Econ 302: Lecture 1

Hisam Sabouni

9/10/2018

Overview

In this course we will build a strong foundation in macroeconomics. The course introduces core concepts in macroeconmics through the general equilbirium framework. We will use microeconomic foundations to model the interactions between firms, consumers, and governments to gain insight into the macroeconomy. While covering theoretical models we will take an applied approach to test our models.

More percisely, the aim of this class is to equip you with a set of tools to analyze macroeconomic movements in the long and short-run. We will use macroeconomic data on incomes, prices, unemployment, interest rates, etc. to help model various pieces of the economy. We will begin by analyzing clasical theory in macroeconomics, to model long-run dynamics, then proceed to analyze new Keynesian models, to model short-run dyanmics. We will conclude by putting everything together and building models that capture both short and long-run dynamics.

Tools

We will rely on the R programming language to build our models and analyze economic data. R can be downloaded at the following URL: https://cran.r-project.org/. In addition to R, we will be using the R studio integrated development enviornment (IDE), which allows us to create smart documents and program in a better enviornment that R provides. R studio can be downloaded for free at the following URL: https://www.rstudio.com/products/rstudio/download/. One of the great features of R is that we can easily load in data from pretty much anywhere really quickly. Furthermore, R is an open-source programming language where developers from all over the world contribute to the create of packages (https://cran.r-project.org/web/packages/available_packages_by_name.html). A package we will quite often rely upon is quantmod, which will allow us to pull data from FRED directly into R.

Why do we care?

Macroeconomics helps us think about why some countries have higher standards of living (in terms of money, mortality rates, education, etc.) compared to others. Marcoeconomics merges aspects of all fields in economics together to shed light into the future prospects of a country. Furthermore, macroeconoimcs has endless real world applicability that directly influences the lives of people around the world, Robert Lucas summarized this nicely by stating:

"Is there some action a government in India could take that would lead the Indian economy to grow like Indonesia's or Egypts? If so, what, exactly? If not, what is it about the"nature of India" that makes it so? The consequences for human welfare involved in questions like these are simply staggering: Once one starts to think about them, it is hard to think about anything else."

Open any respectable news outlet today and you will see a variety of headlines covering topics such as tariffs, exchange rates, interest rates, inflation rates, etc. Throughout this class we will try to equip you with tools to understand these topics.

Data

In macroeconomics, we rely heavily on a variety of data sources for our analysis. We will pull most of our data from the Federal Reserve Bank of St. Louis's website (FRED) https://fred.stlouisfed.org/ and from the World Bank's website https://data.worldbank.org/. A few of the variables of interest to us are:

- Inflation Rate: Measures how fast prices are rising by tracking the prices of a *fixed* basket of goods and services over time. FRED Code: Consumer Price Index: Total All Items for the United States (CPALTT01USQ657N)

```
#install.packages('quantmod')
library(quantmod)
```

```
## Loading required package: xts
```

```
## Loading required package: zoo
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
## Loading required package: TTR
```

```
## Version 0.4-0 included new data defaults. See ?getSymbols.
```

```
#?getSymbols
getSymbols('CPALTT01USQ657N',src = 'FRED')
```

```
## 'getSymbols' currently uses auto.assign=TRUE by default, but will
## use auto.assign=FALSE in 0.5-0. You will still be able to use
## 'loadSymbols' to automatically load data. getOption("getSymbols.env")
## and getOption("getSymbols.auto.assign") will still be checked for
## alternate defaults.
##
## This message is shown once per session and may be disabled by setting
## options("getSymbols.warning4.0"=FALSE). See ?getSymbols for details.
```

```
## Warning in strptime(xx, f <- "%Y-%m-%d", tz = "GMT"): unknown timezone
## 'zone/tz/2018e.1.0/zoneinfo/America/Los_Angeles'
```

```
## [1] "CPALTT01USQ657N"
```

```
cpi.changes <- CPALTT01USQ657N
head(cpi.changes)
```

