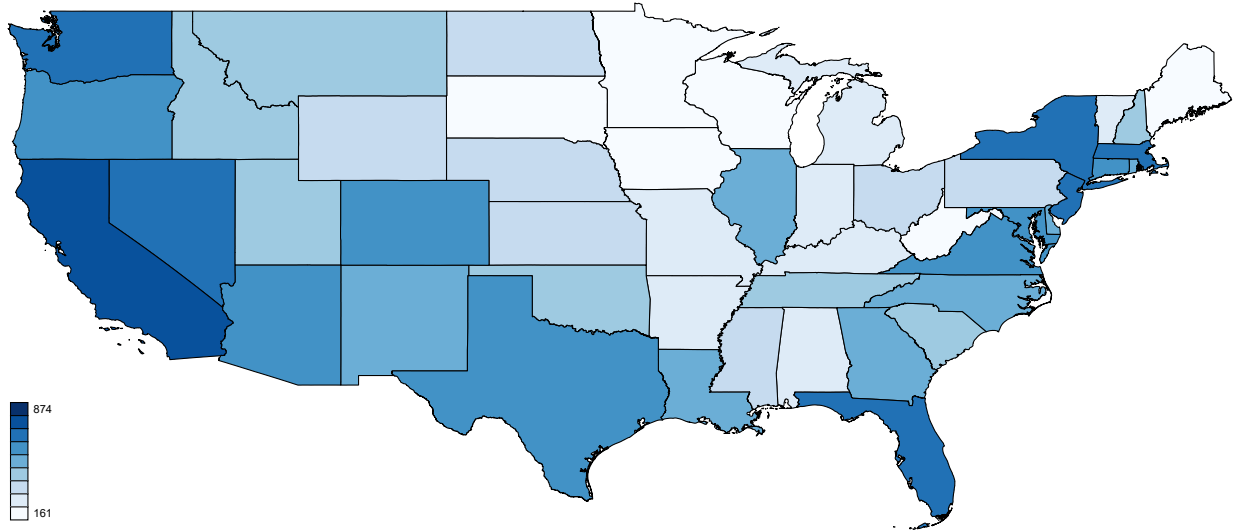
Source: American Community Survey, Tim Murray.

Figure 1.4: Median Sales Price of Houses Sold for the United States, 1963–2020



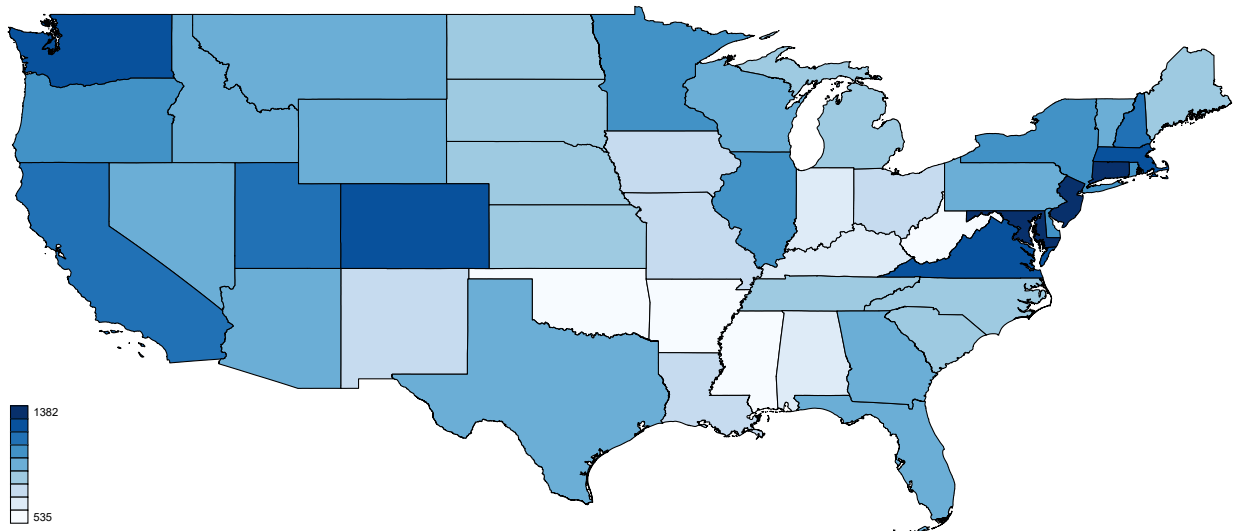
Source: US Department of Housing and Urban Development via FRED, Tim Murray.

Figure 1.5: Average Monthly Rent Payment by State, 2019



Source: American Community Survey, Tim Murray.

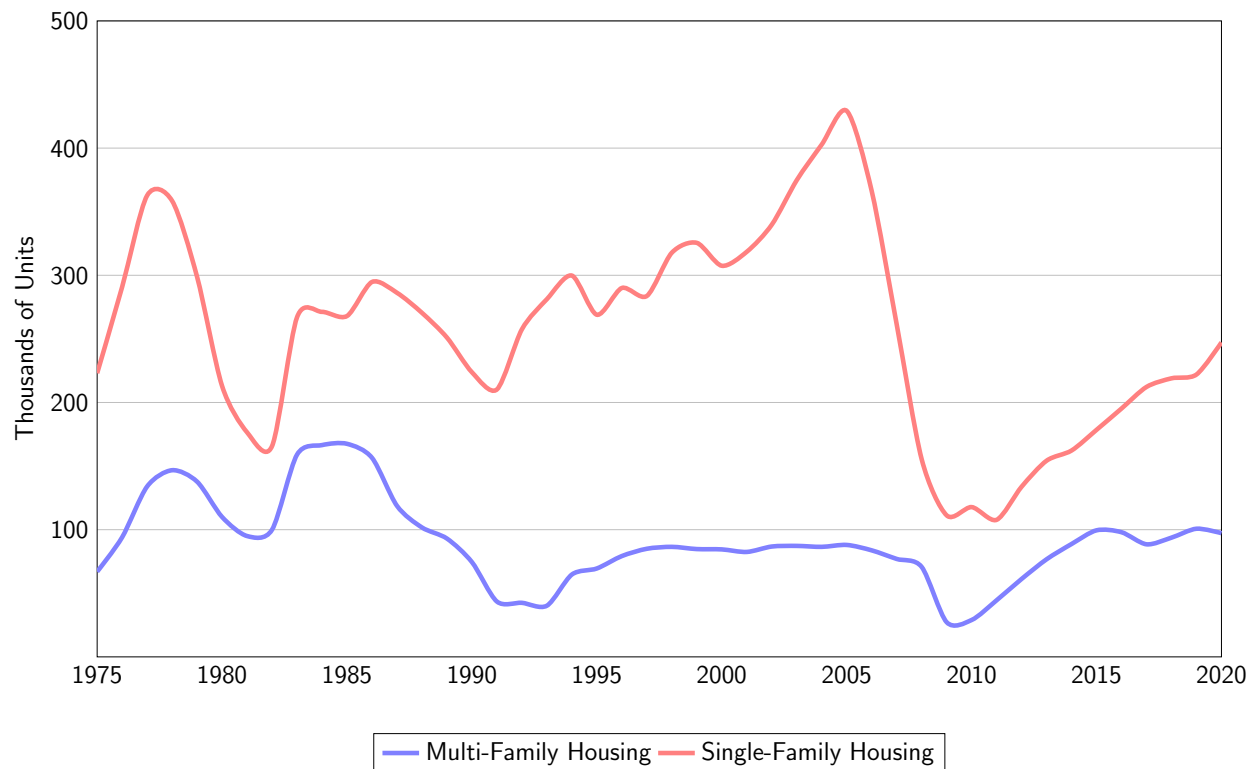
Figure 1.6: Average Monthly Mortgage Payment by State, 2019



Source: American Community Survey, Tim Murray.



Figure 1.7: Annual New Privately Owned Housing Starts, 1975–2020



**Source:** US Department of Housing and Urban Development via FRED, Tim Murray.

### 1.1.2 Housing Policy in the United States

- [Katz et al. \(2003\)](#) lay out seven goals for housing policy:
  - Preserve and expand the supply of good-quality housing units.
  - Make existing housing more affordable and more readily available.
  - Promote racial and economic diversity in residential neighborhoods.
  - Help households build wealth.
  - Strengthen families.
  - Link housing with essential supportive services.
  - Promote balanced metropolitan growth.
- Governments can shape housing policies in various ways.
  - Can provide assistance in the form of direct subsidies or tax incentives.
    - Public housing.
    - Block grants that give local governments the ability to build their own programs.
    - Subsidy programs to support construction and renovations.
    - Rental vouchers to help families afford housing.

- Programs often favor particular groups.
  - \* Income
  - \* Elderly
  - \* Disabilities
  - \* Homeless
- Can use regulatory power to influence:
  - Availability of mortgages.
  - Practices of real estate agents.
  - Type, amount, and cost of housing that can be built.
- Around 7 million low-income renters benefit from federal housing subsidies.
  - Federal expenditure totaled around \$48 billion.
- Around 34 million homeowners take advantage of the mortgage interest deduction on federal income taxes.
  - Total benefits were around \$220 billion
  - Most of these benefits go to households with incomes over \$100,000

## References

**Katz, Bruce, Margery Austin Turner, Karen Destorel Brown, Mary Cunningham, and Noah Sawyer.** 2003. "Rethinking local affordable housing strategies: lessons from 70 years of policy and practice." *Washington, DC: The Brookings Institute.*

# HOMEOWNERSHIP

- Homeownership is a goal for many Americans
- In 2020, around 66% of Americans own a home
- Many of those that do not own, and who rent are young and will be future homeowners
- Many view homeownership a more than just a place to live, but also as an investment
  - Economists refer to a house as both a consumption good (consumption for shelter) and an investment good
- Housing and housing-related services make up about 15% of GDP in the United States
- Federal income tax policy favors homeownership by allowing mortgage interest to be deducted from Federal taxes and, excluding capital gains from taxation on the sale of a property under certain conditions
- In this section, we are going to talk about the factors that determine house prices and valuation, financing homeownership and mortgage basics and the effects of time and risk on house value

## 2.1 House Valuation and Prices

- A house is a physical structure in which we live, but it is also a physical asset that has a variety of characteristics such as size, quality, and location
- Determining the value of a house is difficult:
  - Each house has its own unique set of characteristics
  - Two houses with very similar characteristics in different locations can be valued differently
  - Housing is a long-term durable good, therefore houses with very different ages can be on the market at the same time
  - Certain housing characteristics may be valued differently in different markets

### 2.1.1 Appraised Value

- An appraised value is an evaluation of a property's value based on a given point in time
- The evaluation is performed by a professional appraiser during the mortgage origination process
  - The appraised value plays a role in determining how much money may be borrowed and under what terms
  - The appraised value may or may not correspond to the actual market value, or selling price of a home or other asset

### 2.1.2 Discounted Cash Flow Model

- When a house sells, the price that is agreed upon is the present discounted value of the stream of housing services that the housing unit will provide
- Implicit housing rents reflect the opportunity costs incurred by homeowners by living in their own home instead of renting it out
  - You can think of this as the money you could make in rental income had you chosen to rent out your house instead of living in it
  - Implicit housing rents are not constant over time
  - Because a house is a physical asset, it deteriorates over time causing the rents to decline in real terms (when adjusted for inflation)
  - Generally, households also spend money on repair and improvements which impacts the implicit rents
- The discount rate represents how much value is assigned to benefits received today rather than in the future
  - A high discount rate means that we value the present more than the future
  - Typically the discount rate falls somewhere between 6%–12%
- The selling price is therefore determined by the present value formula:

$$Value = \frac{R_1}{(1+r)} + \frac{R_2}{(1+r)^2} + \frac{R_3}{(1+r)^3} + \dots + \frac{R_n + \text{Sale Price}}{(1+r)^n} \quad (2.1)$$

where,

$R_i$  = the stream of implicit housing rents

$r$  = the discount rate

$n$  = the number of years in the economic life of the house

- In order to calculate the market value of the home, we need to estimate pro forma cash flows for the length of time we expect to own the home

- Pro forma is a method of calculating financial results using projections
- We can visualize this with an example, but first we need to define some terminology:
  - Potential Gross Income (PGI) is the total amount of rental income the property would produce assuming no losses
  - Collection Loss is the money that is lost if the property were to sit idle or a tenant did not pay rent
  - Operating Expense is the money that is spent to maintain the property and includes maintenance/repairs and property taxes
  - Capital Expenditures are improvements, renovations, and replacements to a house that prolong its life and increase its value

### Example

Suppose you have the following information on a house you plan to own for the next 6 years and then sell it for \$250,000. What is the value of this house today if the discount rate is 10%?

Year	1	2	3	4	5	6
Potential Gross Income	\$12,000	\$12,100	\$12,200	\$12,300	\$12,400	\$12,500
– Collection Losses	1,000	1,100	1,200	1,300	1,400	1,500
– Operating Expenses	500	500	500	500	500	500
– Capital Expenditures	0	0	2,000	0	0	0
Implicit Rental Income	10,500	10,500	8,500	10,500	10,500	10,500

$$Value = \frac{10,500}{1.10} + \frac{10,500}{1.10^2} + \frac{8,500}{1.10^3} + \frac{10,500}{1.10^4} + \frac{10,500}{1.10^5} + \frac{10,500 + 250,000}{1.10^6} = \$185,483$$

- In practice, it is difficult to estimate the imputed rental income and the future sale price of the house

### 2.1.3 Hedonic Pricing Models

- In economics, there is a vast body of research that attempts to explain the value of housing by its individual components
- Typically, this is done by estimating a hedonic pricing model
- Hedonic pricing models are usually estimated for a particular housing market as it's is hard to generalize one model across different locations
- Unlikely most consumer goods, the price of individual features of a house cannot be observed, only the sale price or estimated value of the house

- We assume that people derive utility from various housing features (e.g., bathrooms, bedrooms, kitchen, pool, deck, etc.) and the value of the utility can be expressed in terms of the price of the house
- Consumers will maximize their utility within their budget constraint regarding housing consumption
- Hedonic pricing models are usually estimated using regression techniques

- **LINEAR REGRESSION PRIMER – Found in APPENDIX A**

- The hedonic pricing model generally takes the following form:

$$\text{Price} = f(\text{Physical Characteristics, Location, Other Factors}) \quad (2.2)$$

- Physical characteristics = square footage, bathrooms, age, etc.
  - Other factors = school quality, neighborhood quality, safety, etc.
- Hedonic pricing models are estimated using regression analysis
  - To do this, data would be collected on housing in a particular market or region
  - See [Sirmans, Macpherson and Zietz \(2005\)](#) for details on the types of data and variables that are collected and used in these types of models
- A regression equation might look something like this:

$$\text{Price}_i = \beta_0 + \beta_1 \text{LotSize}_i + \beta_2 \text{Bedrooms}_i + \beta_3 \text{Bathrooms}_i + \beta_4 \text{Age}_i + \beta_5 \text{Garage}_i + \beta_6 \text{Pool}_i + \beta_7 \text{Fireplace}_i + \varepsilon_i \quad (2.3)$$

- Once you have the estimated coefficients,  $\hat{\beta}_i$ , from the regression model, they could be used to predict the price of a house

### Example

Estimate a linear regression using the model in equation 2.3 using the following R code with the provided data set:

```
1 library(fixest)
2
3 feols(SalePrice ~ LotSize + Bedrooms + Bathrooms + Age + Garage +
4 Pool + Fireplace, data=housevalue)
```

Which generates the following output:

```

1 OLS estimation, Dep. Var.: SalePrice
2 Observations: 50
3 Standard-errors: IID
4
5      Estimate Std. Error   t value   Pr(>t)
6 (Intercept) 128925.47951 28556.7136  4.514717 5.0591e-05 ***
7 LotSize      7.24028    2.1647    3.344701 1.7422e-03 **
8 Bedrooms    1050.61837   4237.4388  0.247937 8.0539e-01
9 Bathrooms   27313.58908  6972.8494  3.917135 3.2371e-04 ***
10 Age        -1310.20518   525.2563  -2.494411 1.6636e-02 *
11 Garage      4540.57680   7151.4823  0.634914 5.2893e-01
12 Pool        15639.90947  7964.5151  1.963699 5.6207e-02 .
13 Fireplace   1964.18293   6458.1066  0.304142 7.6252e-01
14 ---
15 Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
16 RMSE: 18,671.6   Adj. R2: 0.611379

```

We could also right the regression results as follows:

$$\widehat{Price}_i = 128,925.48 + 7.24LotSize_i + 1,050.62Bedrooms_i + 27,313.59Bathrooms_i - 1,310.21Age_i + 4,540.58Garage_i + 15,639.91Pool_i + 1,964.18Fireplace_i$$

Now suppose you own a house that has a lot size of 5,900 sq ft, 3 bedrooms, 2.5 bathrooms, is 13 years old, has a garage, but does not have a pool or a fireplace. We can use the regression equation to predict the house value:

$$\widehat{Price}_i = 128,925.48 + 7.24(5,900) + 1,050.62(3) + 27,313.59(2.5) - 1,310.21(13) + 4,540.58(1) + 15,639.91(0) + 1,964.18(0) = \$230,585.20$$

- Sometimes value-added projects have a larger impact on some homes than others
- For example, adding a bedroom to a \$100,000 house may have a much larger impact on its value than adding a bedroom to a \$500,000 house
- Therefore, sometimes this regression is estimated using the  $\ln(Price_i)$  as the dependent variable instead
  - This means the coefficient estimates can be interpreted as a one unit increase in a given variable leads to an X% change in price

## 2.2 Effects of Time and Risk on Value

- The decision to own a house is usually a commitment over many years and homeowners make many decisions
  - How much to spend on routine maintenance and upkeep each year
  - If they want to make updates, renovations, or expand the house
  - Whether to stay in the home or to sell the home
- Each one of these decisions is an investment decision where a homeowner must compare the immediate costs of the action against the future benefits (the value of the home and rent or implicit rents)
- However, knowing the future value of these benefits is difficult for two reasons
  - The value of future benefits declines over time because you must wait for the benefits
    - People generally prefer money today compared to money in the future, so we cannot compare the money that we will receive in the future to the money we receive today
  - The value we think we are going to get from rent or implicit rents is rarely actually what we forecast it to be due to risks
- We already covered valuing future streams of cash flows in the Discounted Cash Flow Model
- To account for risk, we need to calculate a risk-adjusted rate of return that serves as a hurdle rate
  - The hurdle rate is the minimum rate of return you would be willing to accept
- We can use the calculated hurdle rate as the discount rate in the Discounted Cash Flow Model

$$r_i = r_f + b_i(r_H - r_f) \quad (2.4)$$

where,

$r_i$  = the risk-adjusted rate of return (hurdle rate)

$r_f$  = the risk-free interest rate of a US Treasury Security of similar maturity

$r_H$  = the average returns of the local housing market

$b_i$  = the beta of the local housing market

- Beta tells us the risk of the investment relative to the risk of the stock market



## 2.2.1 Calculating Beta for Real Estate

- There are two ways we can calculate beta,  $b_i$ , for real estate

- **Method 1 – Variance and Covariance**

$$b_i = \frac{\text{cov}(r_H, r_M)}{\text{var}(r_M)} \quad (2.5)$$

where,

$r_M$  = the average returns of the stock market

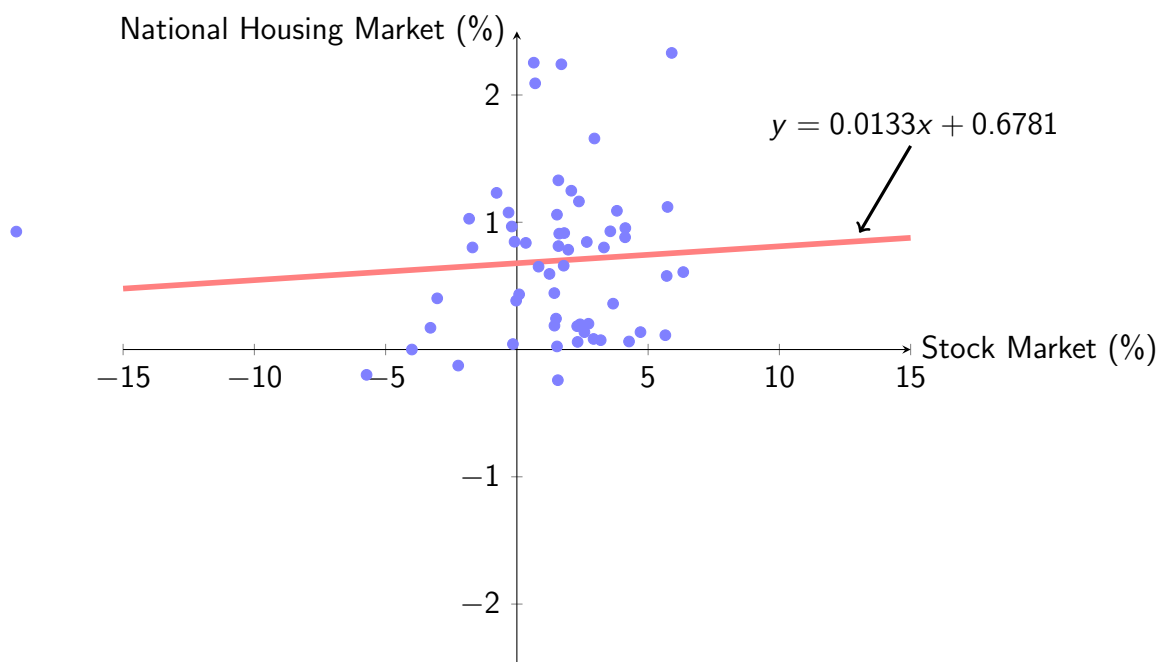
$r_H$  = the average returns of the local housing market

- **Method 2 – Market Model Regression**

- If we were to plot all of the returns to a local housing market and the stock market, we could estimate a linear regression to estimate the relationship between the two markets
- The regression equation would be:

$$\Delta \text{HouseValue}_{it} = \alpha + \beta \Delta \text{S\&P500value}_t + \varepsilon_{it} \quad (2.6)$$

Figure 2.1: Monthly Rates of Return: National Case-Shiller Index and S&P 500



Source: S&P Dow Jones Indices LLC via FRED, Tim Murray.

- The slope of the regression line, or the coefficient estimated for the stock market, is beta

- One good data source for local housing markets is the Case-Shiller Index, which can be found at the [Federal Reserve Economic Database \(FRED\)](#).
- The beta you get for both methods should be similar
- When using the regression method, you can add additional controls into the model to control for other factors that might influence the housing market
- **Interpreting Beta**
  - If  $b_i < 1$ , the investment is less risky relative to the market
  - If  $b_i = 1$ , the investment has an equal risk to the market
  - If  $b_i > 1$ , the investment is more risky relative to the market
- In this example, we used national housing data, but there are large variations between local housing markets and beta should be estimated as granular as possible for a given locality (which you will do on a homework assignment)

## 2.3 Financing Homeownership and Mortgages

- Most people who buy a home cannot afford to pay for it out-of-pocket, therefore they borrow money using a mortgage
- A mortgage is a specific type of loan that is used to buy property
- A mortgage is what is called a secured loan because the borrower promises collateral to the lender if they stop making payments
- For a mortgage, the collateral is your home
- If you stop making payments, the lender can take possession of your home using a process called foreclosure
- Mortgage Terminology
  - **Lender:** A financial institution that loans you money
  - **Borrower:** The individual seeking a loan
  - **Amortization:** Part of each monthly payment the borrower makes goes toward paying down the principal balance and part goes to interest
  - **Down Payment:** Money that must be paid upfront to purchase a home
    - The size of the down payment depends on the type of loan
  - **Escrow:** An account that is managed by your lender that functions like a checking account that is used to pay property taxes and homeowners insurance
    - If your down payment is less than 20%, you must have an escrow account

- If you don't have an escrow account, you must pay property taxes and homeowners insurance yourself
- **Interest Rate:** The percent of your balance that is paid as a fee for borrowing money
  - **Fixed Interest Rate:** A interest rate that stays the same for the length of the mortgage
  - **Adjustable Interest Rate:** Interest rates that adjust with the market
    - \* Adjustable rate loans typically have some period of a fixed rate, after which the interest rate adjusted up or down every six months to a year
- There are a variety of types of mortgages loans, each with different requirements and interest rates, some are more common than others
  - **Federal Housing Association (FHA) Loans**
    - Low down payment, as low as 3.5%
    - Low credit score, as low as 580
    - These loans reduce the risk to lenders because they are backed by the FHA, which will reimburse lenders in the event of a default
  - **Conventional Loans**
    - Any mortgage loan not backed by the federal government
    - If you put less than 20% down, you are usually required to pay private mortgage insurance, which protects the lender in the event of default
  - **Veterans Affairs Loans**
    - For active-duty military members and veterans
    - Let you buy a home with 0% down and no private mortgage insurance
  - **USDA Loans**
    - Only for homes in eligible rural areas
      - \* Many homes in suburbs qualify as "rural"
      - \* To get a USDA loan, your household income can't exceed 115% of the area median income
      - \* Allow you to buy a home with 0% down
- Most mortgages have a term of either 30 years or 15 years

### 2.3.1 Amortization Tables

- When you borrow money, the interest you pay is the "fee" for borrowing
- Each month, you pay a fixed amount back on your loan, part of it goes towards interest and the rest to paying off the balance
- We can construct an amortization table to look at how a mortgage gets repaid
- The monthly payment on a mortgage is an annuity payment

- An annuity is a fixed stream of payments made over a specified length of time
- To calculate what a monthly mortgage payment will be, we can use the formula for the present value of an ordinary annuity

$$PVA_{ord} = \frac{PMT}{i/m} \left[ 1 - \frac{1}{(1 + i/m)^{n \times m}} \right] \quad (2.7)$$

where,

$PV$  = the present value of the loan (value of the loan)

$PMT$  = the regular payment

$i$  = the interest rate on the loan

$n$  = the number of years on the loan

$m$  = the number of times each year a payment is made on the loan (for a mortgage this is monthly, so  $m = 12$ )

- We can rearrange (2.7) and substituting  $m = 12$  to solve for the monthly payment:

$$PMT = \frac{PVA_{ord} (i/12)}{1 - \frac{1}{(1 + i/12)^{12n}}} \quad (2.8)$$

### Example

You want to buy a house for \$300,000. You put 20% down and finance the rest with a 30-year fixed mortgage with an APR of 3.0%. Construct an amortization table for this loan.

A 20% down payment for a \$300,000 loan is \$60,000.

So the amount that needs to be financed is  $\$300,000 - \$60,000 = \$240,000$

$$PMT = \frac{240,000 (.03/12)}{1 - \frac{1}{(1 + .03/12)^{12(30)}}$$

$$PMT = \$1,011.849$$

This means that every month you would pay \$1,011.85 for 30 years towards the loan.

To determine how this payment will be split between paying interest and paying back the principal, we need to construct an amortization table.

Month	Payment	Interest	Principal Repayment	Balance
0				\$240,000
1	\$1,011.85	$240,000(.03/12)$ = \$600	$1,011.85 - 600$ = \$411.85	$240,000 - 411.85$ = \$239,588.15
2	\$1,011.85	$239,588.15(.03/12)$ = \$598.97	$1,011.85 - 598.97$ = \$412.88	$239,588.15 - 412.88$ = \$239,175.27
3	\$1,011.85	$239,175.27(.03/12)$ = \$597.94	$1,011.85 - 597.94$ = \$413.91	$239,175.27 - 413.91$ = \$238,761.36
⋮	⋮	⋮	⋮	⋮
360	\$1,011.85	$1009.33(.03/12)$ = \$2.52	$1,011.85 - 2.52$ = \$1,009.33	$1,009.33 - 1,009.33$ = \$0

- If a borrower has an escrow account, the borrower's monthly payment will include the payment towards the loan (towards interest and principal) and payments into an escrow account which includes property taxes, primary mortgage insurance, and homeowners insurance
  - The monthly payment for **Primary mortgage insurance** is typically is 0.50%-1.00% of the annual value of the loan  $\left(\frac{\text{Loan Value}}{\text{Loan Term}}\right)$
  - **Property taxes** are typically set by a local government and are a percent of the total house value and calculated on an annual basis
  - **Homeowners insurance** varies by location and for each house; the average American pays around \$1,300 per year (\$108 per month)
- Primary mortgage insurance will be paid until the Loan-to-Value (LTV) is 78%
  - $LTV = \frac{\text{Loan Balance}}{\text{House Value}}$
- These payments are made monthly into an escrow account managed by the lender and makes the payments when they are due

## References

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# RENTING

- There are some benefits to owning a home
  - Monthly mortgage payments build equity, which increases your wealth
  - Interest from your mortgage payment may be tax deductible
  - Access to certain neighborhoods
- However, there are also some limitations to owning as well
  - Maintenance costs to keep your home in good condition can at times be costly
  - May be difficult to sell your home should you need the money from equity accumulation
  - Because of difficulty selling, may make moving to a new location more challenging
  - There is no guarantee your home will increase in value after you buy it
- While most people consider owning a home to be part of the “American Dream,” around 35% of Americans rent instead of own
  - Around 60% of people under 35 rent
  - Around 20% of people over age 65 rent
- When it comes to renting, there are two sides to a rental agreement: the landlord and the renter, we will discuss both

## 3.1 The Decision to Own Rental Property

- Before someone can become a landlord, they first must make a decision whether or not buying a rental property is a good investment

### 3.1.1 Net Present Value

- The first metric that can be used to evaluate if buying a rental property is a good investment is to compare the investment value (discounted cash flows) to the acquisition costs (purchase price)

- We can do this by calculating the net present value (*NPV*) of the investment

$$NPV = \overbrace{-CF_0}^{\text{Purchase Price}} + \underbrace{\frac{R_1}{(1+r)} + \frac{R_2}{(1+r)^2} + \frac{R_3}{(1+r)^3} + \dots + \frac{R_n + \text{Sale Price}}{(1+r)^n}}_{DCF} \quad (3.1)$$

or,

$$NPV = DCF - \text{Purchase Price} \quad (3.2)$$

- If  $NPV > 0$ , then the rental property will add value to the investor's wealth and they should purchase the property
  - If  $NPV < 0$ , then the rental property will subtract value from the investor's wealth and they should not purchase the property
  - If  $NPV = 0$ , then the rental property neither adds nor subtracts value from the investor's wealth and they would be indifferent between purchasing and not purchasing
- It is important to know how long the investor will keep the property when calculating *NPV*
  - Alternatively, *NPV* could be used to determine the number of years an investor needs to hold the property and collect rental income before selling it would become profitable

### 3.1.2 The Payback Period

- Another metric that can be used is to determine how many years of rental income will it take to recover the funds used to buy the property

$$\text{Payback Period} = \text{Number Years Prior to Full Payback} + \frac{\left| \text{Uncovered Cost at Start of Year} \right|}{\text{Cash Flow During that Year}} \quad (3.3)$$

#### Example

Suppose you make an \$80,000 investment where you will receive \$30,000 annually in income. Find how long it will take to recover your investment.

	Cash Flows			
	0	1	2	3
Cash Flows	(\$80,000)	\$30,000	\$30,000	\$30,000

- To calculate the payback period, you first must calculate “cumulative cash flow”

	Cash Flows			
	0	1	2	3
Cash Flows	(\$80,000)	\$30,000	\$30,000	\$30,000
Cumulative Cash Flow	-80,000	-80,000 + 30,000 = -50,000	-50,000 + 30,000 = -20,000	-20,000 + 30,000 = 10,000

- The year that the cumulative cash flows turn positive is year 3
- Therefore there are 2 years prior to full payback
- The uncovered cost from the start of the year is the cumulative cash flow in the year prior to full payback: -\$20,000
- The cash flow during the payback year \$30,000

$$\text{Payback Period} = 2 + \frac{|-20,000|}{30,000} = 2.67 \text{ years}$$

- While there is no benchmark to compare the payback period to, it can be a useful tool to determine at what point the rental income becomes profitable

## 3.2 Responsibilities of Landlord

- Most state and local governments have building codes and laws that state the standards for construction, maintenance, and living standards of rental units (see [Nicely \(2020\)](#) for more information)
- Generally, landlords have the following responsibilities:
  1. **Provide habitable living**
    - Conducting regular maintenance checks
    - Supply trash receptacles (individual trash cans or dumpsters)
    - Maintaining common areas (in a complex)
    - Keep utilities (electrical, plumbing, heating, air conditioning, etc.) in good working order
    - Dealing with pests and vermin (ants, termites, mice, etc.)
    - It is a good idea in a lease to add that it is the tenant's responsibility to notify you immediately as problems arise
  2. **Ensure a quiet living environment**
    - Make sure that tenants are not making loud noise to disrupt other tenants, it is worth putting a noise clause in the lease
  3. **Maintain tenant safety**



- Specific legal requirements vary, but generally:
- Screen all tenants using a rental application that has a background check (where allowed by law)
- Install new locks before each tenant moves in and ensure locks on doors and windows work
- Provide safety equipment: smoke detector, monoxide detector, fire extinguishers, etc.
- Supervise hired maintenance workers and contractors to prevent theft, property damage, and unwanted encounters
- Give advanced notice of entry to the apartment by the landlord, maintenance workers, or contractors

#### 4. Respond to repair requests and perform repairs

- Maintenance issues can negatively impact your tenant's quality of life and require immediate attention
- If a tenant experiences a major issue (heating, air conditioning, plumbing, electrical, security concerns, flooding, pest infestation, mold), the landlord typically must respond within 24 hours

#### 5. Monitor unit for normal wear and tear

- When a tenant moves out, landlords should repair normal wear and tear (paint, damaged carpet, hardware, etc.)
- The lease should explain the responsibilities of the tenant for what is considered normal wear and tear
- It is a good idea to collect a security deposit to pay for any damage that is not normal wear and tear
- The definition of normal wear and tear should be clearly outlined in the lease

### 3.3 Documenting Responsibilities in a Lease

- We noted previously some things that are worth considering in a lease, however, there are several other issues that should be considered

#### 1. Landscaping and lawn maintenance

- The landlord must decide whether they will provide landscaping services like mowing the lawn and raking the leaves or whether the tenant should be responsible

#### 2. Snow removal

- The landlord should specify which areas they will be responsible for removing snow (if any) and what areas the tenant will be responsible for (sidewalks, stairs, driveways, etc.)

#### 3. Property usage rules

- The landlord should specify certain usage rules such as:

- How they are allowed to modify the property (painting walls, drilling holes, etc.)
- The ability to sublet
- Displays on the outside of the property (signs, decorations, flags, etc.)
- Policies regarding pets

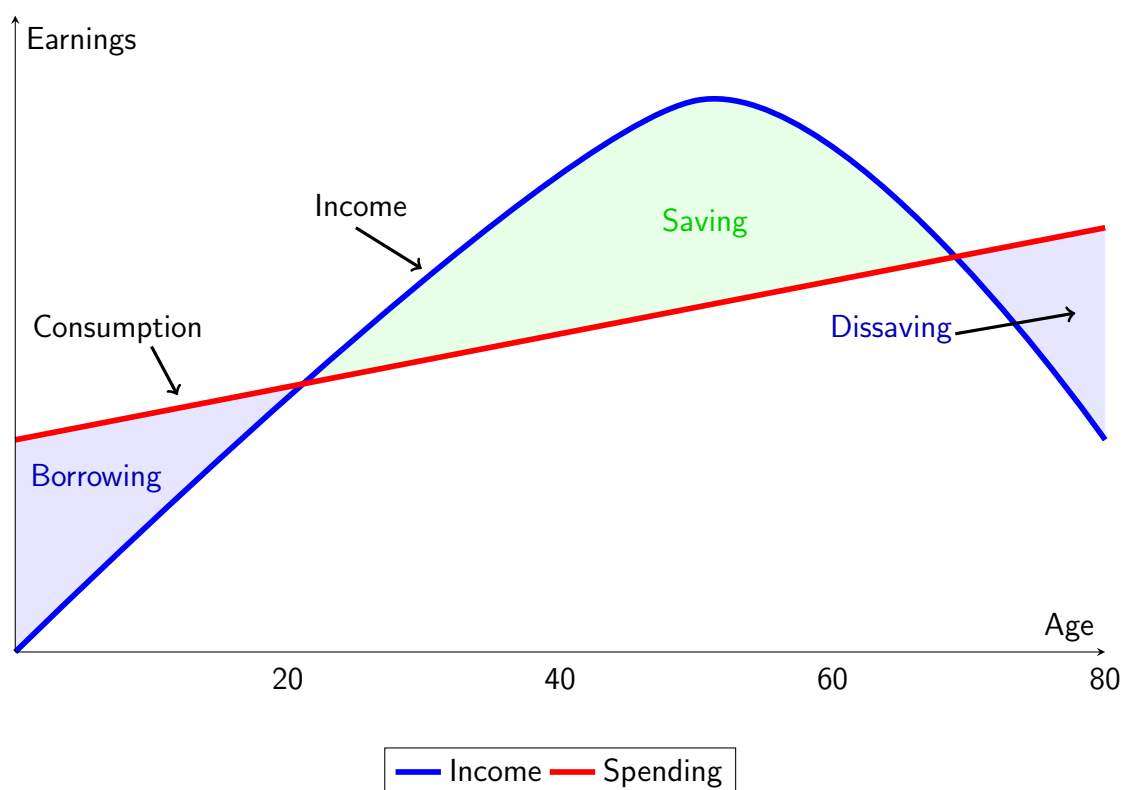
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# INTERTEMPORAL CHOICE

- [Modigliani and Brumberg \(1954\)](#) developed The Life Cycle Hypothesis (LCH), which is an economic theory that describes the spending and savings habits that people exhibit over their lifetime.
- The LCH assumes that people plan their spending over their lifetime, taking into account their future income, “smoothing their consumption” over their lifetime
  - People don’t want to have large swings in the amount of money they spend on consumption, so they try to maintain a constant level or a gradually increasing level of consumption throughout their life.
- Because people assume that their income will increase in the future, they take out debt when they are young (e.g., student loans) that they pay off with future income
- During their working years, people save, and they use that money so that they can maintain the same level of consumption after they retire
- This highlights the importance of the decision intertemporal decisions households have to make and allows us to revisit the intertemporal budget constraint.
- Households can use their savings,  $s_t$ , and their house,  $p_t h_t$ , to smooth consumption,  $c_t$ , from one period to the next
- [Figure 4.1](#) shows spending, saving, and consumption throughout the life cycle and how people smooth consumption according to LCH.

Figure 4.1: Life-Cycle Consumption and Spending



## 4.1 Intertemporal Utility Maximization

- In Intermediate Microeconomics you discuss Utility Maximization over two goods for a given set of prices and income.
- Those problems were done at a single point in time.
- In reality, the decisions we make today impact the decisions we can make in the future.
  - If you borrow money today to spend on consumption, you will have to pay that money back at a future date, which will lower how much you have to spend on
- Intertemporal choice is the process by which people make decisions and how those decisions influence possible decisions at other times.
- We can think of the LCH as people who maximize not just their utility in the present, but the discounted present value of utility throughout their lifetime.
  - We call this intertemporal utility maximization.

### 4.1.1 The Intertemporal Budget Constraint

- We have two choices on how to use our income: spend it on consumption today or save it to spend in the future, where the money saved collects interest.

- We can look at this using a two-period model. We can think of period 1 as being “young” age and period 2 as being “old” age or retired.

$$c_1 = y_1 - s_1 \quad (4.1)$$

where,

$s_1$  is savings in period 1

$y_1$  is income in period 1

$c_1$  is consumption expenditure in period 1

- In period 1, the amount of money available to spend on consumption is equal to the income in period 1 minus how much money was saved in period 1 to spend in period 2.
- In period 2, the amount of money available to spend on consumption is equal to the income in period 2 plus the amount of money saved in period 1 and the interest it gained while saving.
  - $s$  could also be negative, which means that money is borrowed to increase consumption in period 1 and must be paid back with interest in period 2.

$$c_2 = y_2 + s_1(1 + i) \quad (4.2)$$

where,

$c_2$  is consumption in period 2

$y_2$  is income in period 2

$s_1$  is savings from period 1

$i$  is the interest rate

- If we substitute (4.10) into (4.11), we get

$$c_2 = y_2 + (y_1 - c_1)(1 + i) \quad (4.3)$$

$$c_2 = y_2 + y_1(1 + i) - c_1(1 + i) \quad (4.4)$$

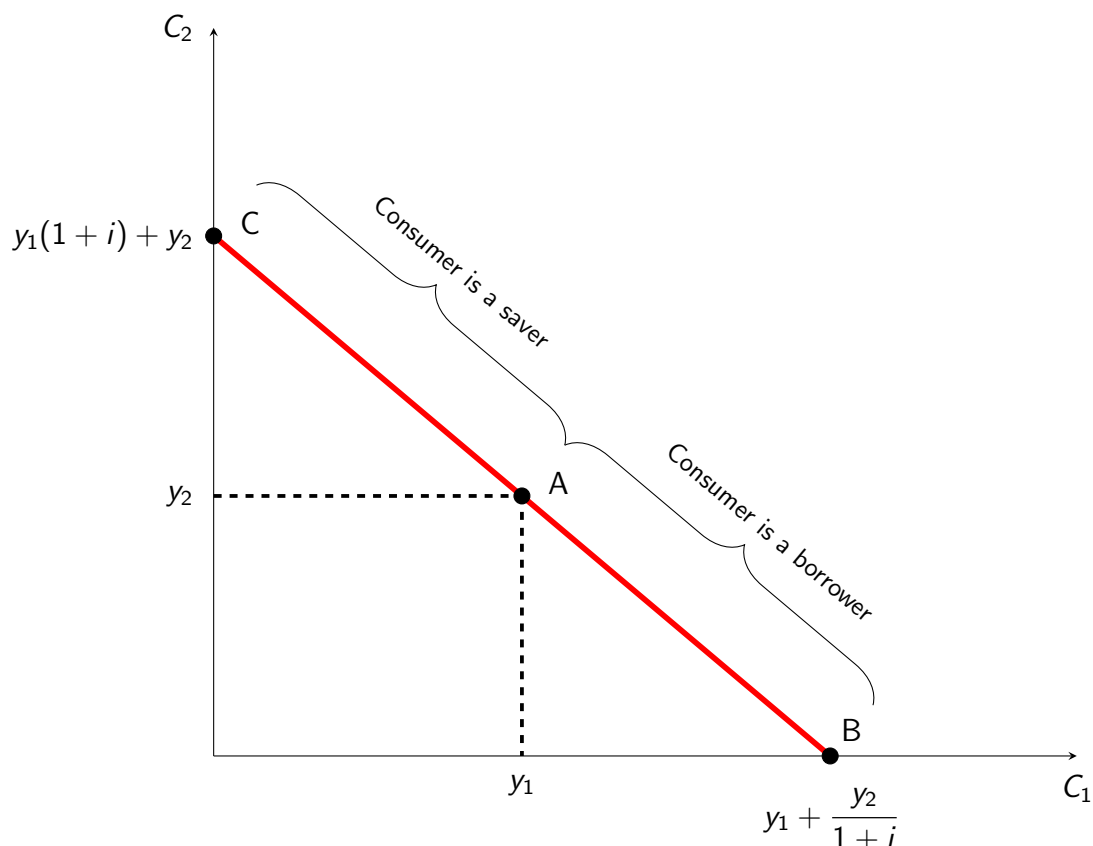
$$c_1(1 + i) + c_2 = y_1(1 + i) + y_2 \quad (4.5)$$

- We can rearrange (4.14) to get:

$$c_1 + \frac{c_2}{1 + i} = y_1 + \frac{y_2}{1 + i} \quad (4.6)$$

- You will notice that (4.15) expresses the budget constraint in the present value and (4.14) expresses it as future value.
- We can look at a graphical representation of the budget constraint in Figure 4.2.

Figure 4.2: Intertemporal Budget Constraint



- The budget constraint shows every possible combination of consumption in period 1 and period 2.
- At point A, a consumer would spend all their income in period 1,  $y_1$ , on consumption in period 1,  $c_1$  saving nothing for period 2 ( $s_1 = 0$ ). They would then spend all of their income in period 2,  $y_2$  on consumption in period 2,  $c_2$ .
  - This would be an example of someone who lives paycheck to paycheck.
- At point B, a consumer would spend all of their income in period 1 plus borrow all of their income from period 2 to spend on consumption in period 1, leaving them with nothing to spend on consumption in period 2.
- At point C, a consumer would have no consumption in period 1 and save everything from period 1 to spend in period 2 ( $s_1 = y_1$ ).
- In the real world, consumers are rarely at points B or C, they are either borrowers or savers.
  - If a consumer's optimal point is between points A and B, then that consumer is borrowing money so they can increase consumption today, knowing they will have to pay it back in the future.

- An example of this would be someone in college borrowing money knowing that they will have to pay it back later.
- If a consumer's optimal point is between points A and C, then that consumer is saving money today to collect interest so they can spend more in the future.
  - An example of this would be someone saving for retirement.

### 4.1.2 Intertemporal Utility

- If you recall from previous courses, utility is a measure of “happiness” or the level of satisfaction people have.
- Each person has their own unique set of preferences and those preferences are captured in their utility function.
- The more people consume the things they like or participate in the activities they like, the higher their utility and the more happy they are in life.
- In this simple model of two periods, people have to make a choice as to how much to consume today in period 1 and how much to consume in the future in period 2.
- Each person has their own preferences as to how much they value the future versus the present.
  - If you recall from earlier, this is captured by the discount rate.
  - The higher the discount rate, the more emphasis an individual puts on the present.
- Intertemporal utility is the discounted present value of a person's lifetime utility.
  - In other words, it is the sum of the utility each person receives in each period discounted to the present period.
- For our two-period model, intertemporal utility is defined as:

$$u(c_1, c_2) = u(c_1) + \beta u(c_2) \quad (4.7)$$

where,

$c_1$  is consumption in period 1.