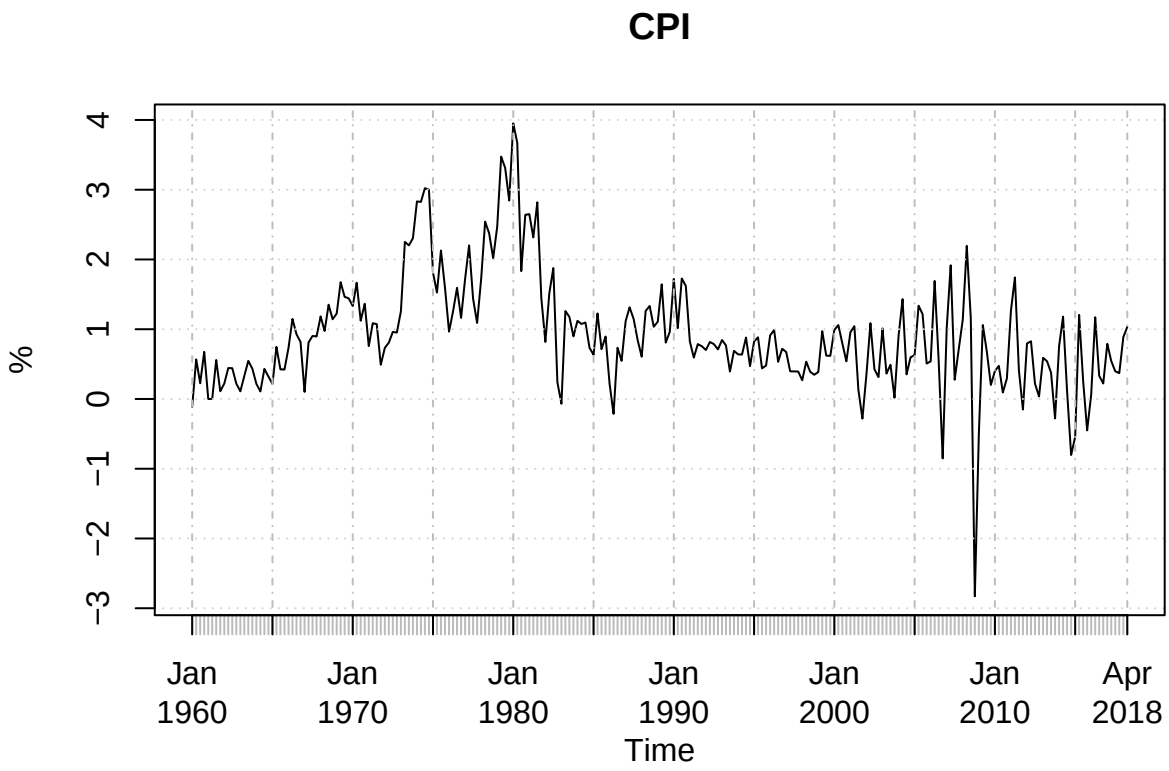
```
##            CPALTT01USQ657N
## 1960-01-01      -0.1133787
## 1960-04-01       0.5675369
## 1960-07-01       0.2257336
## 1960-10-01       0.6756757
## 1961-01-01       0.0000000
## 1961-04-01       0.0000000
```

```
summary(cpi.changes)
```

```
##      Index            CPALTT01USQ657N
##  Min.   :1960-01-01   Min.   :-2.8285
##  1st Qu.:1974-07-24   1st Qu.: 0.4244
```

```
##  Median :1989-02-15   Median : 0.8092
##  Mean   :1989-02-14   Mean   : 0.9246
##  3rd Qu.:2003-09-08   3rd Qu.: 1.2223
##  Max.   :2018-04-01   Max.   : 3.9508
```

```
plot(cpi.changes,main='CPI',ylab='%',xlab='Time')
```



- Unemployment Rate: Measures the fraction of the labor force that is out of work. FRED Code: Civilian Unemployment Rate (UNRATE)