$c_2$  is consumption in period 2.

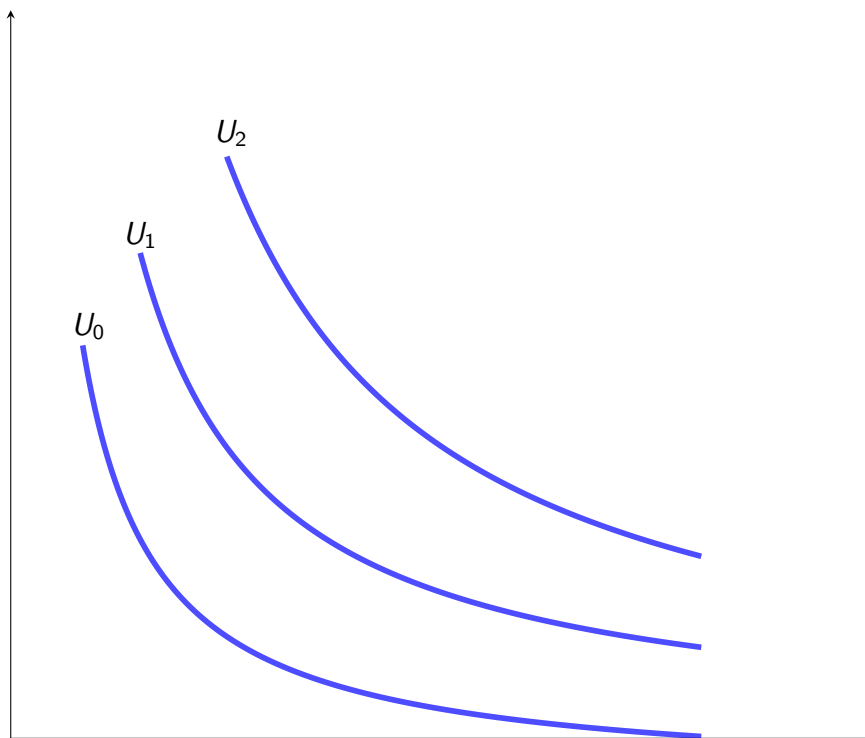
$\beta$  is the subjective discount factor.

$u(c_i)$  is the utility function in each period.

- The discount factor,  $\beta$ , takes values between 0 and 1. The larger  $\beta$ , the more value a person places on future consumption.
  - The discount factor is similar to the discount rate in that it relates preferences about how people value current versus future consumption, but does not take the same values.

- The larger  $\beta$  is, the more “patient” a person is as they value future consumption over current consumption.
- In the two-period model, utility can be represented graphically with indifference curves.

Figure 4.3: Indifference Curves



### 4.1.3 Lifetime Utility Maximization

- The two-period lifetime utility maximization problem combines (4.14) and (4.7):

$$\max_{c_1, c_2} U = u(c_1) + \beta u(c_2) \quad (4.8)$$

$$s.t. \quad c_1(1+i) + c_2 = y_1(1+i) + y_2 \quad (4.9)$$

#### Example

Suppose lifetime utility is defined by  $U = \ln(c_1) + \beta \ln(c_2)$ . The utility maximization problem would be as follows:

$$\begin{aligned} \max_{c_t, c_{t+1}} U &= \ln(c_t) + \beta \ln(c_{t+1}) \\ s.t. \quad c_t(1+i) + c_{t+1} &= y_t(1+i) + y_{t+1} \end{aligned}$$



We can rearrange the budget constraint to be:

$$s.t. \quad c_{t+1} = y_t(1+i) + y_{t+1} - c_t(1+i)$$

We can then substitute it into the utility function:

$$\max_{c_t, c_{t+1}} U = \ln(c_t) + \beta \ln(y_t(1+i) + y_{t+1} - c_t(1+i))$$

To find the value of  $c_t$  that maximizes lifetime utility, set  $\frac{dU}{dc_t} = 0$

$$\frac{dU}{dc_t} = \frac{1}{c_t} - \frac{\beta(1+i)}{y_t(1+i) + y_{t+1} - c_t(1+i)} = 0$$

We know that  $c_{t+1} = y_t(1+i) + y_{t+1} - c_t(1+i)$ , so we can substitute it back in:

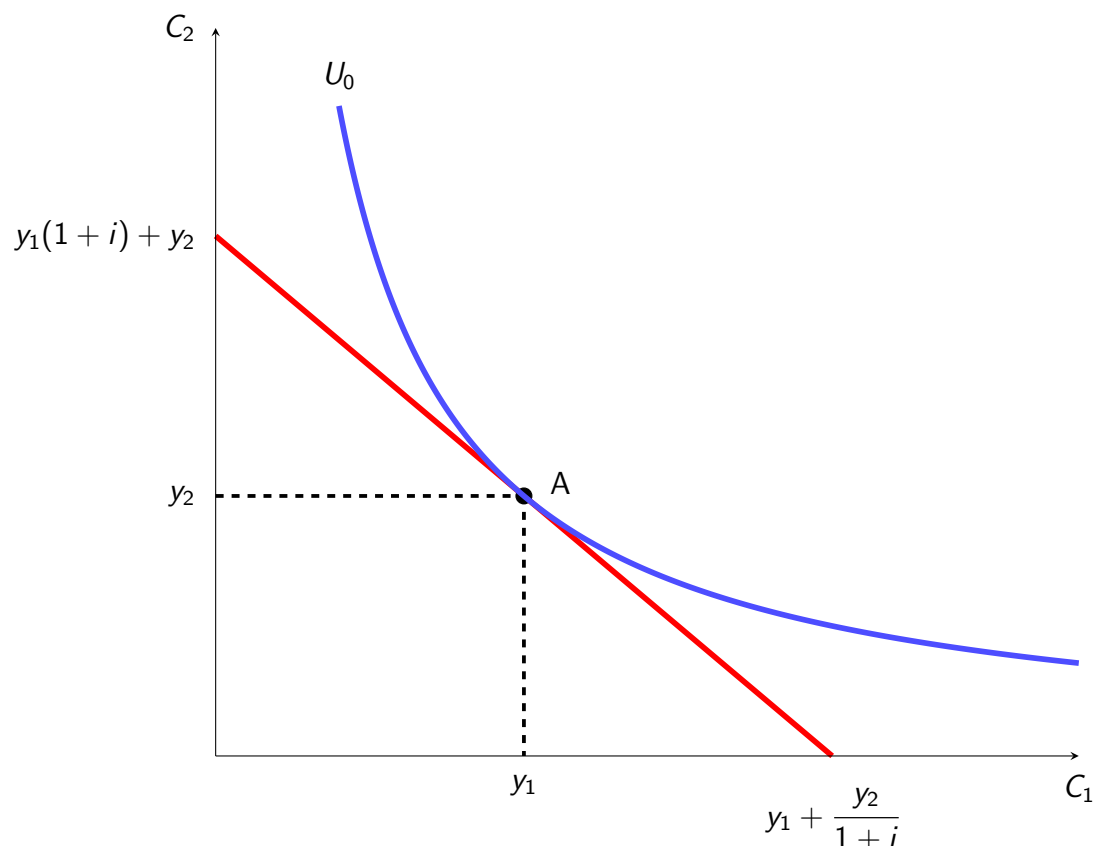
$$\frac{dU}{dc_t} = \frac{1}{c_t} - \frac{\beta(1+i)}{c_{t+1}} = 0$$

We can solve for the Euler equation:

$$\frac{c_{t+1}}{c_t} = \beta(1+i)$$

- The Euler Equation intuitively means that households should choose between consumption today and consumption tomorrow so that the marginal utility of consumption today equals the marginal utility of consumption tomorrow, after accounting for the fact that saving some resources today produces  $(1+i)$  extra resources tomorrow
- Figure 4.4 shows the intertemporal utility maximization problem graphically.
- In this example, given this specific indifference curve, the optimal point of consumption is point A. We learned earlier that this is a point where the consumer equally values consumption in period 1 as in period 2 and therefore would neither borrow nor save.
- An indifference curve with a different shape (and thus a different set of preferences) may lie tangent to the budget constraint at a different point and the consumer may be a borrower or saver, as we saw earlier.

Figure 4.4: Intertemporal Budget Constraint



## 4.2 Extracting Housing Equity

- When people think about savings, they typically think of traditional investments and savings
  - Stocks, bonds, 401Ks, 403Bs, IRAs, savings accounts, CDs, etc.
- Households save using those methods and then convert them to cash to fund consumption in retirement
- Nearly 80 percent of Americans aged 65 and older own a home ([US Census Bureau, 2021](#))
- Their housing equity constitutes a large portion of the total savings and wealth for retirees ([Begley and Chan, 2018](#); [Eggleston et al., 2020](#); [Moulton et al., 2016](#))
- The LCH suggests that retirees should use their savings to fund consumption in retirement
- Housing equity should also be considered savings, and therefore the LCH suggests that households should extract housing equity to help fund consumption in retirement.
- There are three ways in which retirees could extract equity from their homes:

- **Move from owning to renting:** A retiree could sell their home, put the proceeds into a combination of index funds, bonds, and CDs, and move into a rental unit. Although they would have a monthly payment, they could free up a lot of money to spend on non-housing consumption to supplement social security and other savings
- **Downsize:** Households could move to a cheaper house and continue to own
- **Traditional and Reverse Mortgages:** Most Americans prefer to live in their house throughout retirement ([Binette and Vasold, 2018](#); [Munnell, Soto and Aubry, 2007](#)), so they could extract housing equity by taking out a Home Equity Line of Credit (HELOC) or a Reverse Mortgage
- Some retirees extract equity from taking out a HELOC ([Mayer and Moulton, 2020](#))
- Some retirees extract equity by reducing expenditure on home improvement ([Murray and Dunn, 2022](#))
  - From the intertemporal budget constraint, households decrease  $I_t$ , which allows more money to be spent each period on consumption,  $c_t$ , but over time causes the house to depreciate or appreciate at a slower rate depending on the relationship of  $I_t$  to  $\delta$ .
- However, most retirees are not extracting housing equity at the rate to which the LCH suggests they should
- This is a “puzzle” because people are not acting the way a standard economic model suggests they should
- Researchers have attempted to explain this in a variety of ways
- Many Americans want to leave a bequest to their children [Ameriks et al. \(2011\)](#) and since there are favorable tax provisions on inheriting housing, bequeathing a house may be an attractive way for households to pass on wealth to the next generation.
  - Inherited property receives a stepped-up basis, meaning the value of the house for tax purposes is the market value of the house when inherited, not the value of the house when the original owner purchased it. This reduces the amount of capital gains that may need to be paid on the house in the event it is sold after being inherited.
- However, [Engelhardt and Eriksen \(2021\)](#) show that 80% of housing wealth is still available to help smooth consumption, even when accounting for intended bequests, so while this might partially explain why so many retirees do not extract housing equity, it is not the main reason
- It could be that transaction costs are higher for retirees and therefore moving is too costly.
  - Moving takes time and money
  - When you move, you also leave your established social network
  - Some states have favorable property tax provisions that would increase costs if moving

- It could be that retirees are using their housing wealth as precautionary savings, to sell off in the event that they have high medical expenses
  - Medicare only covers 65% of retirees medical bills ([De Nardi et al., 2016](#))
  - Between the ages of 70 and 90, out-of-pocket medical expenses more than double. This is primarily driven by spending on long-term care and nursing home stays, which can cost around \$80,000 a year ([De Nardi et al., 2016](#))
- It also could be that households may derive utility from the non-pecuniary benefits of owning a house. As people age, they are less likely to view the house as an asset, which may be explained by the Socioemotional Selective Theory (SST)
- ST is a lifespan theory of motivation popular in psychology that proposes that people monitor time horizons and adjust motivations, goals, and preferences as they age. Older people are more likely to perceive time as finite. Therefore, they may place more importance on finding emotional meaning and satisfaction in life while investing fewer resources in gathering information and expanding horizons ([Carstensen, 2006](#))
- If people derive utility from non-pecuniary benefits, this could influence their decisions about equity extraction.
- So far, we have focused on housing as an investment
- But we mentioned earlier that housing is also a consumption good
- Housing is an important consumption good in people's day-to-day life as it has a large effect on living conditions
- Spending on housing also represents a significant portion of annual spending, whether on rent or a mortgage and maintenance costs
- If people decide to move, there are transaction costs that are associated with that move
  - Cost of looking for a new place to live
  - Cost of selling a home
  - Cost of buying a new home
  - Cost of physically moving your belongings
  - Security deposit
  - Changes in social network
- In intermediate microeconomics, you covered consumer choice (utility maximization) with two consumption goods and created a budget constraint from the prices of each good and income
- We can look at the choice of housing in the context of consumer choice and utility maximization

- To own or rent
- How big of a house to own or rent
- How much money needs to be spent each year on maintenance to maintain the value of the home?
- However, the utility maximization problems you looked at were static, or, took place at one point in time
- The issue with housing is people are making choices from one year to the next, so we have to set up a intertemporal budget constraint

## 4.3 A Simple Model without Housing

### 4.3.1 Intertemporal Budget Constraint

- We have two choices on how to use our income: spend it on consumption today or save it to spend in the future, where the money saved collects interest

$$s_t = y_t - c_t \quad (4.10)$$

where,

$s_t$  is savings in period  $t$  (today)

$y_t$  is income in period  $t$  (today)

$c_t$  is consumption spending in period  $t$

- In any one period, the amount of money we have available to spend on consumption is equal to our current income plus any money saved in the previous year plus the interest it gained
  - We are going to assume there are only two periods for simplicity, but this model can easily be extended to have many periods

$$c_{t+1} = y_{t+1} + s_t(1 + i) \quad (4.11)$$

where,

$c_{t+1}$  is consumption in period  $t + 1$  (tomorrow)

$y_{t+1}$  is income in period  $t + 1$  (tomorrow)

$s_t$  is savings in period  $t$  (today)

$i$  is the interest rate

- If we substitute (4.10) into (4.11), we get

$$c_{t+1} = y_{t+1} + (y_t - c_t)(1 + i) \quad (4.12)$$

$$c_{t+1} = y_{t+1} + y_t(1 + i) - c_t(1 + i) \quad (4.13)$$

$$c_t(1 + i) + c_{t+1} = y_t(1 + i) + y_{t+1} \quad (4.14)$$

- We can rearrange (4.14) to get:

$$c_t + \frac{c_{t+1}}{1 + i} = y_t + \frac{y_{t+1}}{1 + i} \quad (4.15)$$

- You will notice in (4.15) income and consumption are discounted back to period  $t$

## 4.4 A Model with Housing in the Utility Function

Consider a single infinitely lived consumer who maximizes their utility over the consumption of housing and non-housing goods. Housing evolves according to  $p_{t+1}h_{t+1} = (1 - \delta + l_t)p_t h_t$  where  $h_t$  denotes the quantity of housing at time  $t$ ,  $p_t$  is the price per unit of housing,  $\delta \in (0, 1)$  is the depreciation rate, and  $l_t$  is the investment rate in home improvement and maintenance at time  $t$ . If  $\delta = l_t$ , then the consumer is investing in their home at the same rate that housing depreciates. When  $\delta < l_t$ , the consumer invests more in their home to increase the value (e.g., adding an addition, upgrading, etc.). When  $\delta > l_t$ , the consumer is allowing the home to depreciate. The consumer's lifetime utility function is defined by

$$\max_{\{c_t, h_{t+1}, a_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t u(c_t, h_t) \quad (4.16)$$

where  $\beta \in (0, 1)$  is the subjective discount factor and  $c_t$  denotes non-housing consumption at time  $t$ . The consumer's choices are subject to the following sequential budget constraint.

$$c_t + p_{t+1}h_{t+1} + s_{t+1} = y_t + (1 - \delta + l_t)p_t h_t + (1 + i)s_t \quad (4.17)$$

$$c_t \geq 0, h_t \geq 0$$

where  $y_t$  is income at time  $t$  and  $s_t$  is non-housing asset holdings at time  $t$  that earn rate of return  $i > 0$ . The consumer's utility maximization problem is solved by

$$\mathcal{L} = \sum_{t=0}^{\infty} \beta^t [u(c_t, h_t) + \lambda_t (y_t + (1 - \delta + l_t)p_t h_t + (1 + i)s_t - c_t - p_{t+1}h_{t+1} - s_{t+1})] \quad (4.18)$$

which yields the following first-order conditions:

$$\frac{\partial \mathcal{L}}{\partial c_t} = \beta^t [u_c(c_t, h_t) - \lambda_t] = 0 \quad (4.19)$$

$$\frac{\partial \mathcal{L}}{\partial s_{t+1}} = \beta^t (-\lambda_t) + \beta^{t+1} \lambda_{t+1} (1 + i) = 0 \quad (4.20)$$

$$\frac{\partial \mathcal{L}}{\partial h_{t+1}} = \beta^t (-\lambda_t) p_{t+1} + \beta^{t+1} [u_h(c_{t+1}, h_{t+1}) + \lambda_{t+1} (1 - \delta + l_{t+1}) p_{t+1}] = 0 \quad (4.21)$$

By substituting (4) into (5) we get

$$u_c(c_t, h_t) = \beta (1 + i) u_c(c_{t+1}, h_{t+1}) \quad (4.22)$$

and substituting (4) into (6) we get

$$u_c(c_t, h_t) p_{t+1} = \beta [u_h(c_{t+1}, h_{t+1}) + u_c(c_{t+1}, h_{t+1}) p_{t+1} (1 - \delta + l_{t+1})] \quad (4.23)$$

Then substituting (7) into (8) we get

$$(1 + i) u_c(c_{t+1}, h_{t+1}) p_{t+1} = u_h(c_{t+1}, h_{t+1}) + u_c(c_{t+1}, h_{t+1}) p_{t+1} (1 - \delta + l_{t+1}) \quad (4.24)$$

$$u_h(c_{t+1}, h_{t+1}) = u_c(c_{t+1}, h_{t+1}) p_{t+1} [i + \delta - l_{t+1}] \quad (4.25)$$

For simplicity, if we assume Cobb-Douglas utility so that  $u(c_t, h_t) = c_t^\alpha h_t^{1-\alpha}$ , then we can rearrange (10) to show

$$\frac{c_{t+1}}{p_{t+1} h_{t+1}} = \frac{\alpha}{1 - \alpha} (i + \delta - l_{t+1}) \quad (4.26)$$

Equation (11) implies that there is an inverse relationship between the investment rate into the home,  $l_{t+1}$ , and the value of consumption relative to the value of housing. This has two implications. First, any household can reduce the rate that they reinvest into their home to increase consumption expenditure. Second, because housing evolved according to  $p_{t+1} h_{t+1} = (1 - \delta + l_t) p_t h_t$ , the decreased investment in the home has a direct impact on the value of the house. If households decrease  $l_t$  and  $\delta < l_t$ , then the house will still appreciate, but at a lower rate.

#### 4.4.1 Dissecting the Budget Constraint

- Let us dissect the budget constraint in more detail:

$$\underbrace{c_t + p_{t+1} h_{t+1} + s_{t+1}}_{\text{Choice on Spending Current Assets}} = \underbrace{y_t + (1 - \delta + l_t) p_t h_t + (1 + i) s_t}_{\text{Current Assets}} \quad (4.27)$$

- In each period, people have their current income, their savings from the last period plus accumulated interest, and their housing wealth
- They have a choice between consuming all of their current assets by spending all of their income, and savings, and selling the house

- They could consume some of their current assets, save some for the future, and invest some in their housing to preserve its value
- The main takeaway from the intertemporal budget constraint is that our choices on what we do with our current assets today impact the choices we will be able to make in the future

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# DEMAND FOR HOUSING

## 5.1 Interest Rates

- Short-term interest rates can be approximated using the Fisher Equation:

$$i = r^* + \pi^e + DR_p \quad (5.1)$$

Where,

$i$  is the interest rate

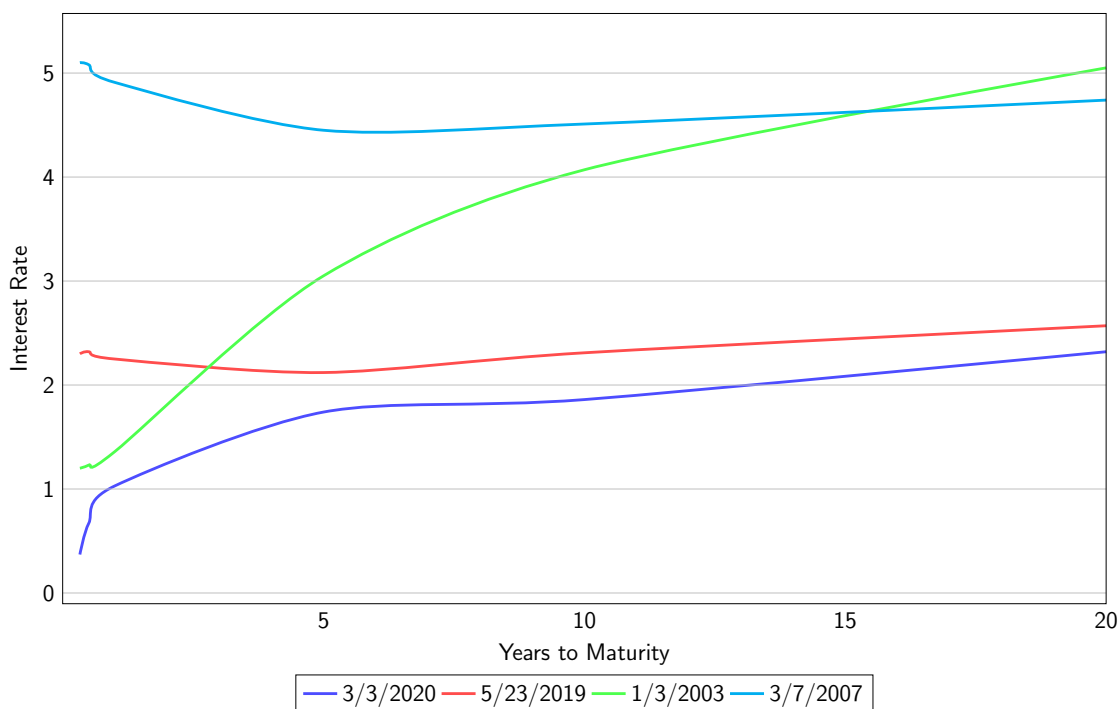
$r^*$  is the risk-free interest rate ( $\sim$ the rate on a 3-month US Treasury Bill)

$\pi^e$  is the average expected inflation until maturity

$DR_p$  is the default risk premium

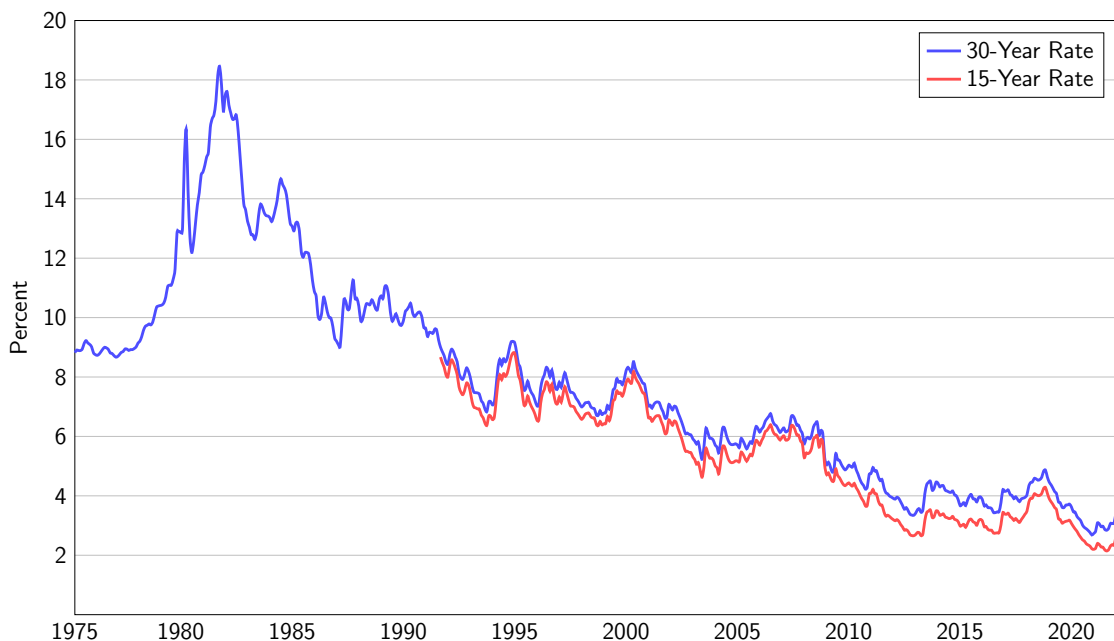
- The longer until maturity, investors must be compensated for not being able to spend that money today
- This is captured in the **term structure** of interest rates
  - The longer until maturity (the term), the higher the interest rate
  - This can visually be captured using the **yield curve**
    - When interest rates increase as the term gets longer, we have a normal yield curve
    - When interest rates decrease as the term gets longer, we have an inverted yield curve
      - \* The yield curve inverts because investors expect interest rates to decline and they try to lock in a fixed interest rate with longer-term investments
      - \* Every recession has been preceded by an inverted yield curve, though there has not always been a recession every time the yield curve inverts

Figure 5.1: Select Interest Rate Term Structure's



Source: Federal Reserve Board of Governors via FRED, Tim Murray.

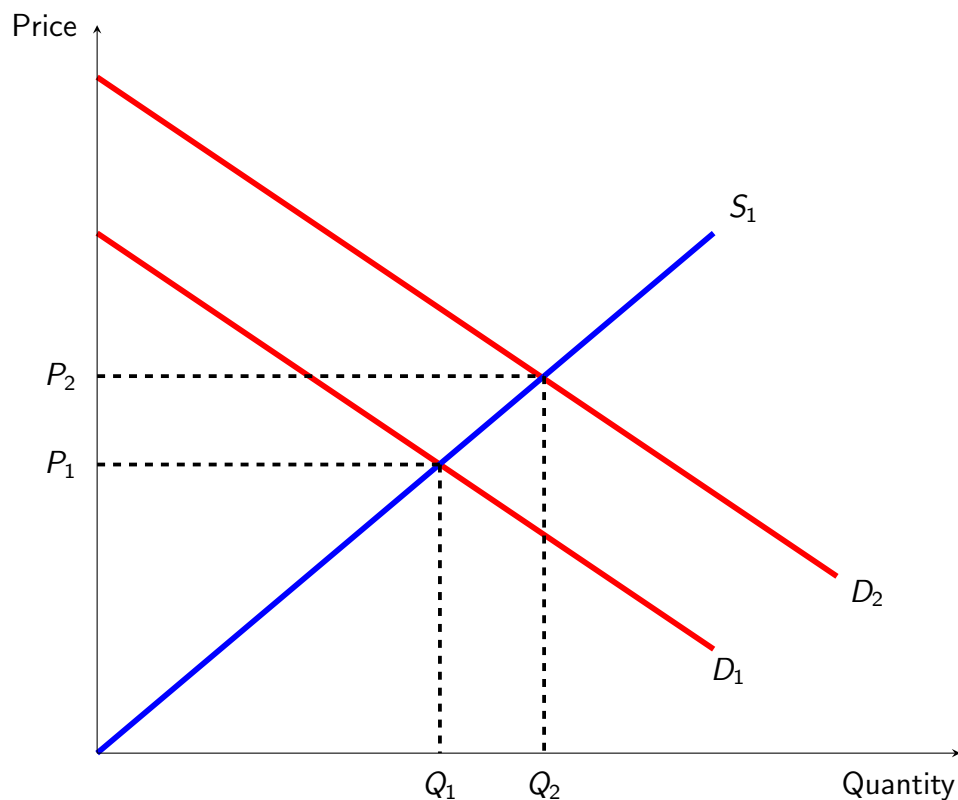
Figure 5.2: 30- and 15-year Conventional Fixed Mortgage Rates, April 1975–February 2022



Source: Freddie Mac via FRED, Tim Murray.

- When mortgage rates decrease, the cost of borrowing decreases
- Drawing on lessons from Principles of Microeconomics, this will lead to an increase in the demand for housing

Figure 5.3: Market for Housing



- This increase in demand will lead to an increase in housing prices, assuming supply remains constant
- If mortgage rates were to increase, then demand would decrease, which will lead to a decrease in housing prices
- There are other things besides mortgage rates that influence the demand for housing

## 5.2 Property Taxes

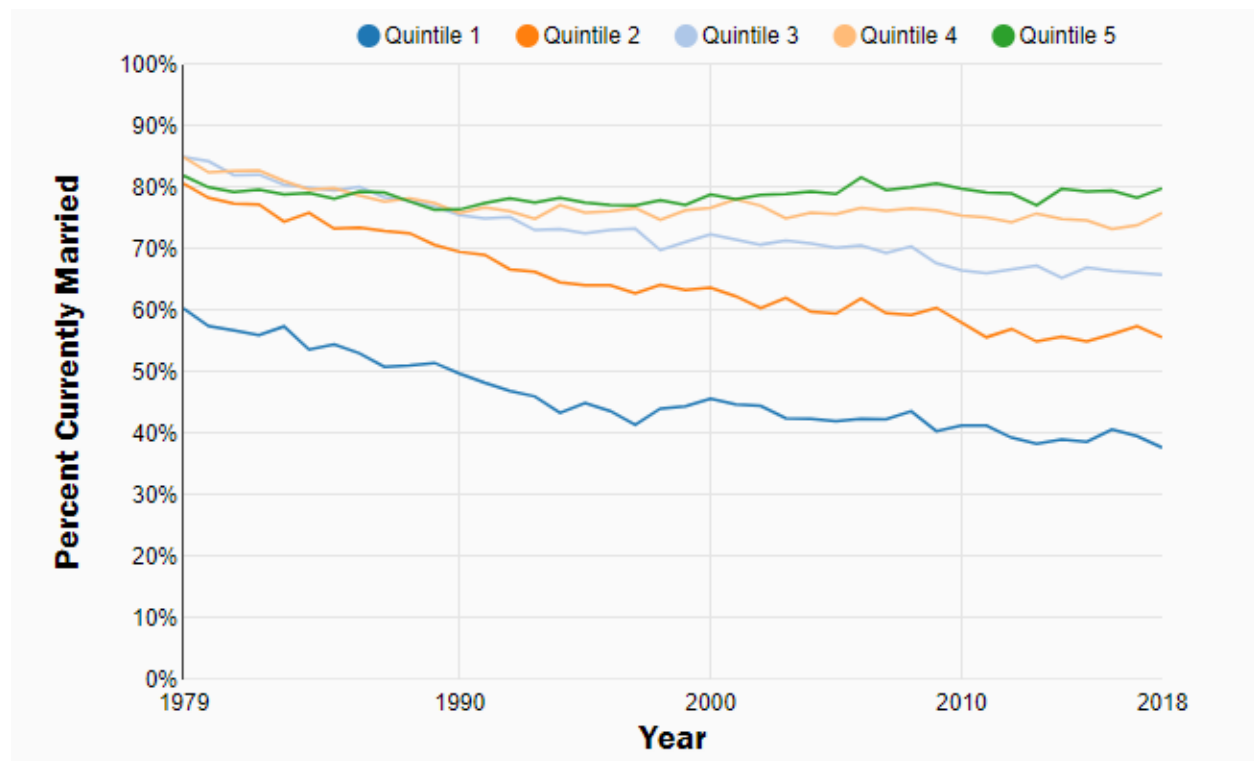
- A property tax is a tax paid on property that is owned by an individual or corporation
- Property taxes are determined by local governments and are usually an ad-valorem tax, or a tax based on the value of the property
- The most common property tax is on real estate

- Local governments use the money collected from property taxes to fund law enforcement, fire protection, education, libraries, road maintenance, water/sewer improvements, and other services that benefit the local community
- The amount a homeowner pays in taxes is determined by that tax rate set by the local government and the assessed property value
- Local governments hire tax assessors who determine the fair market value of the home
- The dollar value of the property tax can increase if the tax rate increases or if the assessed value of the home increases
- For a current homeowner, property taxes can be shown on the budget constraint as  $p_t h_t \tau^P$ , where  $\tau^P$  is the tax rate
- Property taxes are a large consideration when buying a home
  - A \$300,000 home in Lexington, VA pays a property tax rate of 0.74%, which would be \$2,200 annually
  - In San Francisco, CA, the property tax rate is 1.1801%, which for the same house would be \$5,403 annually
- Property taxes are essentially a local fee you have to pay in order to live in a specific area
- If an individual cannot afford the fee, they will not purchase a home in that area
- There are sets of government policies related to property taxes that can impact the demand for housing
- In 1978, California voters approved Proposition 13 as an amendment to its state constitution.
  - The maximum amount of any ad-valorem tax on real property shall not exceed one percent (1%) of the full cash value of such property. The one percent (1%) tax is to be collected by the counties and apportioned according to law to the districts within the counties
  - The proposition decreased property taxes by assessing values at their 1976 value and restricted annual increases of assessed value to an inflation factor, not to exceed 2% per year
  - It prohibits reassessment of a new base year value except in cases of a change in ownership, or completion of new construction
- Proposition 13 increases the amount of time people live in their current home, because by moving, there could be a large change in property taxes paid

### 5.3 Demographics and Housing Demand

- Notes from this section come from [Loh and Farrar \(2020\)](#) unless otherwise noted
- The types and distribution of household structures in the United States have been evolving for decades
- The “nuclear family” is no longer the dominant household type
- Marriage rates have been declining since 1980
  - In 1980, 84% of middle-class households were married between the ages 33-44
  - In 2018, 66% of middle-class households were married between ages 33-44 ([Reeves and Pulliam, 2020](#))

Figure 5.4: Percent Currently Married, Age 33-34

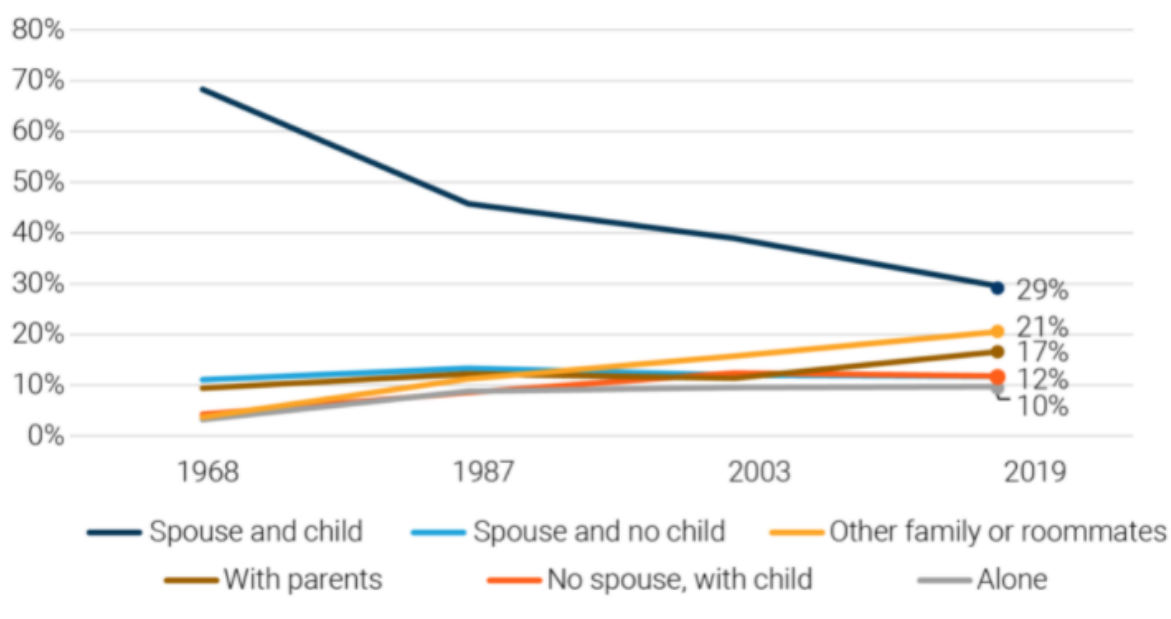


Source: Reeves and Pulliam (2020).

- Birthrates have fallen from over 3.0 per woman around 1980 to around 1.73 in 2018 ([Livingston, 2019](#))
- In 1968, married couples with at least one child made up 70% of US households, in 2018 they made up 30%
- Single-parent households make up 12% of all households compared to 5% in the 1960's

- Americans over the age of 65 make up 16.2% of the population compared to 11.5% in 1980
- These numbers will continue to rise and are expected to reach 35% by 2038
- 75% of retirees plan to remain in their current home throughout retirement
- There is an increase in multigenerational households
  - Since 2000, the number of people age 23-38 living with their parents increased from 12% to 22% (almost double)

Figure 5.5: Household Living Arrangements of Americans aged 23 to 38

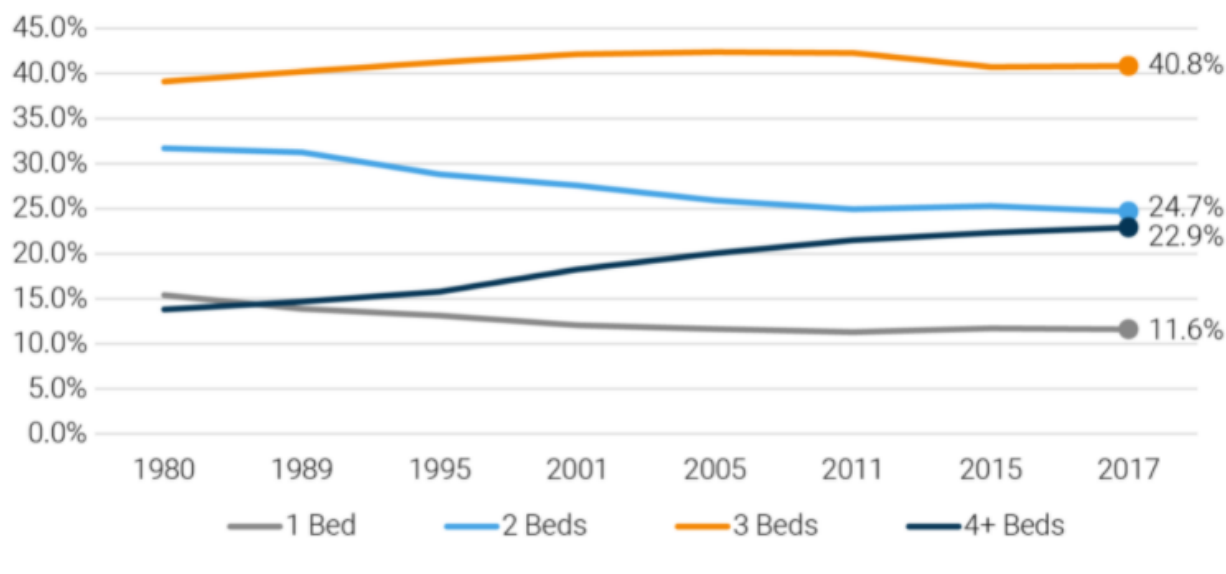


**Source:** Loh and Farrar (2020).

- America's housing production has failed to keep up with the changing demographics and changing demand
- These changing demographics are reducing the demand for single-family homes, largely due to zoning restrictions (which we will cover later).
  - Since 2013, 50% of all new houses built had 4 or more bedrooms in the 15 largest markets compared to 16.7% for one-bedroom units
- In the 15 largest markets, one-bedroom houses are mostly full and on average have 1.5 people living in them
- In those same markets, many three- and four-bedroom houses remain empty

- This shows a fundamental mismatch between housing demand and current inventories.

Figure 5.6: Nationwide Housing Inventory by Number of Bedrooms

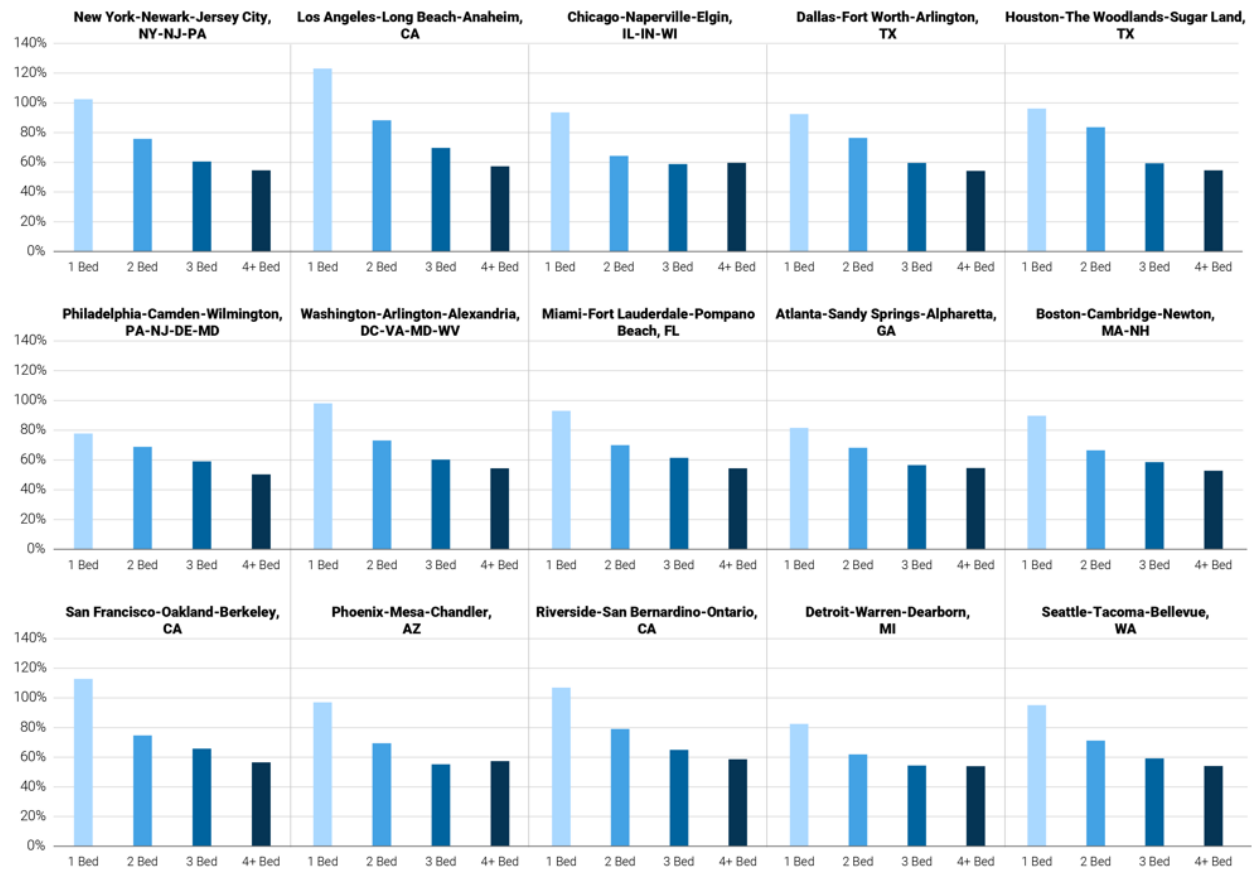


**Source:** Loh and Farrar (2020).

- Millennials (born between 1981-1996) are the largest generation in the population
- Many are not buying and do not desire to buy the large single-family “starter home” that Baby Boomers bought
- This means that younger people are fighting over the few houses that fit their preferences, driving up prices
- Retirees have a harder time selling their homes or children have a hard time selling after their parent’s death
  - Retirees exiting the housing market far exceeds the number of young home buyers, leaving 15-18 million surplus homes on the market (Myers and Simmons, 2018), often in places people don’t necessarily want to live
- This will be something to think about as we move into the discussion of housing supply.



Figure 5.7: Percentage Capacity Filled by Number of Bedrooms

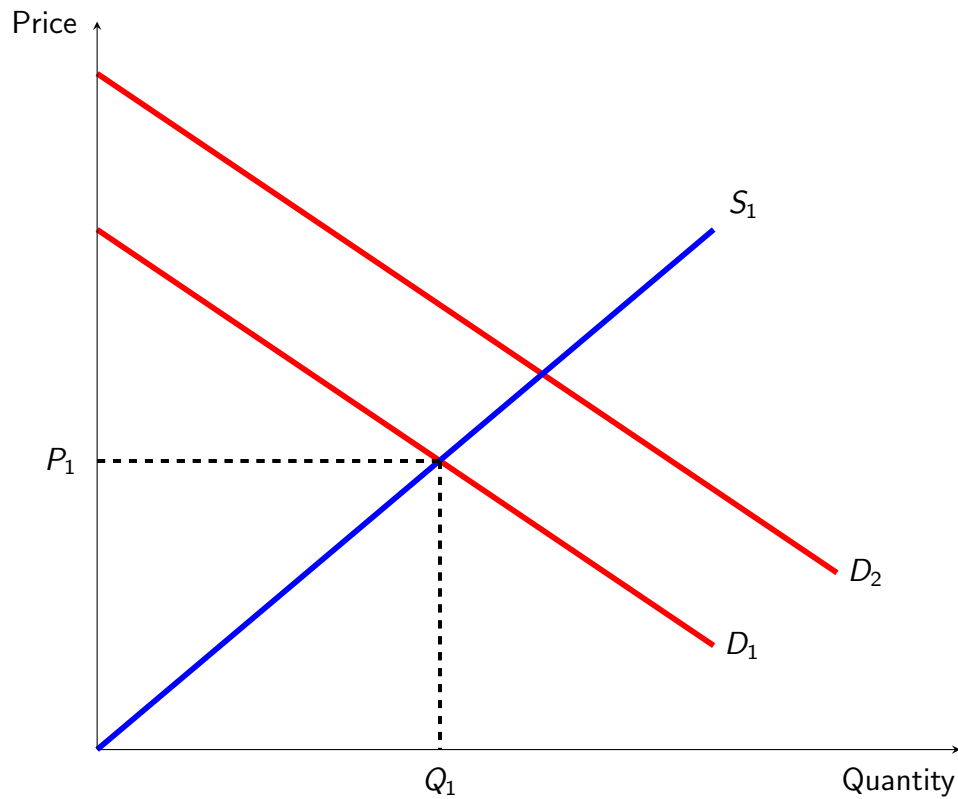


Source: Loh and Farrar (2020).