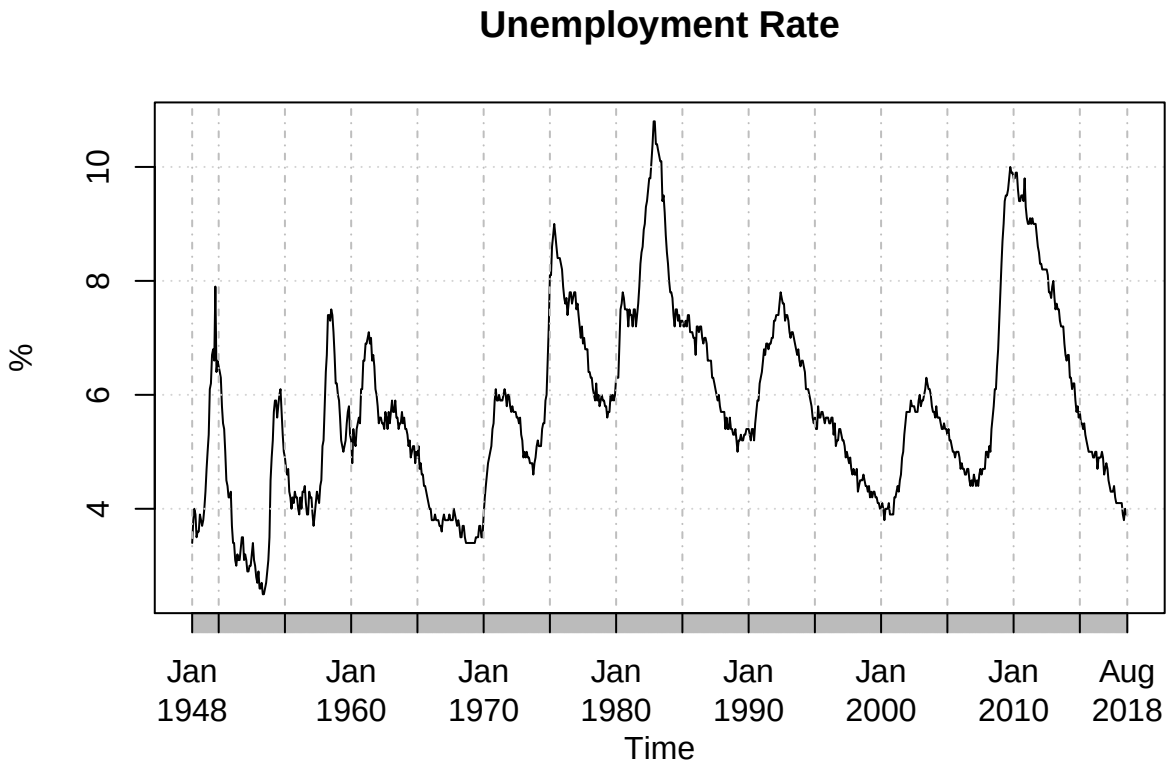
```
getSymbols('UNRATE',src = 'FRED')
```

```
## [1] "UNRATE"
```

```
summary(UNRATE)
```

```
##       Index               UNRATE
##  Min.   :1948-01-01   Min.   : 2.500
##  1st Qu.:1965-08-24   1st Qu.: 4.600
##  Median :1983-04-16   Median : 5.600
##  Mean   :1983-04-16   Mean   : 5.773
##  3rd Qu.:2000-12-08   3rd Qu.: 6.800
##  Max.   :2018-08-01   Max.   :10.800
```

```
plot(UNRATE,main='Unemployment Rate',ylab='%',xlab='Time')
```



- Interest Rate: The market price at which resources are transferred between the present and the future; the return to savings and the cost of borrowing.
- Consumption (C): The goods and services bought by households. FRED Code: Personal Consumption Expenditures (PCEC):