## 5.4 Rental Housing

- Recall from earlier, 34% of Americans live in a rental unit
- There are a multitude of factors that can influence the demand for rental housing in a town or city
  - Cost of owning a home and mortgage rates
  - Lifestyle preferences
  - Migration trends
  - Changing demographic trends
  - Regional job growth
- The factors that increase the demand for owning a house will decrease the demand for renting, and vice versa
- Just like for homeownership, we can use lessons from Principles and Intermediate Microeconomics to understand rental pricing:

Figure 5.8: Market for Rental Housing

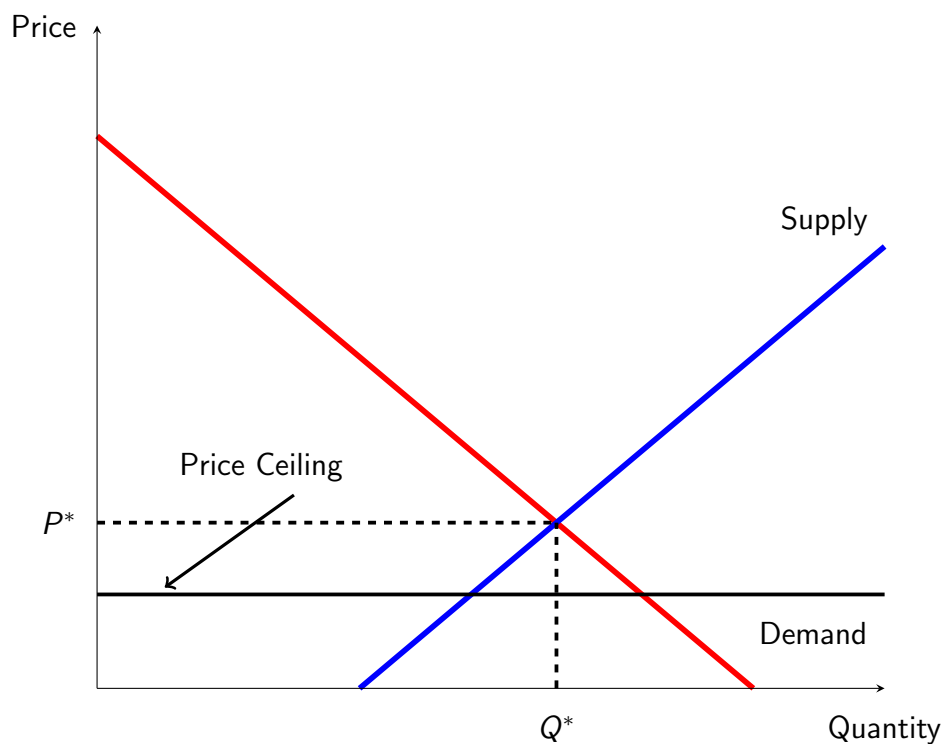


- In many locations, it is difficult to build new apartments (e.g., New York City, Chicago, etc.)
- So, the price of a rental unit is largely a determinant of demand, which is a cause for expensive rents.

### 5.4.1 Rent Control

- In response to high rents, some local governments impose rent control
- Rent control is a government program that limits how much a landlord can charge for rent and how much they can increase the rent when renewing a lease
- 182 local governments have rent control regulations.
  - All of them are in New York, New Jersey, California, Maryland, and Washington, DC
  - 31 states outlaw local governments from implementing rent control laws
  - Oregon has a statewide rent control law that limits rent increases to 7% plus inflation
- Rent control laws put a price ceiling on rent
- We can also see how a price ceiling works quantitatively.

Figure 5.9: Rent Control as a Price Ceiling



### Example

Suppose the market for renting an apartment in Lexington is defined by the following:

$$Q_D = 5000 - P$$

$$Q_S = P$$

- To find  $P^*$  and  $Q^*$ , set  $Q_D = Q_S$
- $P = 5000 - P$
- $2P = 5000 \rightarrow P^* = 2,500$
- Plug  $P^*$  into  $Q_S$  or  $Q_D$  and get that  $Q^* = 2,500$

Suppose the government thinks that \$2,500 is too high for the price of rent and institutes rent control (or a price ceiling) stating the maximum price of rent is \$2,000. How does this change  $Q_S$  and  $Q_D$ ?

- $Q_D = 5000 - 2000 = 3000$
- $Q_S = 2000$

- When the market is in equilibrium,  $Q_D = Q_S = 2500$
- With the price ceiling,  $Q_D > Q_S$
- Because the price is lower, more people will want to rent apartments and landlords will be less likely to rent their property
- To see the gap in  $Q_S$  and  $Q_D$ :  $Q_S - Q_D = -1000$
- This means that there is a shortage of 1,000 apartments.

- There are several main arguments against rent control:
  - Because rent control lowers rent, some landlords will convert their rental properties into commercial properties or sell it
  - Lower rental prices discourage new investment in rental properties
  - Decrease in the quality of rental housing because landlords are less likely to invest in the property due to lower return on their investment
- There are two main arguments in favor of rent control:
  - In many cities, rent is increasing faster than incomes
  - Can help people stay in their home once they are living there by decreasing the rate of rent increases

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# SUPPLY OF HOUSING

- The supply of housing is the number of houses that are available to be purchased at any point in time
- It is important also to consider the “type” of housing that is available
  - **Single-family home**
    - Freestanding residential buildings that do not share a wall with another building where the owner typically owns the building and the land that the building sits on
  - **Multi-family home**
    - **Townhouse**
      - \* A multi-floor single-family home that shares two walls with another house on both sides (unless a unit on the end)
    - **Semi-detached home**
      - \* A single-family home that shares one wall with another house and the two are usually mirrors of each other
      - \* Unlike a townhouse, there is only one wall shared
    - **Condominium**
      - \* A condominium is a building structure divided into several units that are individually owned that share a common space that is jointly owned
    - **Apartments**
      - \* An apartment is a unit inside of a building structure comprised of similarly styled individual units
      - \* A tenant rents an apartment from a landlord
- There are two primary determinants of the supply of housing:
  - The number of current homeowners who decide they want to move and therefore want to sell their home
  - The number of new houses that are completed and are on the market
- In this section, we are going to focus on what influences the building of new single-family and multi-family homes
- There is no one national policy for housing

- While there are federal programs for housing assistance, most housing policy is at the state and local level
- This means that there are thousands of different sets of housing policies in the United States
- While it would be very difficult to analyze all of them, we can focus on some of the larger policy issues around regulation and zoning

## 6.1 Building Permits

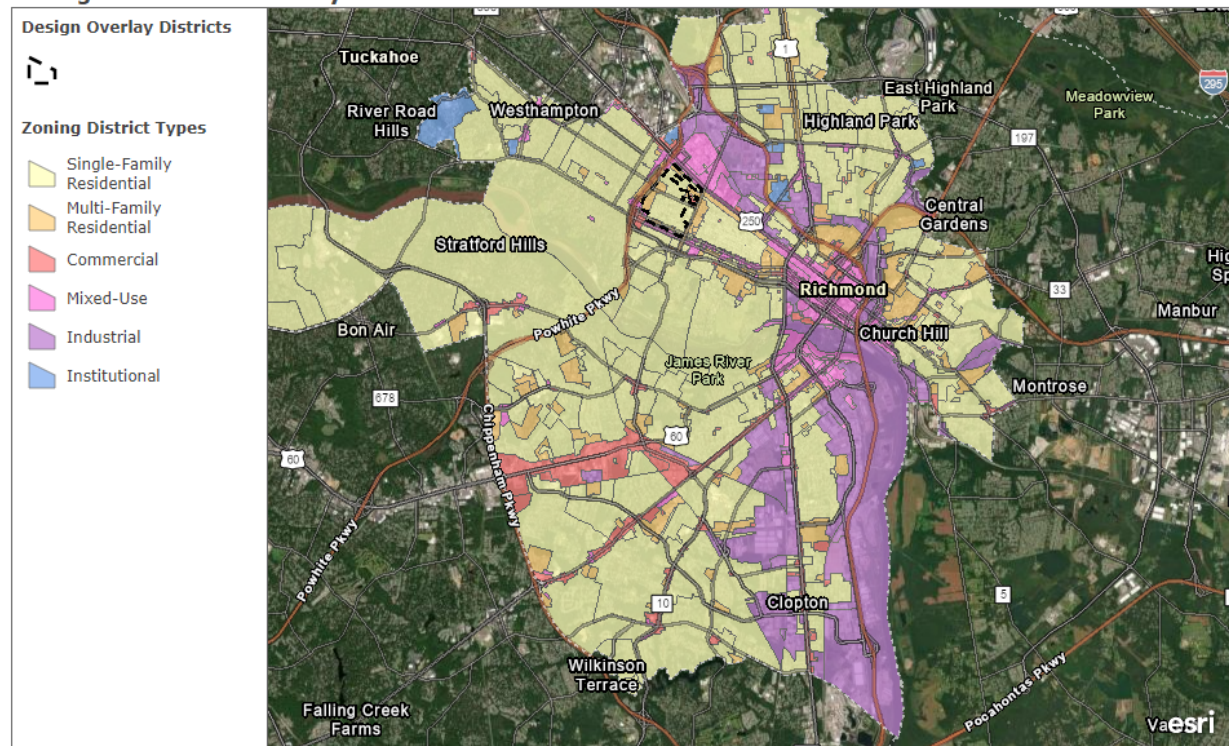
- For most goods and services, companies respond to changes in demand by adjusting supply
  - If there is a high demand for Play Station, Sony will produce more to meet the demand
- With housing, landowners and construction companies can't just build new homes and they cannot modify existing structures without a building permit
  - A building permit is issued by a local government that allows the landowner or a contractor to build on or make changes to your property
  - This is intended to ensure that the project complies with local standards and to ensure the safety of current and future occupants
    - Framing work, sanitation, fire protection, electrical service, sewer lines, water, etc.
  - The building permit process varies by locality, but is not always a quick endeavor, but generally follows these steps:
    - Step 1: Apply for and submit a building permit that includes drawings of the work plan along with materials that are going to be used
    - Step 2: Pay the permit application fee and wait for approval
      - \* In 2021, the average permit costed \$1,218, ranging from \$432 to \$2,211, depending on the type of project ([HomeAdvisor, 2022](#))
    - Step 3: Once work begins, you must post the permit to a door or window where the work is being done
    - Step 4: At specific points during the construction, an inspection must occur to review the quality of the work and order any changes to be made. Once the inspector finalizes the work, then the permit no longer needs to be displayed
- Building new homes takes time and the permit process can extend that time, which can make it so that the supply of new homes is slow to respond to the demand for new homes
- The building permit process also ensures that the structure being built or any modifications to the existing structure are in accordance with local zoning ordinances

## 6.2 Zoning

- Zoning is a process where local governments divide the land into zones that have different rules for how they can be developed
- The primary reason for zoning historically was to separate types of development that are not compatible
  - You don't want a factory or a shopping center right next to a house
- Let's look at an example of [zoning ordinances from Richmond, VA](#)

Figure 6.1: Zoning Districts, Richmond, VA, 2022

### Zoning Districts and Overlays



Zoning districts and overlays.

Earthstar Geographics | City of Richmond, County of Henrico, VGIN, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA

- For each “zone,” there are very detailed rules about the size of the lot, the size of the building, the way the yard needs to look, etc.
  - **R1-R6:** Single-family residential zoning
    - Each class has a different allotment for property size from 5,000 sq. ft. to 20,000 sq. ft.
  - **R7-R8:** Two-Family attached or detached zone

- “The intent of the R-7 single- and two-family urban residential district is to preserve and enhance the established character of older urban residential neighborhoods in the inner areas of the city. The district regulations are designed to reflect the urban nature of such neighborhoods as characterized by a mixture of detached and attached single- and two-family dwellings situated on small lots with narrow yards and modest setbacks.”
- **R43-R73**: Multi-family residential zone
- **RMH**: Mobile home zone
- In practice, zoning is also used to prevent new development from interfering with existing uses and/or to preserve the “character” of a community

### 6.2.1 Local Governments and Zoning Ordinances

- The process for creating a zoning ordinance is as follows:
  - Staff and consultants create a draft zoning ordinance
  - Public hearings are held to get input from the public
  - Staff and consultants modify and repeat
  - Eventually a draft is given to the city planning commission, which seeks more public input
  - The planning commission sends it to the city council, which either approves, rejects, or asks for modifications
- Once adopted, the zoning ordinance is legally binding and to change the ordinance requires a repeat of this process

### 6.2.2 Issues with Zoning Ordinance Process

- The passing of a zoning ordinance relies heavily on community involvement
- However, it is typically the case that the people who participate in this process are not representative of the community as a whole ([Einstein, Glick and Palmer, 2019](#))
  - They tend to be older, affluent, and white homeowners
  - This is true even if they are not the majority of the community
- These homeowners generally perceive new development, particularly of low-income or moderately priced housing, as threats to their property values
- They fight back against changes to “neighborhood character” (see text from the city of Richmond, VA) ([Schuetz, 2022](#))
- These people have been given the nickname of NIMBYs (Not in my backyard)



- The idea behind NIMBYism is that people are generally in favor of something (e.g., affordable housing) but as long as it is not in my backyard
  - We see NIMBYism in many issues: green energy, nuclear power, refugees, etc.
- As a result, most cities and counties in the United States have the majority of land exclusively zoned for single-family homes
- This can drastically reduce the ability to build new housing, particularly in dense population settings which increases housing costs relative to what the market would have provided otherwise
  - This means someone can't convert a three-story house into three separate residences
  - I can bulldoze my house and build condos on my property
  - A builder can't build a set of townhouses or condos next to a single-family home
- This limits the amount of low-cost and affordable housing that can be built in areas that are in high-demand areas
- Essentially, zoning distorts the market and makes housing scarcer and more expensive ([Schuetz, 2022](#))

### 6.2.3 Solutions to Zoning Issues

- According to [Schuetz \(2022\)](#), finding policy solutions to exclusionary zoning can be divided into two questions:
  1. What do better land policies and housing outcomes look like?
  2. What kind of fiscal, legal, or political levers can be used to nudge local governments to adopt better policies?
- **Better land policies and housing outcomes** ([Schuetz, 2022](#))
  - Local housing markets vary in land values, population density, land regulations, and existing housing structures
  - Because of this, it is impossible to develop a “one size fits all” policy to fix zoning issues
  - However, local zoning ordinances should be more flexible to allow multiple types and sizes of homes and the development processes should be shorter and simpler
  - Additionally, local governments should not just focus on reforming zoning ordinances but should think about what the goal of zoning reform is: better housing outcomes
    - For example, a wealthy neighborhood could expand its population by allowing 3+ bedroom single-family homes on large lots, but this would only be accessible to more wealthy families

- Allowing for a multitude of structure types, lot sizes, and house sizes would reduce the price of entry into a variety of communities and make housing more accessible and affordable in high-demand areas
- **Fiscal, legal, and political reforms** (Schuetz, 2022)
  - Two major concerns often raised at public hearings are schools and traffic
  - More housing means more students may attend local schools and there will be an increase in the number of cars on the road, which will make parking at a premium
    - These concerns are not totally unfounded, though sometimes they are used as an excuse to prevent demographic change
  - There isn't a simple answer as to who should pay for infrastructure and how it should be financed
  - What does the term “infrastructure” actually mean, many people have their own definitions
    - Generally, infrastructure means the physical systems that support cities and towns
      - \* Roads
      - \* Bridges
      - \* Public transportation
      - \* Water and sewer systems
      - \* Internet
      - \* Electricity production and distribution
    - More broadly, we can include economic and social institutions that support local communities
      - \* Public schools
      - \* Libraries
      - \* Parks and recreation facilities
      - \* Hospitals
      - \* Childcare
  - The COVID-19 pandemic highlighted the importance of economic and social institutions to local communities
  - Paying for new infrastructure and maintaining existing infrastructure can be expensive
  - Local governments rely heavily on property taxes and other fees for revenue
  - Fiscal reforms
    - Reform property tax structures to tax the value of the land instead of the value of the structure
      - \* This would impact low-density land development of single-family homes with large yards and would encourage developing multi-family homes to split the property tax rate

- Have federal and statewide initiatives that increase access to economic and social institutions
  - \* Local government revenues to fund these initiatives will inevitably lead to gaps in quality of service based on where property tax revenue is coming from and those that show up to public forums
  - \* Increased access and quality of economic and social institutions increase the desirability to live in and the property values of lower-income areas
- **Overcoming the limits of localism** ([Schuetz, 2022](#))
  - In theory, local control over public services offers some advantages in a country as large as the United States
  - Mayors and city council members likely have better information on what voters in their jurisdiction want than Congress and, theoretically, could be more easily held accountable
  - However in practice, allowing each city or county to determine how much housing to build (or not to build) leads to poor economic and social outcomes due to local political and fiscal incentives
  - Additionally, local governments vary widely in their resources and institutional capacity, which impacts their ability to plan and implement policies, creating a large variance between localities
  - Furthermore, policies that are popular with local voters may harm broader regional or national well-being
    - We all want our local Starbucks, Chipotle, Bars, and entertainment venues to be fully staffed
    - Due to the market wages paid by these institutions, asking these workers to commute a long distance is unreasonable and unsustainable
    - However, because of NIMBYism, there is often a lack of access to affordable housing in wealthier areas
    - This creates a regional imbalance between jobs and housing
  - Reforms
    - This is where the federal and state governments can provide financial incentives for local governments to act in the best interest of broader regional cooperation between local governments for land development and use
    - This is easier said than done because federal and state policy initiatives can swing when power switches from one party to another and most state governments don't have the capacity to deal with land use issues state-wide
- Since the 1990s, the supply of public housing has been declining as older units are demolished and redeveloped into mixed-income areas
- In these mixed-income areas, the new public housing is very high quality, but there are often fewer units built

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# PUBLIC POLICY FOR AFFORDABLE HOUSING

## 7.1 The Low-Income Housing Tax Credit

- See [Tax Policy Center \(2020\)](#) and [Schwartz \(2015\)](#) for more information
- The Tax Reform Act of 1986 established the Low-Income Housing Tax Credit (LIHTC)
- The LIHTC is the largest subsidy for the production of low-income rental housing in the United States
- The LIHTC subsidizes the acquisition, construction, and rehabilitation of affordable rental housing for low- and moderate-income tenants.
  - Since the mid-1990s, the LIHTC has supported the construction or rehabilitation of about 110,000 affordable rental units each year (over 2 million units in all since its inception).
- The federal government issues tax credits to state and local governments
- State housing agencies then award the credits to private developers of affordable rental housing projects through a competitive process
- Developers generally sell the credits to private investors to obtain funding
- Once the housing project is made available to tenants, investors can claim the LIHTC over a 10-year period.

### 7.1.1 Qualifying for the LIHTC

- Many types of rental properties are LIHTC eligible, including apartment buildings, single-family dwellings, townhouses, and duplexes
- Owners or developers of projects receiving the LIHTC agree to meet an income test for tenants and a gross rent test in one of three ways:
  1. At least 20% of the project units are occupied by tenants with an income of 50% or less of the adjusted area median income for family size (AMI)
  2. At least 40% of the units are occupied by tenants with an income of 60% or less of AMI

3. At least 40 percent of the units are occupied by tenants with income averaging no more than 60% of AMI, and no units are occupied by tenants with income greater than 80% of AMI.
- All LIHTC projects must comply with the income and rent tests for 15 years or the credits are recaptured.
    - Often, a 30-year extended compliance is imposed.

### 7.1.2 Calculating the LIHTC

- First, calculate the qualified basis
  - $(\text{Construction Costs} - \text{Nondepreciating Costs}) \times \text{Applicable Fraction}$ 
    - Non-depreciating costs include land, interest rates, and insurance
    - The applicable fraction is the percentage of units built that meet the definition to qualify above (often 100%)
- Second, multiply the qualified basis by the LIHTC applicable federal rate (AFR)
  - “9% Rate” for new construction or substantial rehabilitation to existing structures
  - “4% Rate” for rehabilitation projects
    - These rates are not exactly 9% and 4%, but are set each month by the IRS
- This gives you the annual credit, which can be applied for 10 years

#### Example

Suppose you build a new apartment building for \$5,000,000 excluding land, interest rates, and insurance. 100% of the units are going to be used for low-income housing. The IRS has set the current 9% AFR at 7.5%.

$$\text{Qualified Basis} = \$5,000,000 \times 100\% = \$5,000,000$$

$$\text{Annual Credit} = \$5,000,000 \times .075 = \$375,000$$

$$\text{Over 10 Years} = \$375,000 \times 10 = \$3,750,000$$

These credits are often sold to investors to obtain initial funding.

### 7.1.3 Benefits and criticism

- The LIHTC costs around \$9.5 billion per year
- LIHTC addresses a major market failure: the lack of quality affordable housing in low-income communities

- LIHTC build housing accommodates twice as many households as public housing, which has been in place for 50 years longer
- Critics of the LIHTC argue that the federal subsidy per unit of new construction is higher than it needs to be because of the various intermediaries involved in its financing.
  - Organizers, general partners, managers, and investors.
- As a result, a significant part of the federal tax subsidy does not go directly into the creation of new rental housing stock
- Some state housing finance authorities tend to approve LIHTC projects in ways that concentrate low-income communities where they have historically been segregated and where economic opportunities may be limited
- The LIHTC helps construct new affordable housing, maintaining that affordability is challenging once the required compliance periods are over.