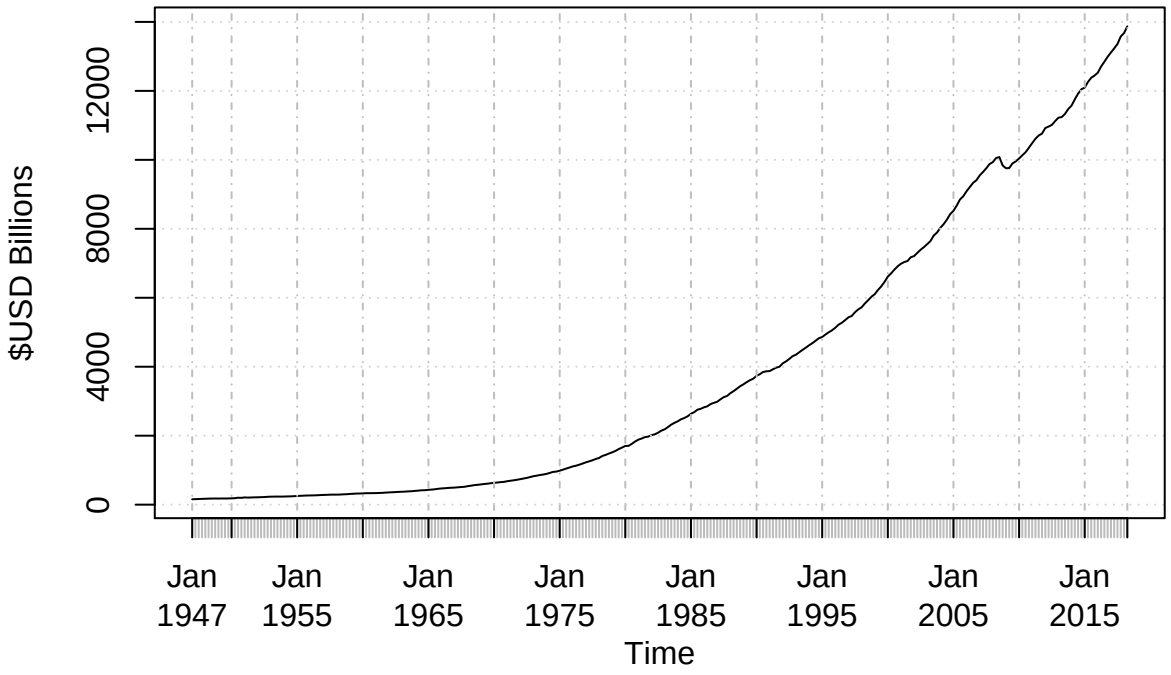
```
getSymbols('PCEC',src = 'FRED')
```

```
## [1] "PCEC"
```

```
summary(PCEC)
```

```
##       Index                 PCEC
##  Min.   :1947-01-01   Min.   :  156.2
##  1st Qu.:1964-10-24   1st Qu.:  421.7
##  Median :1982-08-16   Median : 2115.6
##  Mean   :1982-08-16   Mean   : 3885.7
##  3rd Qu.:2000-06-08   3rd Qu.: 6788.4
##  Max.   :2018-04-01   Max.   :13871.6
```

```
plot(PCEC,main='Personal Consumption Expenditures',ylab='$USD Billions',xlab='Time')
```



- Durable (lasts a long time). FRED Code: Personal Consumption Expenditures: Durable Goods (PCDG)

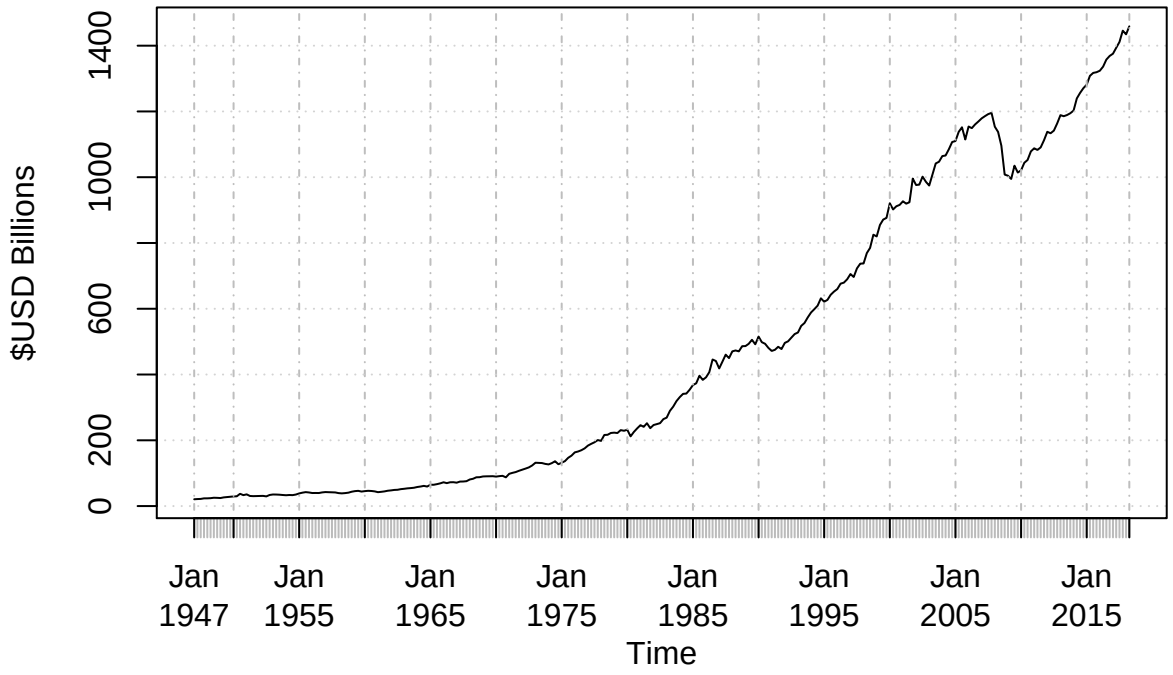
```
getSymbols('PCDG',src = 'FRED')
```

```
## [1] "PCDG"
```

```
summary(PCDG)
```

```
##       Index                PCDG
##  Min.   :1947-01-01   Min.   :  20.72
##  1st Qu.:1964-10-24   1st Qu.:  62.24
##  Median :1982-08-16   Median : 258.23
##  Mean   :1982-08-16   Mean   : 468.52
##  3rd Qu.:2000-06-08   3rd Qu.: 914.78
##  Max.   :2018-04-01   Max.   :1458.74
```

```
plot(PCDG,main='Personal Consumption Expenditures: Durable Goods',ylab='$USD Billions',xlab='Time')
```



- Non-durable (doesn't last a long time). FRED Code: Personal Consumption Expenditures: Nondurable Goods (PCND)

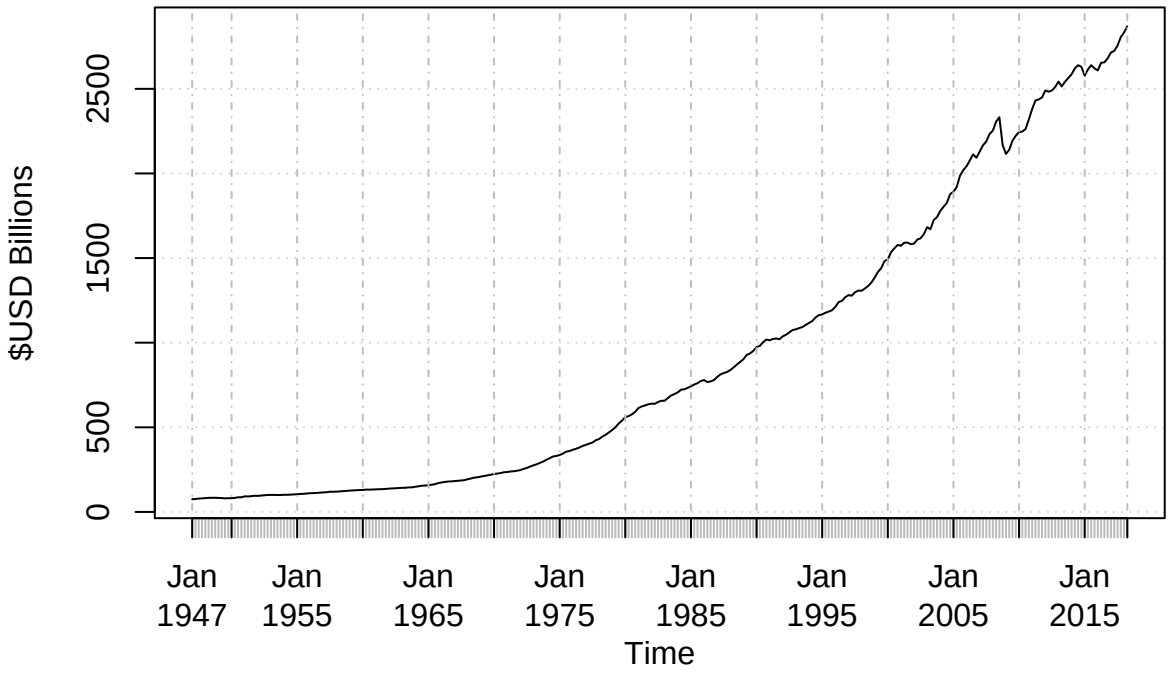
```
getSymbols('PCND',src = 'FRED')
```

```
## [1] "PCND"
```

```
summary(PCND)
```

```
##       Index                 PCND
##  Min.   :1947-01-01   Min.   :  74.87
##  1st Qu.:1964-10-24   1st Qu.: 156.29
##  Median :1982-08-16   Median : 653.23
##  Mean   :1982-08-16   Mean   : 926.29
##  3rd Qu.:2000-06-08   3rd Qu.:1551.90
##  Max.   :2018-04-01   Max.   :2869.07
```

```
plot(PCND,main='Personal Consumption Expenditures: Nondurable Goods',ylab='$USD Billions',xlab='Time')
```