## 7.2 Public Housing

- See [Schwartz \(2015\)](#)
- Public housing is the most widely known form of subsidized low-income housing in the United States
- The public housing program originated in 1937 as a part of the New Deal
- Public housing was established to provide decent and safe rental housing for eligible low-income families, the elderly, and persons with disabilities
- This law authorized local public housing authorities (PHAs) to issue bonds to finance the development costs of public housing where the federal government pays the interest and principal on the bonds
- Public housing comes in all sizes and types, from scattered single-family houses to high-rise apartments for elderly families
- There are approximately 970,000 households living in public housing units, managed by 3,300 PHAs
- Only 9% of public housing units have been built after 1989 (as of 2012)
- In the last 30 years, far more resources have been dedicated to preserving and redeveloping existing public housing than expanding the number of public housing units
- Public housing building types (as of 2012):
  - Single-family homes: 35,257 (2.7%)
  - Townhouses: 297,370 (23.1%)

- Semi-detached: 120,592 (9.4%)
- Walkup apartments: 146,963 (11.4%)
- High-rise elevator apartments: 389,731 (30.3%)
- Mixed: 296,201 (23.0%)
- **Total:** 1,286,114

### 7.2.1 Eligibility

- Public housing is home to some of the nation's poorest and most vulnerable households
- Families that are eligible for public housing have incomes far below the level necessary to secure housing in the private market
- An local PHA determines your eligibility based on:
  1. Annual income
  2. Whether you qualify as elderly, a person with a disability, or as a family
  3. U.S. citizenship or eligible immigration status
- The Department of Housing and Urban Development (HUD) sets the lower income limits at 80% and very low-income limits at 50% of the median income for a local area
- Because median incomes can vary drastically, someone may qualify in one area but not in another.
  - The average annual income for residents of public housing is \$13,724
  - Only 12% of people who live in public housing make over \$25,000 per year
  - 36% are disabled
  - 32% are elderly
  - 46% have only 1 person
  - 21% have 2 people
- Rent is calculated based on a families income minus deductions
  - Households can deduct \$480 for each dependent; \$400 for any elderly family or a person with a disability; and some medical deductions for families headed by an elderly person or a person with disabilities.
- The formula for calculating the rent payment is the highest of the following, rounded to the nearest dollar:
  1. 30% of the monthly adjusted income [(annual income – deductions)/12]
  2. 10% of monthly income
  3. \$25–%50 minimum rent as set by a local PHA
- Issues



- Despite its many problems, public housing is a durable program that provides low-income housing
- While some units have substandard construction, weak management, inadequate maintenance and upkeep, extreme poverty, and crime – most public housing developments manage to provide adequate housing
- The difference between public housing and housing that is subsidized (e.g, LIHTC), is that it is owned by the public
- This means that after a certain number of years, these units cannot be repurposed for market-rate occupancy
- Long-term threats to public housing are adequate funding and management, to ensure that buildings are adequately maintained, which will help alleviate the widely accepted idea that public housing is a failure
- Another challenge is that there may be many low-income families living in subsidized housing (e.g., LIHTC, vouchers), and if those units get torn down to be redeveloped, they may not qualify for newer public housing being built, especially those with felonies, substance abuse problems, and erratic work histories
  - Having a stable place to live is an important factor in overcoming substance abuse and erratic work history
  - Many low-income families are difficult to house because they face multiple barriers.
    - \* Large families
    - \* Poor physical or mental health
    - \* Limited education

### 7.3 Housing Vouchers

- The LIHTC and public housing are programs that promote the construction of new buildings for low-income housing
- Housing vouchers enable low-income households to obtain housing that already exists in the private-market
- Vouchers tend to be less expensive than the LIHTC and public housing and provide access to a wider range of neighborhoods and homes
- Section 8 of the Housing Act of 1937 established the Section 8 housing voucher program but did not become a large part of US housing policy until the passing of the Housing and Community Development Act of 1975 and is now called the Housing Choice Voucher Program
- Housing vouchers are administered locally by public housing authorities (PHAs)
- The PHAs receive federal funds from the Department of Housing and Urban Development (HUD) to administer the voucher program

- A family that is issued a housing voucher is responsible for finding a suitable housing unit of the family's choice where the owner agrees to rent under the program
  - HUD sets minimum standards for housing and housing must be inspected by local PHA before a voucher can be used
  - Often, those who apply for housing vouchers are placed on a waiting list for multiple years.
- Eligibility
  - Eligibility for a housing voucher is determined by the PHA based on the total annual gross income and family size
  - In general, the family's income may not exceed 50% of the area median income
  - By law, a PHA must provide 75 percent of its voucher to applicants whose incomes do not exceed 30% of the area median income.
- Average annual income = \$24, 087 (2022)
- Average monthly payment = \$569
- 4.3% are non-disabled elderly
- 50% are disabled
- Average household size = 2.7

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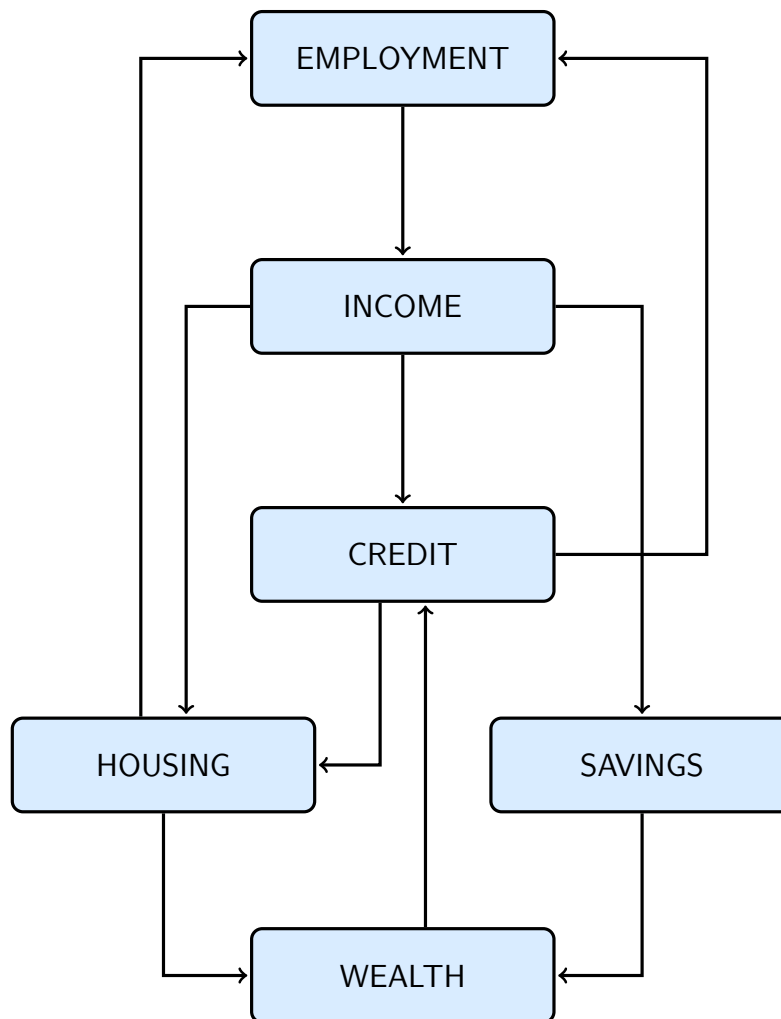
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# HOUSING DISCRIMINATION

- In this section, we are going to talk about historical discrimination in housing markets, the impacts of historical discrimination today, and what types of discrimination exist today
- First, we need to understand what is discrimination:
  - Individual discrimination
    - When people are treated differently based on their personal characteristics (race, gender, religion, age, etc.)
      - \* “White Only” water fountains
      - \* Hiring/promotion discrimination
      - \* Wage discrimination
  - Geographic discrimination
    - When people are treated differently based on where they live
      - \* Redlining
      - \* Urban vs rural
  - Structural (systemic) discrimination
    - Inequality that rooted in societies norms, laws, and culture
      - \* Jim Crow laws
      - \* American Indian boarding schools
      - \* Crack vs cocaine laws
- Discrimination in housing and lending markets has historically and can still occur in these forms
- People’s homes and neighborhoods are the foundation in their lives
- They provide stability, security, social networks, and the ability to raise a family
- Owning a home and the neighborhood people live in can also offer economic benefits
  - Quality of education
  - Health
  - Wealth accumulation
  - Borrowing power
  - Intergenerational wealth transfers

- When discrimination does occur, it affects all of these

Figure 8.1: Relationship between Housing, Wealth, and Employment



- Most people get income from their employer
  - We know from our intertemporal budget constraint, that we have a choice to spend this money on consumption, to save it for the next period, and/or to spend it on housing
- For most households, the majority of their wealth and net worth comes from housing wealth
- In order to buy a house, most people need to borrow money
- To be able to borrow money, people must have access to credit
- Access to credit is determined by people's income and total wealth

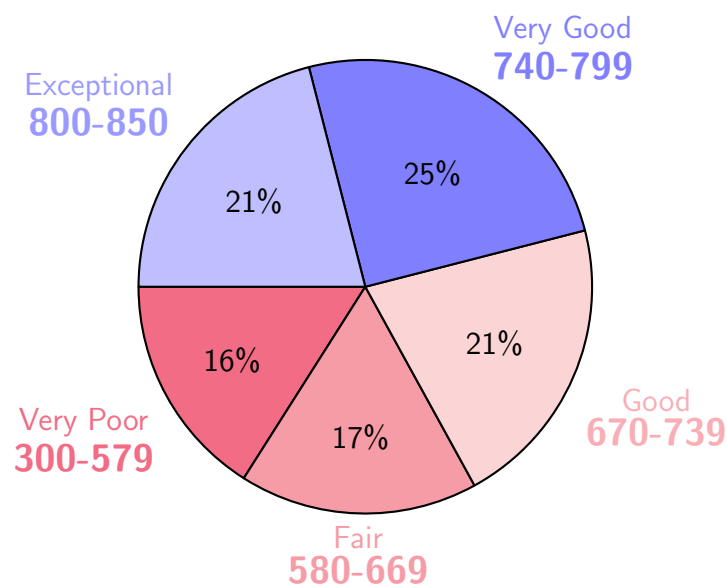
- Since owning a home is the largest part of people's total wealth, owning a home makes it easier to borrow money
- Some companies use credit checks in the hiring decision
  - Credit is influenced by homeownership
- The location of someone's house can influence where they live
  - People generally work close to where they live
- If is discrimination at any point in the flow chart in Figure 8.1, it can have negative effects on the ability to:
  - Work
  - Save
  - Borrow money
  - Transfer wealth to the next generation
- The negative economic consequences can indirectly affect other economic outcomes:
  - Quality of education
  - Level of education
  - Health
  - Social networks

## 8.1 Credit and Lending

- When someone wants to borrow money from a lender to buy something of value, they agree that they will pay it back at a later date with interest
- People borrow money for a variety of things:
  - Education
  - Housing
    - Mortgage
    - Home improvement
  - Cars
  - Business operations
  - Medical emergencies
- People can access credit through several channels:
  - Direct bank loan

- Credit cards
- Peer-to-peer lending
- There are two types of credit:
  - Revolving debt – credit cards
  - Installment loans – Mortgages, car loans, student loans
- The availability of credit and the interest rate on a loan is determined by your credit history and your credit score
- Credit scores and history are determined by one of the three credit bureaus: Experian, Equifax, and Transunion
- The most common score used is called the FICO score
- Not everyone has a credit score, those who do not have what are called “thin files”

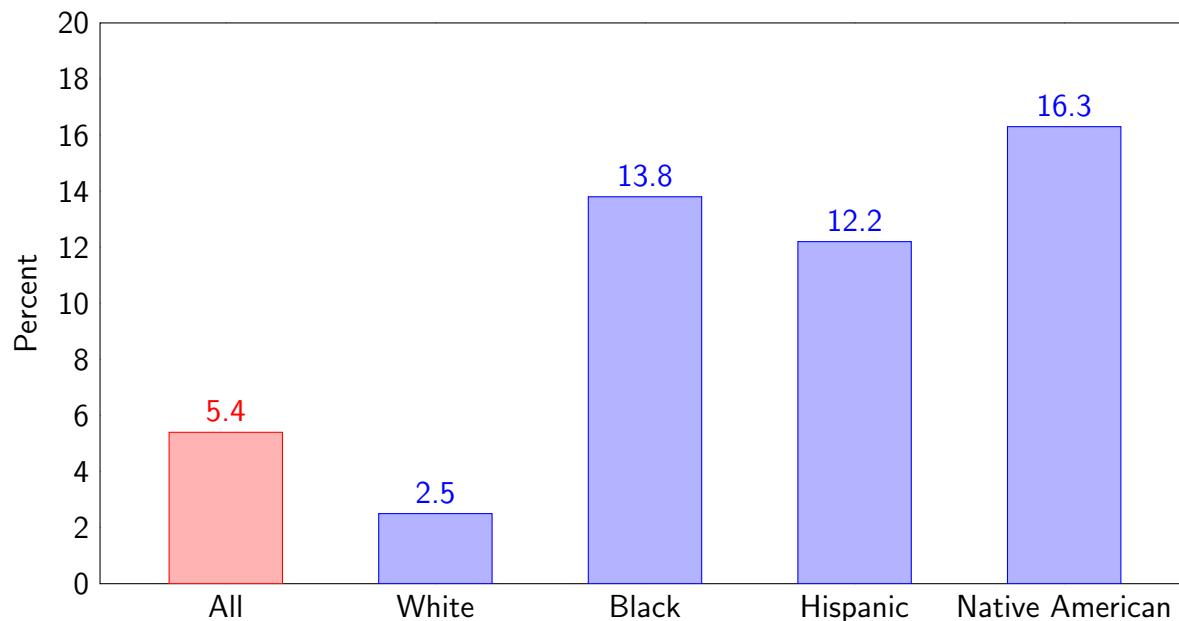
Figure 8.2: FICO Score Breakdown



Source: Experian

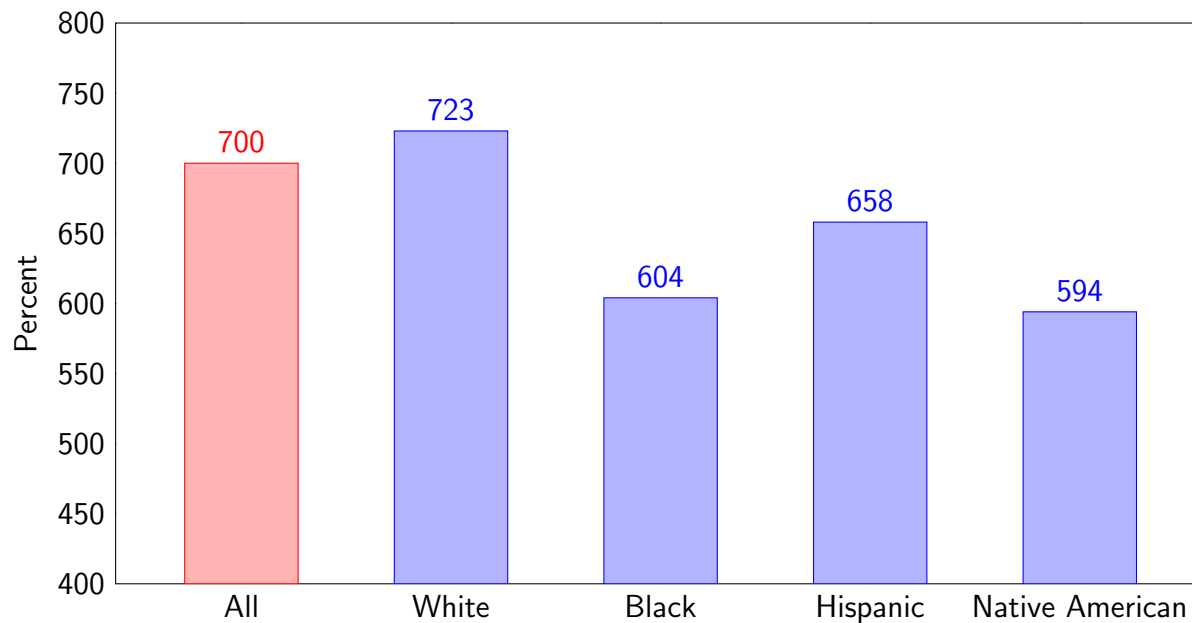
- Some people in the United States are unbanked, which means that nobody in the household has a checking account or a savings account at a bank or credit union
- 5.4% of Americans were unbanked in 2019, representing 7.1 million households

Figure 8.3: Unbanked Households in the United States, 2019



Source: FDIC

Figure 8.4: Median Credit Score, 2020



Source: Urban Institute

## 8.2 Redlining

### 8.2.1 Federal Housing Administration

- After the Civil War, during Reconstruction, southern states passed many laws limiting Black people's ability to work, own property, vote, and go to school
  - Black codes, sharecropping, literacy tests, grandfather clauses, etc.
- In 1896, the US Supreme Court ruled in *Plessy v. Ferguson* that racial segregation laws did not violate the Constitution as long as the facilities were "separate but equal"
- The Housing Act of 1934 established the Federal Housing Administration (FHA) which insures mortgages made by private lenders and protects lenders against losses
- If a property owner defaults on their mortgage, FHA pays a claim to the lender for the unpaid principal balance
- Because lenders take on less risk, they are able to offer more mortgages
- The goal of the FHA is to facilitate access to affordable mortgage credit for low- and moderate-income and first-time home buyers, for the construction of affordable and market-rate rental properties, and for hospitals and residential care facilities in communities
- The FHA was created because, during the Great Depression, many banks failed, causing a large decrease in home loans issued and homeownership
- However, when the FHA was created, these practices were restricted to only white Americans
- The FHA calculated appraisal value based on eight criteria and directed its agents (called "appraisers") to lend more for higher appraised projects, up to a maximum cap. The two most important were "Relative Economic Stability", which constituted 40% of appraisal value, and "protection from adverse influences", which made up another 20%
- In 1935, the FHA provided its appraisers with an Underwriting Manual, which gave the following instruction: "If a neighborhood is to retain stability it is necessary that properties shall continue to be occupied by the same social and racial classes. A change in social or racial occupancy generally leads to instability and a reduction of values."
- Appraisers were then told to give higher property and zoning ratings where "protection against some adverse influences is obtained", and defined adverse influences as "infiltration by inharmonious racial or nationality groups"
- Because the FHA's appraisal standards included a whites-only requirement, racial segregation became an official requirement of the federal mortgage insurance program, as the FHA frequently judged any properties in racially mixed neighborhoods or in close proximity to black neighborhoods as being high-risk



Figure 8.5: Examples of Racial Discrimination from the FHA Underwriting Manual, 1936

(a) Example 1

**233. The Valuator should investigate areas surrounding the location to determine whether or not incompatible racial and social groups are present, to the end that an intelligent prediction may be made regarding the possibility or probability of the location being invaded by such groups. If a neighborhood is to retain stability it is necessary that properties shall continue to be occupied by the same social and racial classes. A change in social or racial occupancy generally leads to instability and a reduction in values. The protection offered against adverse changes should be found adequate before a high rating is given to this feature. Once the character of a neighborhood has been established it is usually impossible to induce a higher social class than those already in the neighborhood to purchase and occupy properties in its various locations.**

(b) Example 2

**289 (1). Adequacy of Civic, Social, and Commercial Centers.—These elements of comfortable living usually follow rather than precede development. Those centers serving the city or section in which the development is situated should be readily available to its occupants. Schools should be appropriate to the needs of the new community and they should not be attended in large numbers by inharmonious racial groups. Employment centers, preferably diversified in nature, should be at a convenient distance.**

Source: [Federal Housing Administration \(1936\)](#), Digitized by Google

### 8.2.2 Home Owners' Loan Corporation

- In 1933, the Home Owners' Loan Corporation Act established the Home Owners' Loan Corporation (HOLC)
- Its purpose was to refinance home mortgages currently in default to prevent foreclosure, as well as to expand home-buying opportunities
- HOLC drafted Residential Security maps of major cities as part of its City Survey Program
- To create the maps, HOLC examiners classified neighborhoods on a "perceived level of lending risk" based on information they gathered from local appraisers, bank loan officers, city officials, and real estate agents

- The grades were based on the following factors:
  - The age and condition of the housing
  - Access to transportation
  - The closeness of popular amenities such as parks
  - Proximity to undesirable properties such as polluting industries
  - The residents' economic class and employment status
  - The residents' ethnic and racial composition
- Neighborhoods were color-coded on maps, with each color representing the area's perceived risk to lenders

Table 8.1: HOLC Map Codes

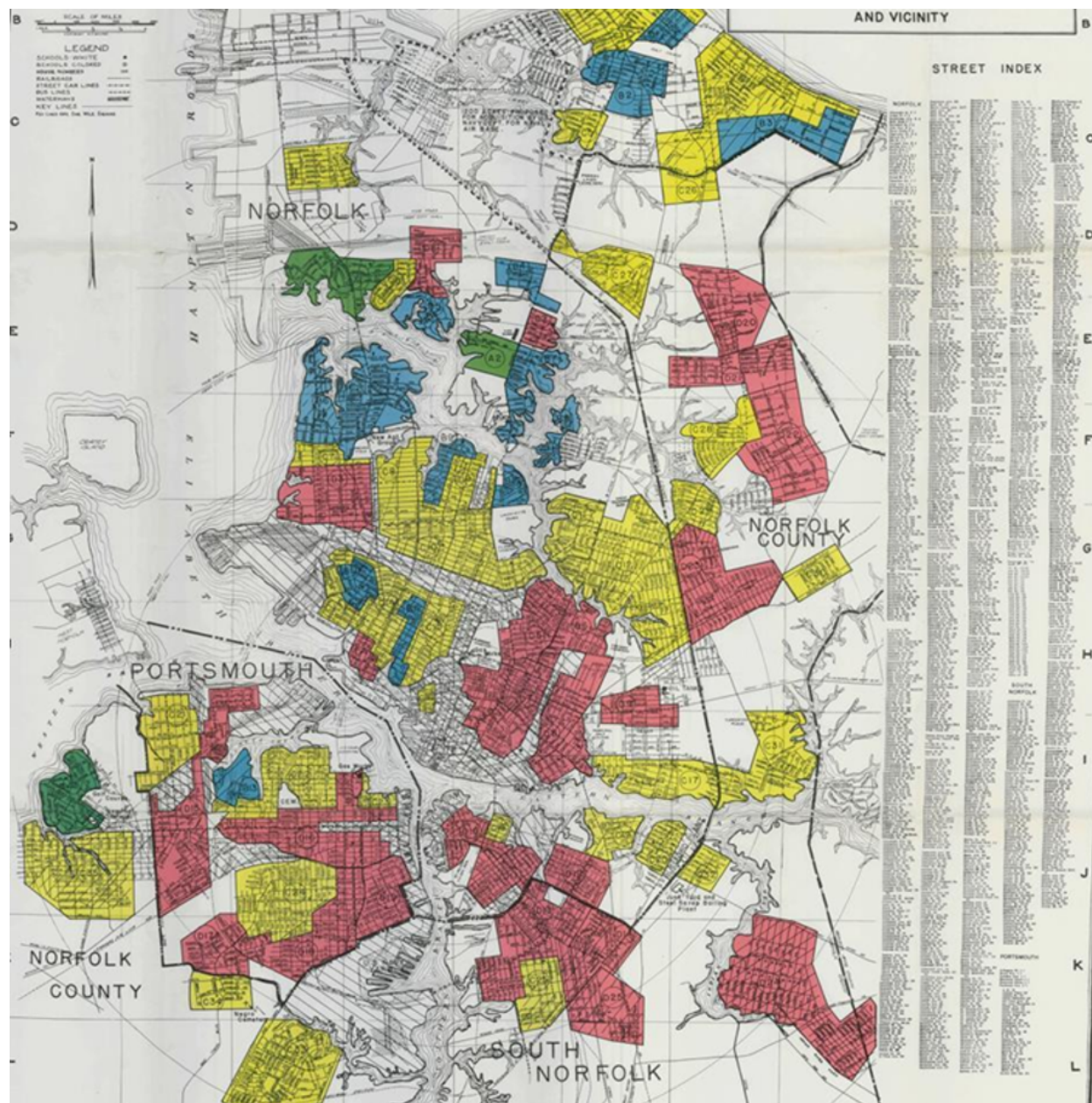
Grade	Risk	Color	HOLC Description
A	Best	Green	HOLC described A areas as “hot spots’ . . . where good mortgage lenders with available funds are willing to make their maximum loans. . . –perhaps up to 75-80% of appraisal.”
B	Still Desirable	Blue	HOLC described B areas as “still good” but not as “hot’ as A areas.” “They are neighborhoods where good mortgage lenders will have a tendency to hold commitments 10-15 under the limit,” or around 65 of appraisal.
C	Definitely Declining	Yellow	C neighborhoods were characterized by “obsolescence [and] infiltration of lower grade population.” “Good mortgage lenders are more conservative in Third grade or C areas and hold commitments under the lending ratio for the A and B areas.”
D	Hazardous	Red	HOLC described D areas as “characterized by detrimental influences in a pronounced degree, undesirable population or an infiltration of it.” It recommended lenders “refuse to make loans in these areas [or] only on a conservative basis.”

Source: [Folger \(2022\)](#)

- Neighborhoods with predominantly racial and ethnic minority populations were colored red—hence, “redlined.”
- The HOLC maps were a tool for widespread discrimination

- Would-be homeowners in certain areas found it difficult or impossible to get a mortgage because capital was directed to White families living in green and blue neighborhoods—away from Black and immigrant families in yellow and red communities

Figure 8.6: Redlining Map of Norfolk, VA





## 8.3 Housing Covenants

- Historically, a covenant is a promise to engage or refrain from a specific action
- A covenant is similar to a contract
- In housing, covenants were embedded in property deeds all over the country to keep people who were not white from buying or even occupying land (see Figure 8.7 for examples)
- Cities known for their widespread use of racial covenants include Chicago, Baltimore, Detroit, Milwaukee, Los Angeles, Seattle, and St. Louis
- Racially discriminatory housing covenants emerged during the mid-1800s but became widespread in the 1920s after the Supreme Court ruled in *Corrigan v. Buckley (1926)* that housing covenants were a legally-binding contract, forcing a sale of a home to a black family to be voided

Figure 8.7: Examples of Racial Discrimination in Housing Covenants

(a) Example 1

4. That no building shall be left with paper exposure or with the exterior incomplete.  
5. That the said land or buildings thereon shall never be rented, leased or sold, transferred or conveyed to, nor shall same be occupied exclusively by person or persons other than of the Caucasian Race.

6. The forgoing covenant and restriction shall run with the land and shall bind the grantee herein and the heirs, executors, administrators, successors and assigns of said grantee until the first day of January A.D. Nineteen hundred and Forty.

(b) Example 2

This conveyance is subject to the following provisions, the violation of which shall automatically revert the title herein in the vendors, their heirs or assigns, Party of the second part, his heirs, executors, administrators, or assigns, agrees not to sell or rent or permit said premises to be occupied by persons of African or Semitic race. According to the plat thereof on file and of record in the office of the Register of Deeds in and for the County of Hennepin and State of Minnesota.

(c) Example 3

E. No persons of any race other than the Aryan race shall use or occupy any building or any lot, except that this covenant shall not prevent occupancy by domestic servants of a different race domiciled with an owner or tenant.

F. No trailer, basement, tent, shack, garage, barn or other outbuilding erected in the tract shall at any time be used as a residence temporarily or permanently, nor shall any structure of a temporary character be used as a residence.

Source: [University of Minnesota Libraries \(2022\)](#)

- In 1948, the Supreme Court ruled in *Shelley v. Kraemer* that racially discriminatory housing violated the constitution's Equal Protection Clause and therefore could not be enforced by the courts
  - The ruling did not outlaw or ban racially discriminatory housing covenants and said that the private parties could abide by the terms, only that a court could not force one party to abide by the covenant

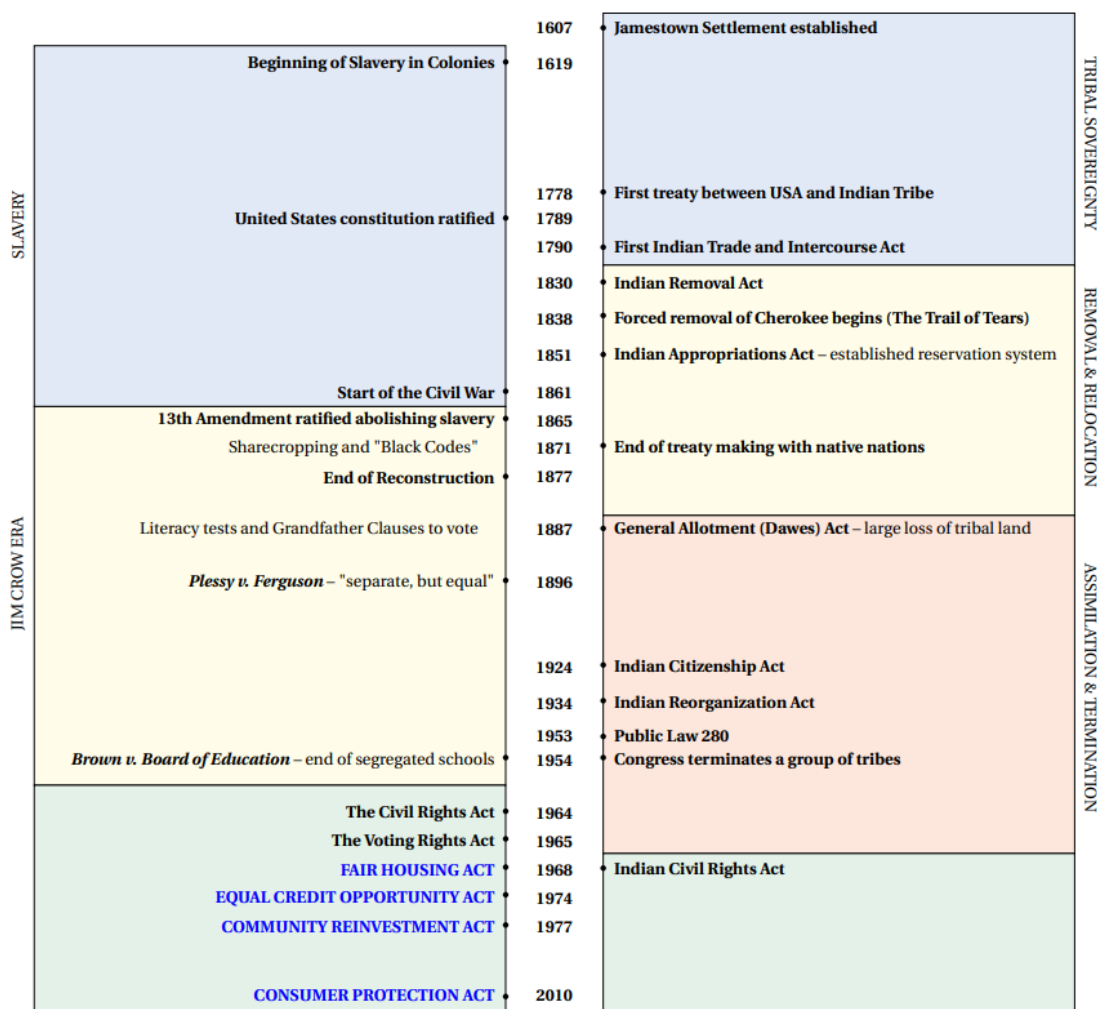
## 8.4 Outlawing Discriminatory Housing Practices

- The Fair Housing Act was enacted in 1968 and prohibited the following forms of discrimination:
  - Refusal to sell or rent a dwelling to any person because of their race, color, religion, or national origin
    - Sex was added to this list in 1974
    - Disabilities and families with children were added in 1988
  - Discrimination against a person in the terms, conditions, or privilege of the sale or rental of a dwelling
  - Advertising the sale or rental of a dwelling indicating preference of discrimination based on race, color, religion, or national origin
  - Neglecting maintenance and repairs of the units rented by people based on race, religion, sex, or any other discriminatory demographic
  - Restricting access to services and amenities on the basis of the renter's race, gender, religion, or nationality
  - In 2020, the Supreme Court ruled that the term "sex" includes discrimination based on sexual orientation and gender identity
- The Equal Credit Opportunity Act was enacted in 1974 that makes it illegal for any creditor to discriminate against any applicant, with respect to any aspect of a credit transaction, on the basis of race, color, religion, national origin, sex, marital status, or age
- The Community Reinvestment Act of 1977 sought to address discrimination in loans made to individuals and businesses from low and moderate-income and counteract redlining
  - The Community Reinvestment Act has been modified numerous times since it was enacted
- In 2010, the Consumer Protection Act (Dodd-Frank Act) was enacted that overhauled the financial system following the Great Recession
  - Among many other things, the Consumer Protection Act established the Consumer Financial Protection Bureau (CFPB) to prevent predatory mortgage lending and make mortgage terms more transparent to borrowers

## 8.5 Lasting Impact of Historical Housing Discrimination

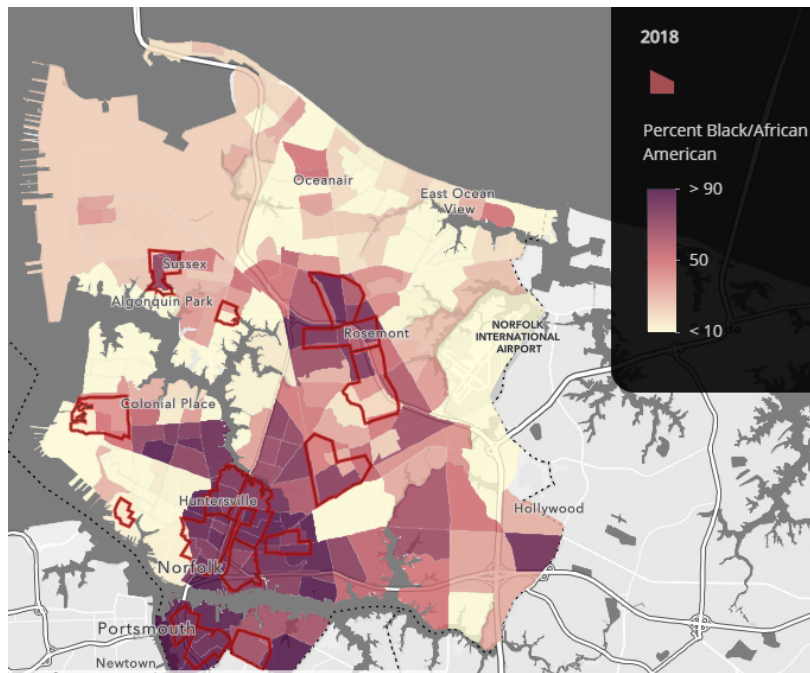
- Even though many discriminatory housing practices have been outlawed, it is worth noting that these are only recent developments in American history
- From 1619 (the beginning of slavery at Jamestown Settlement) until 1968, 349 years, Black and American Indian families were restricted/limited in their access to capital and housing
- The Fair Housing Act was passed 54 years ago (as of 2022), but this act and the other acts discussed earlier only outlawed discriminatory practices, they did not do anything to reverse the effects of those policies

Figure 8.8: Timeline of Structural Discrimination in the United States



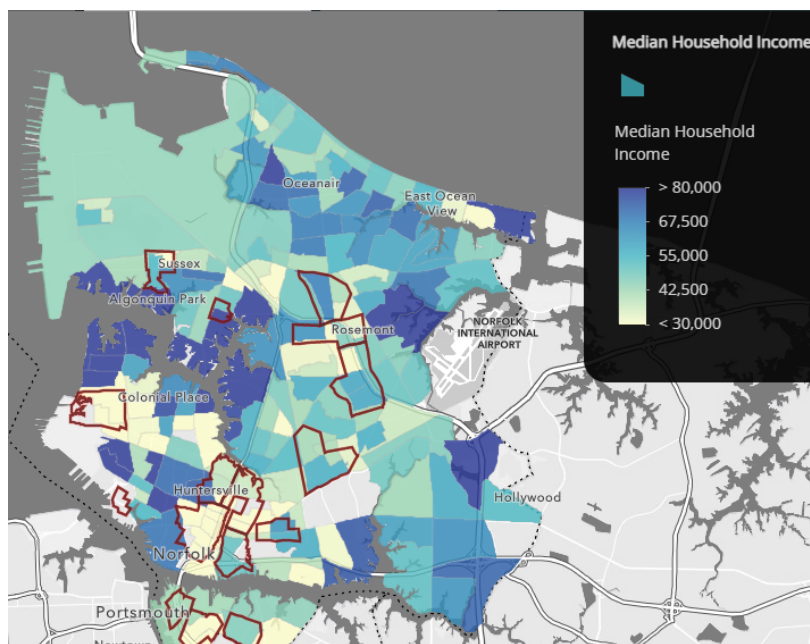
- The effects of these policies can still be seen today as those that were affected lacked the ability to transfer wealth from one generation to the next
- Figures 8.9–8.12 show that a large portion of the previously redlined areas of Norfolk, VA have largely of Black residents, have lower incomes and house values compared to the rest of the city, and those residents are less likely to have health insurance
- Figure 8.13 shows the differences in homeownership rates by race and ethnicity in 2020
- There is a large difference in the White homeownership rate compared to Black, Hispanic, and Native American homeownership rates
- Figure 8.14 shows median household income by race and ethnicity in 2019
- There also is a large difference in incomes between White households compared to Black, Hispanic, and Native American households
  - Quality of education likely is a factor in these differences
  - Because property taxes fund local governments, this impacts school budgets
  - The neighborhood people live in determines the school they go to and school funding will be affected by property taxes, which will vary by race due to lower homeownership rates and lower house values
  - Predominately White school districts have on average \$2,226 more per student than predominately Black school districts (Lombardo, 2019)
  - The neighborhood children grow up in has significant effects on the long-term outcomes of children (Chetty et al., 2020)
  - Differences in SAT scores between Black and White students can be directly attributed to poorer-quality schools and home/neighborhood characteristics (housing segregation, incarceration rates, etc.) (Card and Rothstein, 2007; Rothwell, 2012)
- Figure 8.15 shows Median household wealth by race and ethnicity in 2019
- There is a \$153,400 difference in median wealth between White and Black households
  - Due to discriminatory housing policies, Black households have lower homeownership rates
  - For most households, the home is the largest component of wealth
  - Lower homeownership rates directly lead to lower levels of wealth for Black households and because of historical discrimination, inhibited the ability to pass wealth from one generation to the next

Figure 8.9: Percent Black in Norfolk, VA, 2018



Source: [Murphy and Gregory \(2021\)](#)

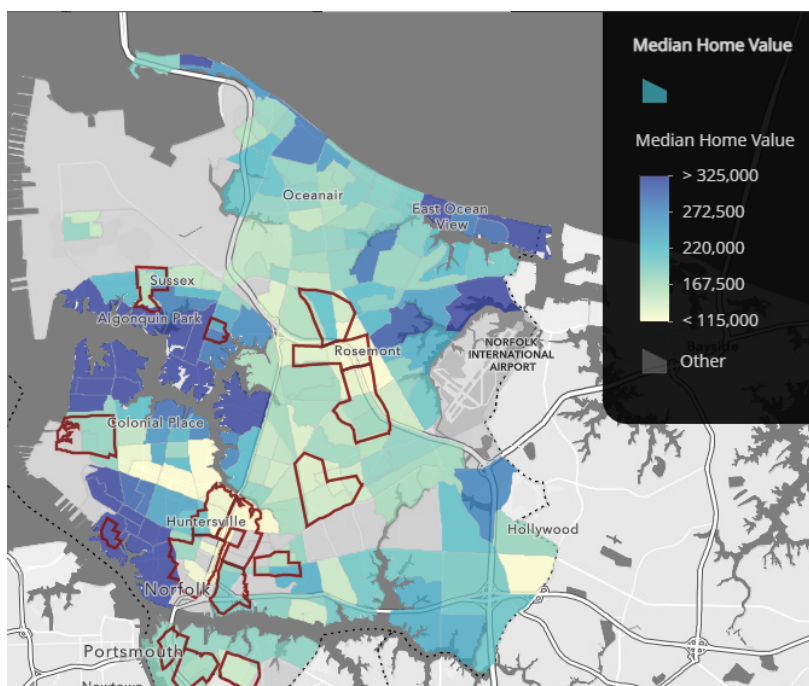
Figure 8.10: Income in Norfolk, VA, 2018



Source: [Murphy and Gregory \(2021\)](#)

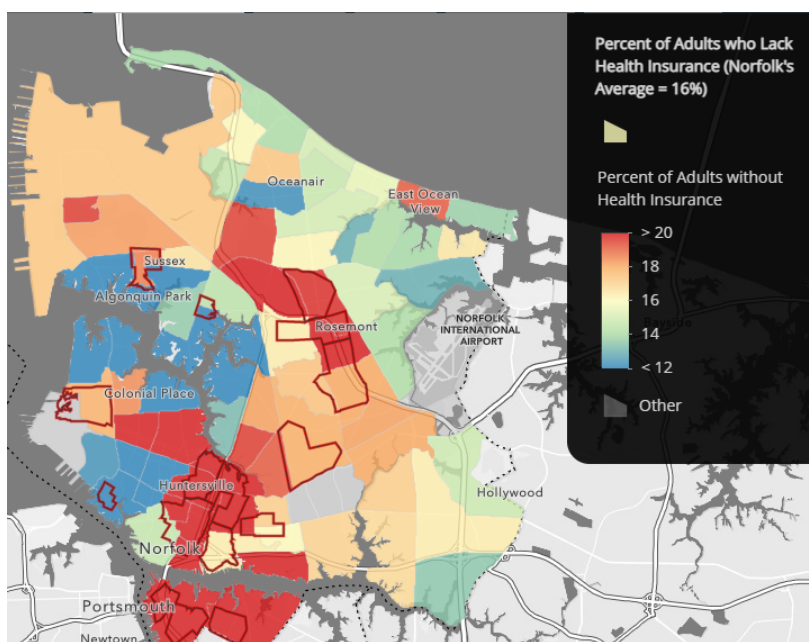


Figure 8.11: House Values in Norfolk, VA, 2018



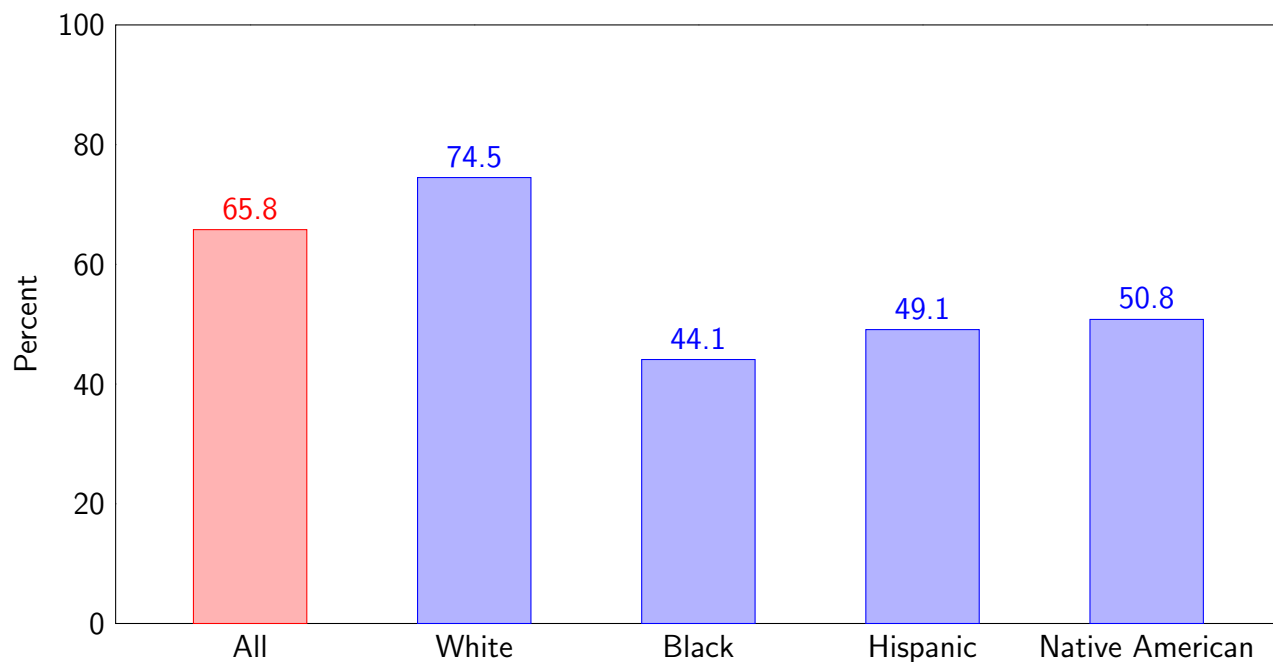
Source: [Murphy and Gregory \(2021\)](#)

Figure 8.12: Percent without Health Insurance, Norfolk, VA, 2018



Source: [Murphy and Gregory \(2021\)](#)