- Services. FRED Code: Personal Consumption Expenditures: Services (PCESV)

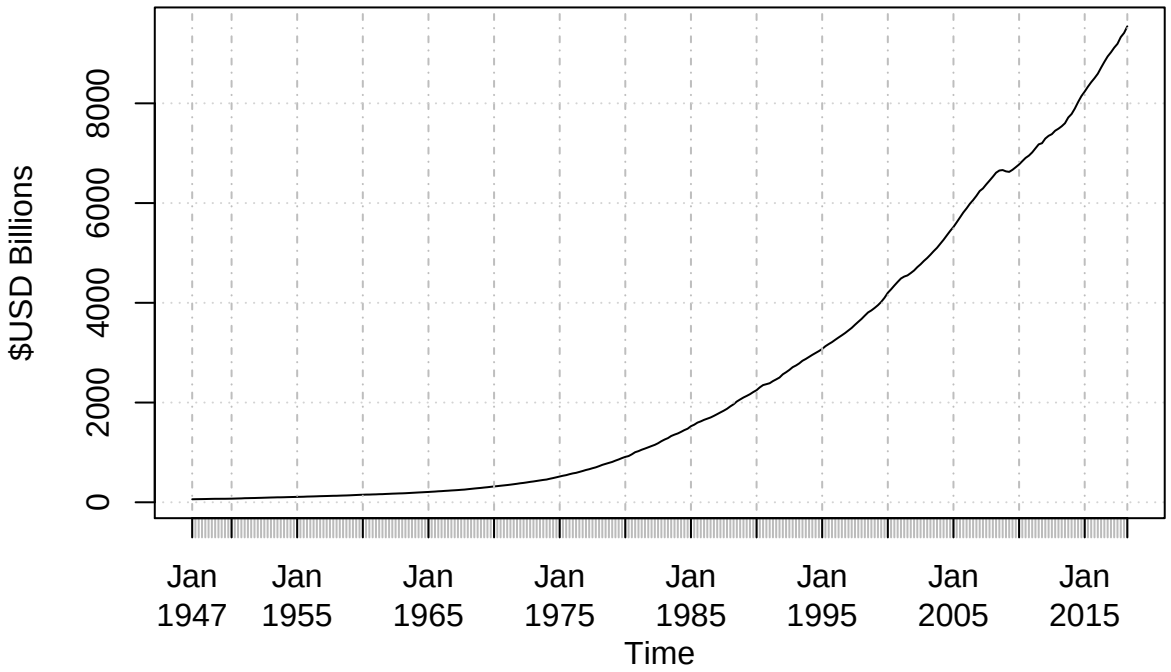
```
getSymbols('PCESV',src = 'FRED')
```

```
## [1] "PCESV"
```

```
summary(PCESV)
```

```
##       Index                PCESV
##  Min.   :1947-01-01   Min.   :  60.57
##  1st Qu.:1964-10-24   1st Qu.: 204.62
##  Median :1982-08-16   Median :1204.15
##  Mean   :1982-08-16   Mean   :2490.90
##  3rd Qu.:2000-06-08   3rd Qu.:4327.28
##  Max.   :2018-04-01   Max.   :9543.82
```

```
plot(PCESV,main='Personal Consumption Expenditures: Services',ylab='$USD Billions',xlab='Time')
```