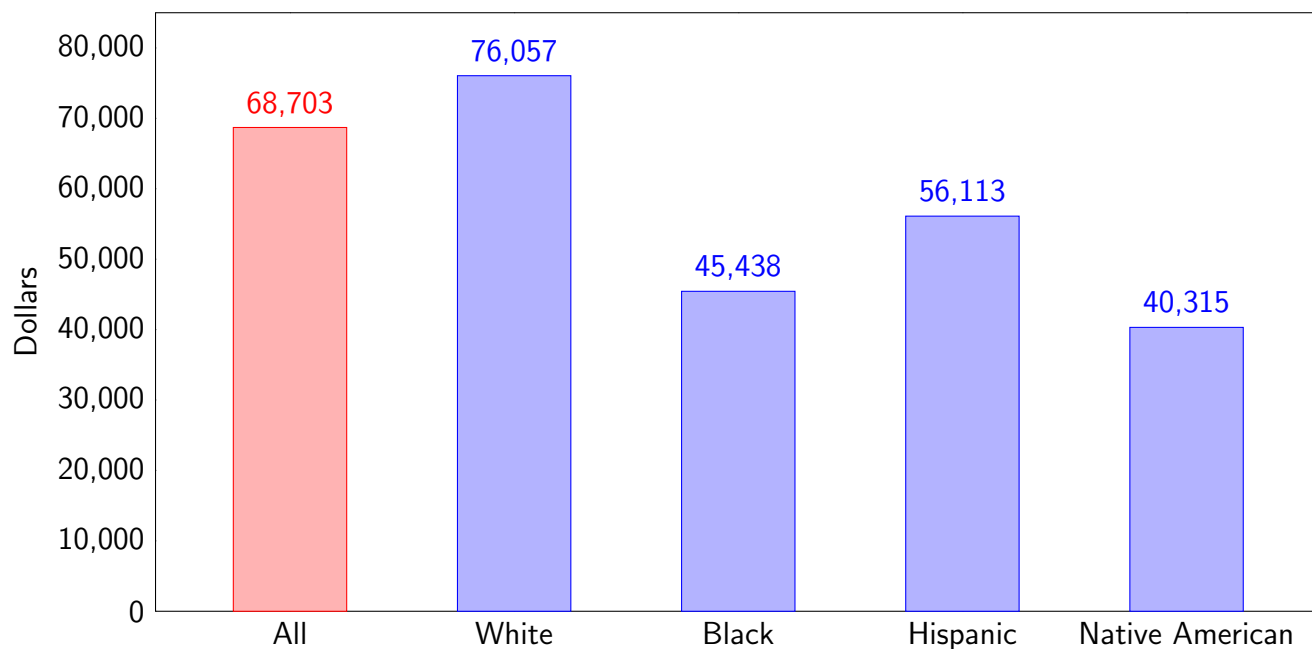
Figure 8.13: Homeownership Rates by Race and Ethnicity, 2020



**Source:** U.S. Census Bureau,

**Note:** Homeownership rate for Native Americans is from 2019

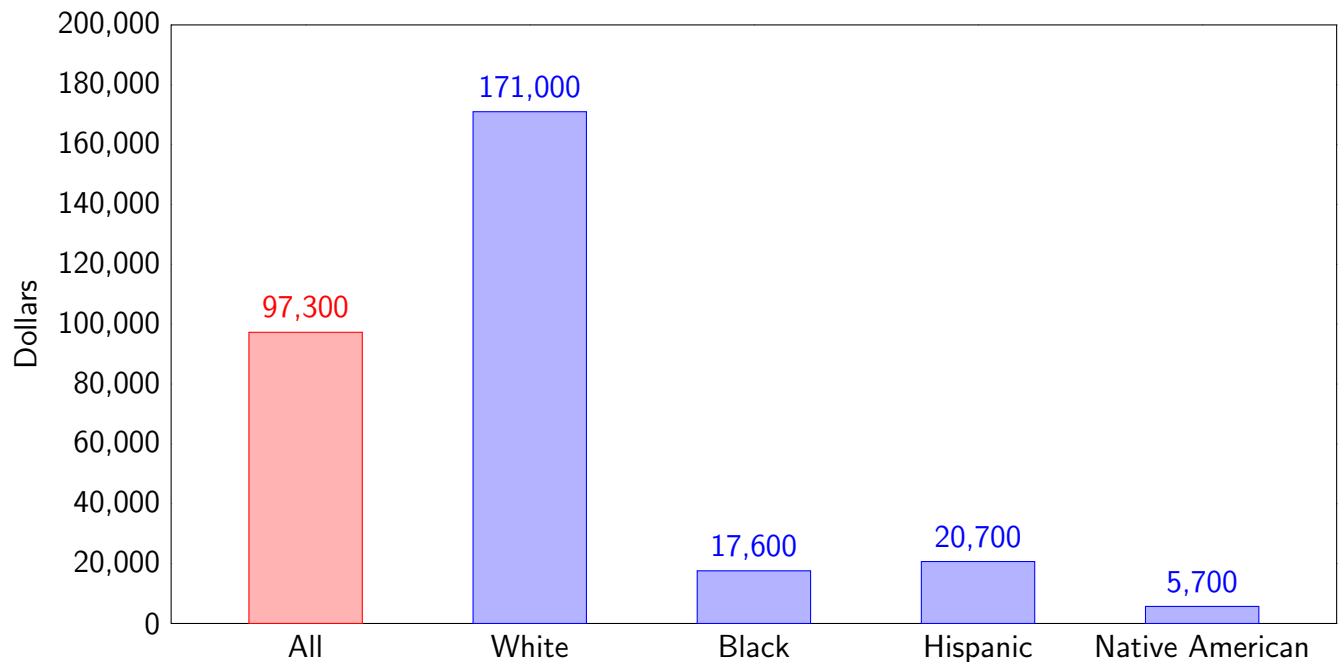
Figure 8.14: Median Household Income in the United States, 2019



**Source:** U.S. Census Bureau, National Congress of American Indians.

**Note:** Income for Native Americans is from 2017.

Figure 8.15: Median Household Wealth in the United States, 2019



**Source:** Federal Reserve, Nonviolence Institute

**Note:** The last time Native American wealth was measured was in 2000

## 8.6 Modern Housing Discrimination

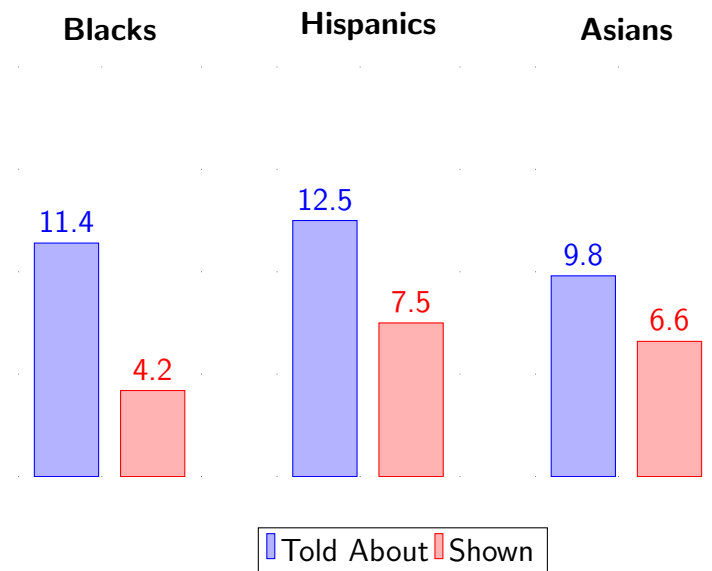
### 8.6.1 Exclusionary Zoning

- Exclusionary zoning is the use of zoning ordinances to exclude certain types of land users from a given community, especially to regulate racial and economic diversity
- We have discussed the effects of past how housing discrimination segregated neighborhoods by race, and those neighborhoods have lower incomes and house values
- Current zoning laws proliferated that have entrenched de facto discrimination
- Instead of explicitly barring people due to their race, these laws include minimum lot size requirements, minimum square footage requirements, prohibitions on multi-family homes, and limits on the height of buildings, which effectively ban more affordable dwellings
- Local governments have also weaponized seemingly neutral regulations that make the cost of development so exorbitant that the only profitable type of homes to build are large or luxury units
  - Zoning regulation increases house prices, reduces construction, and reduces the elasticity of housing supply ([Gyourko and Molloy, 2015](#); [Glaeser and Gyourko, 2002](#))
- Exclusionary zoning rules drive up housing prices, poorer families are kept out of wealthier, high-opportunity neighborhoods

## 8.6.2 Real Estate Agents

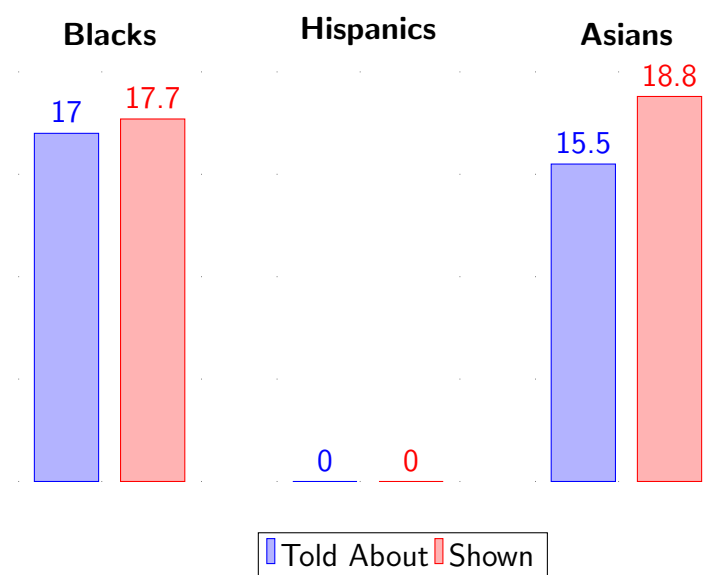
- Minority home seekers are told about and shown fewer housing units compared to white home seekers

Figure 8.16: Minority Homeseekers Compared to White Homeseekers, for Renters



Source: Turner et al. (2014)

Figure 8.17: Minority Homeseekers Compared to White Homeseekers, for Buying



Source: Turner et al. (2014)

### 8.6.3 Credit Cards

- **Cohen-Cole (2011)** shows that credit card issuers systematically gave residents of Black neighborhoods lower credit limits than they gave to individuals with similar financial credentials living in similar, but non-Black, neighborhoods
- White credit card applicants are more likely to receive a credit card offer and be offered favorable terms (**Han, Keys and Li, 2015**; **Firestone, 2014**)

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# Appendix A

- Linear regression is one of the most commonly used statistical tools used in economics
- A regression allows researchers to estimate the impact of some variable,  $x$ , on an outcome,  $y$ , while holding other factors constant (i.e., treating them as if they do not change)
- Typically, a research question is framed as: “I want to know the impact of  $x$  on  $y$ , or, how does  $y$  change as  $x$  changes”

## A.1 Simple Linear Regression

- In the most basic case, a regression takes the following form:

$$y_i = \beta_0 + \beta_1 x_i + \varepsilon_i$$

- The regression equation models the relationship between  $x$  and  $y$  for the population
- $i$  denotes the unit of observation
  - This could be an individual, a house, a city, a state, a country, a school, etc.
- For every research question, there are other factors besides  $x$  that influence  $y$ , sometimes these factors are unobservable to researchers
  - The impact of these factors on  $y$  is captured in what is called the error term, which is represented by  $\varepsilon_i$
  - $\varepsilon_i$  can be thought of as the “margin of error” or, the variation in  $y$  that  $x$  does not explain
  - For a regression model to generate unbiased results, it is assumed that, on average,  $E(\varepsilon_i) = 0$
- If we were to graph the data with  $y$  on the vertical axis and  $x$  on the horizontal axis, linear regression estimates the linear relationship between  $x$  and  $y$  generating a trend line for the data
- The slope of the line can be interpreted as follows: Holding everything else constant, for a given population, for each 1 unit change in  $x$ , there is a  $\beta_1$  unit change in  $y$ 
  - Alternatively,  $\beta_1$  can be interpreted as the derivative of  $y$  with respect to  $x$ , so  $\beta_1 = \frac{dy_i}{dx_i}$

- However, we usually do not have data for the entire population, so we will have a data set that is a sample of  $i = 1, 2, 3, \dots, N$  units of observation from a larger population
- Linear regression generates an estimate for  $\beta_0$  and  $\beta_1$  using the sample of  $N$  units
- The estimated values are represented with a “hat”,  $\hat{\beta}_0$  and  $\hat{\beta}_1$
- The values of  $\hat{\beta}_0$  and  $\hat{\beta}_1$  are calculated by drawing a line that has the smallest vertical distance away from each point on the graph

### Example

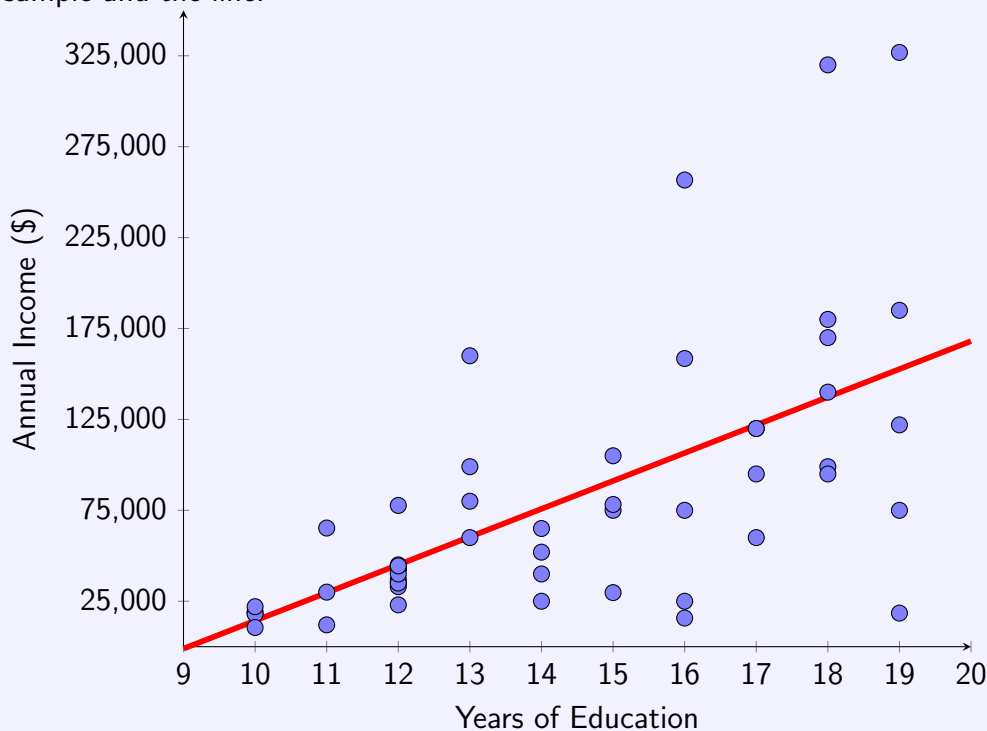
Suppose our research question is as follows: what is the impact of years of education on income?

The regression equation for this research question would look as follows:

$$Income_i = \beta_0 + \beta_1 YearsOfEducation_i + \varepsilon_i$$

For this question, the unit of observation,  $i$ , is the individual. So you collect data from 50 people on the number of years they went to school and their annual income. Since there are 50 individuals, our sample size,  $N = 50$ .

The data that you collected is a sample of the population. By plotting the sample data with income on the vertical axis and years of education on the horizontal axis, the regression will estimate a “line of best fit” that minimizes the vertical distance between each point of the sample and the line:



- The equation for the above regression line is  $Income_i = -139,464 + 15,376 YearsOfEducation_i$



- $\hat{\beta}_0$  is the estimated y-intercept. In this example,  $\hat{\beta}_0 = -139,464$
- $\hat{\beta}_1$  is the estimated slope of the regression line. In this example,  $\hat{\beta}_1 = 15,376$ 
  - Alternatively, if we think about this in terms of the derivative, then
 
$$\hat{\beta}_1 = \frac{dIncome_i}{dYearsOfEducation_i} = 15,376$$
- We can interpret  $\hat{\beta}_1$  as follows: if we hold everything else constant, for every 1 additional year of education, there is a \$15,376 increase in annual income

## A.2 Multiple Linear Regression

- Generally there is more than one variable that influences changes in  $y$
- Using the previous example, while years of education effects income, so does ability, years of experience, where you live, the type of job you have, and other factors
- Because of this, we can extend the simple linear regression model to include multiple variables
  - Recall that anything that effects the outcome,  $y$ , that is not included in the regression model is assumed to be in the error term,  $\varepsilon_i$
  - Since we assume that on average,  $E(\varepsilon_i) = 0$ , then we must include all variables that we can observe that effect the outcome,  $y$ , in our regression model, otherwise the results of the model will be biased
- A multiple regression model takes the following form:

$$y_i = \beta_0 + \beta_1 x_i + \beta_2 z_i + \beta_3 m_i + \varepsilon_i$$

- Linear regression will generate estimated values for  $\hat{\beta}_0$ ,  $\hat{\beta}_1$ ,  $\hat{\beta}_2$ , and  $\hat{\beta}_3$
- $\hat{\beta}_0$  is still called the intercept term
- $\hat{\beta}_1 = \frac{\partial y_i}{\partial x_i}$  and can be interpreted as holding everything else constant, a 1 unit increase in  $x$ , leads to  $\hat{\beta}_1$  unit increase in  $y$
- $\hat{\beta}_2 = \frac{\partial y_i}{\partial z_i}$  and can be interpreted as holding everything else constant, a 1 unit increase in  $z$ , leads to  $\hat{\beta}_2$  unit increase in  $y$
- $\hat{\beta}_3 = \frac{\partial y_i}{\partial m_i}$  and can be interpreted as holding everything else constant, a 1 unit increase in  $m$ , leads to  $\hat{\beta}_3$  unit increase in  $y$

### A.3 Testing Significance of Estimated Results

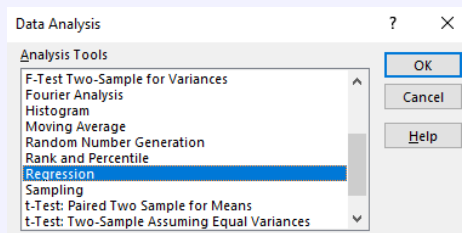
- Because linear regression is estimating the effect of  $x$  on  $y$  using a sample of data generated from the whole population, we need to be confident that we can trust the result of the estimation
- For each coefficient estimate, linear regression also estimates a standard error
- The standard error of the coefficient tells us how precise our estimate is
- The smaller the standard error, the more precise our estimate is
- We can use the standard error to conduct a hypothesis test to determine if our estimated coefficient is statistically significant or not
  - In order to be statistically significant, we want to know if there is enough evidence from our model and data to suggest that the individual regression estimate is statistically different from zero
- To determine if an individual regression estimate is significant, we use the t-test
  - For the t-test, our null hypothesis is,  $H_0 : \hat{\beta}_i = 0$  and the alternative hypothesis is,  $H_1 : \hat{\beta}_i \neq 0$
- We can calculate the t-statistic using the following equation:  $t = \frac{\hat{\beta}_i}{\text{Standard Error}}$
- As a rule of thumb, if the t-statistic  $> 1.96$ , then we can reject the null hypothesis and say that  $\hat{\beta}_i \neq 0$ 
  - This means that the regression estimate is significant at the 95% confidence level
- Alternatively, we can use the t-statistic to generate a p-value
- If the p-value for a given estimate is less than 0.05, then we can say that the estimated value,  $\hat{\beta}_i$  is statistically significant

### A.4 Software to Conduct Regression Estimations

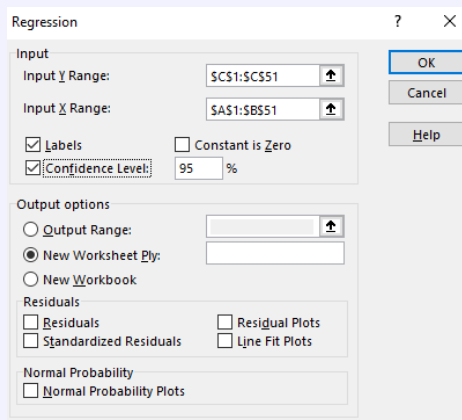
- Regression estimates, standard errors, t-statistics, and p-values are estimated using statistics software
- Some of the most popular software that can estimate regressions are Microsoft Excel, Stata, and R
- Each software will generate regression output in a slightly different format
- While Microsoft Excel can do basic regression analysis, it is recommended using more advanced statistical software such as Stata or R

**Regression in Microsoft Excel**

- **Step 1:** Under the Data tab, select Data Analysis (if you do not see the Data Analysis button, you need to enable the Analysis ToolPak found under File→Options)
- **Step 2:** Select Regression



- **Step 3:** Select your the range of cells for the y variable and select the range(s) of cells for any x variables



- **Step 3:** The regression output will be generated on a new worksheet

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.607622939
R Square	0.369205636
Adjusted R Square	0.342363322
Standard Error	59363.34025
Observations	50

ANOVA					
	df	SS	MS	F	Significance F
Regression	2	96942682839	4.85E+10	13.75461311	1.98319E-05
Residual	47	1.65628E+11	3.52E+09		
Total	49	2.62571E+11			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-145137.0126	46717.73973	-3.10668	0.003205297	-239120.9823	-51153.043	-239120.9823	-51153.04286
Years of Experience	302.1458958	927.4623284	0.325777	0.746039113	-1563.667645	2167.95944	-1563.667645	2167.959437
Years of Education	15421.42498	2940.558823	5.244386	3.66488E-06	9505.783658	21337.0663	9505.783658	21337.06629

## Regression in R

To estimate linear regression in R, it is best practice to use the `feols` command.

In order to use this command, you will need to load the `fixest` library. You can install the `fixest` library using the following command: `install.packages("\fixest")`.

```

1 # Install the fixest package, you only need to do this once
2 install.packages("fixest")
3
4 # Load the fixest library
5 library(fixest)
6
7 # FEOLS command syntax: feols(y ~ x1 + x2 + ... + xN, data=FileName)
8 feols(Income ~ Education + Experience, data=income)

```

The regression output will be displayed as follows:

```

1 OLS estimation, Dep. Var.: Income
2 Observations: 50
3 Standard-errors: IID
4           Estimate Std. Error   t value   Pr(>t)
5 (Intercept) -145137.013  46717.740 -3.106679 3.2053e-03 **
6 Education    15421.425   2940.559  5.244386 3.6649e-06 ***
7 Experience     302.146    927.462  0.325777 7.4604e-01
8 ---
9 Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
10 RMSE: 57,554.9   Adj. R2: 0.342363

```

## Regression in Stata

To estimate the linear regression in Stata, use the `regress` command. The first variable is your  $y$  variable, followed by any  $x$  variables

```
1 * Regression command syntax: reg y x1 x2 ... xN
2 reg Income Education Experience
```

The regression output will be displayed as follows:

```
1      Source |      SS      df      MS      Number of obs      =      50
2      -----+-----
3      Model | 9.6943e+10      2  4.8471e+10      F(2, 47)      =      13.75
4      Residual | 1.6563e+11      47  3.5240e+09      Prob > F      =      0.0000
5      -----+-----
6      Total | 2.6257e+11      49  5.3586e+09      R-squared      =      0.3692
7
8
9      Income | Coefficient  Std. err.      t      P>|t|      [95% conf. interval]
10     -----+-----
11     Education | 15421.42    2940.559      5.24    0.000      9505.784    21337.07
12     Experience | 302.1459    927.4623      0.33    0.746     -1563.668    2167.959
13     _cons | -145137     46717.74     -3.11    0.003     -239121    -51153.04
14     -----+-----
```