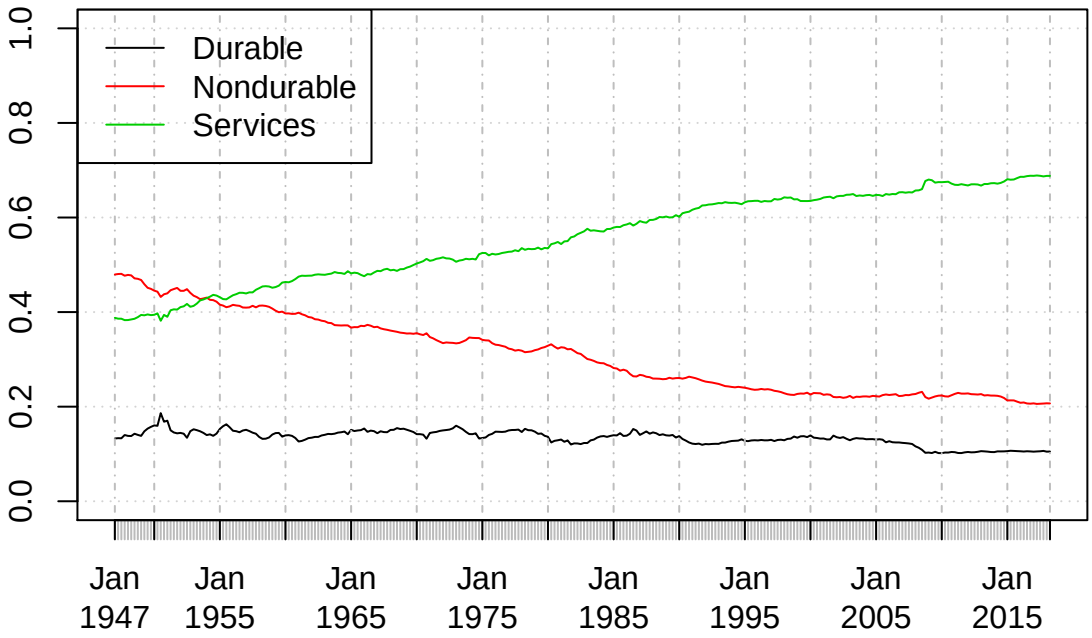

```
#How has the ratio of consumption between the three categories varied over time?
consumptionData <- merge(PCDG,PCND,PCESV,all = T)
head(consumptionData)
```

```
##              PCDG   PCND  PCESV
## 1947-01-01 20.722 74.872 60.567
## 1947-04-01 21.351 76.897 61.783
## 1947-07-01 21.770 78.649 63.124
## 1947-10-01 23.488 79.965 64.219
## 1948-01-01 23.547 81.546 65.279
## 1948-04-01 24.019 83.169 66.954
```

```
consumptionData <- na.omit(consumptionData)
consumptionData$totalConsumption <- apply(consumptionData,1,sum)
head(consumptionData)
```

```
##              PCDG   PCND  PCESV totalConsumption
## 1947-01-01 20.722 74.872 60.567          156.161
## 1947-04-01 21.351 76.897 61.783          160.031
## 1947-07-01 21.770 78.649 63.124          163.543
## 1947-10-01 23.488 79.965 64.219          167.672
## 1948-01-01 23.547 81.546 65.279          170.372
## 1948-04-01 24.019 83.169 66.954          174.142
```

```
consumptionData$fractionDurable <- consumptionData$PCDG/consumptionData$totalConsumption
consumptionData$fractionNondurable <- consumptionData$PCND/consumptionData$totalConsumption
consumptionData$fractionServices <- 1 - consumptionData$fractionDurable - consumptionData$fractionNondu
plot(consumptionData$fractionDurable,main='Consumption Composition',ylim=c(0,1))
lines(consumptionData$fractionNondurable,col = 2)
lines(consumptionData$fractionServices,col = 3)
legend('topleft',legend = c('Durable','Nondurable','Services'),col = 1:3,lty = 1)
```



- Investment (I): Goods bought for future use. Consists of three categories: business fixed investment (new plant and equipment), residential investment (housing), and inventory. FRED Code: Gross Private Domestic Investment (GPDI).

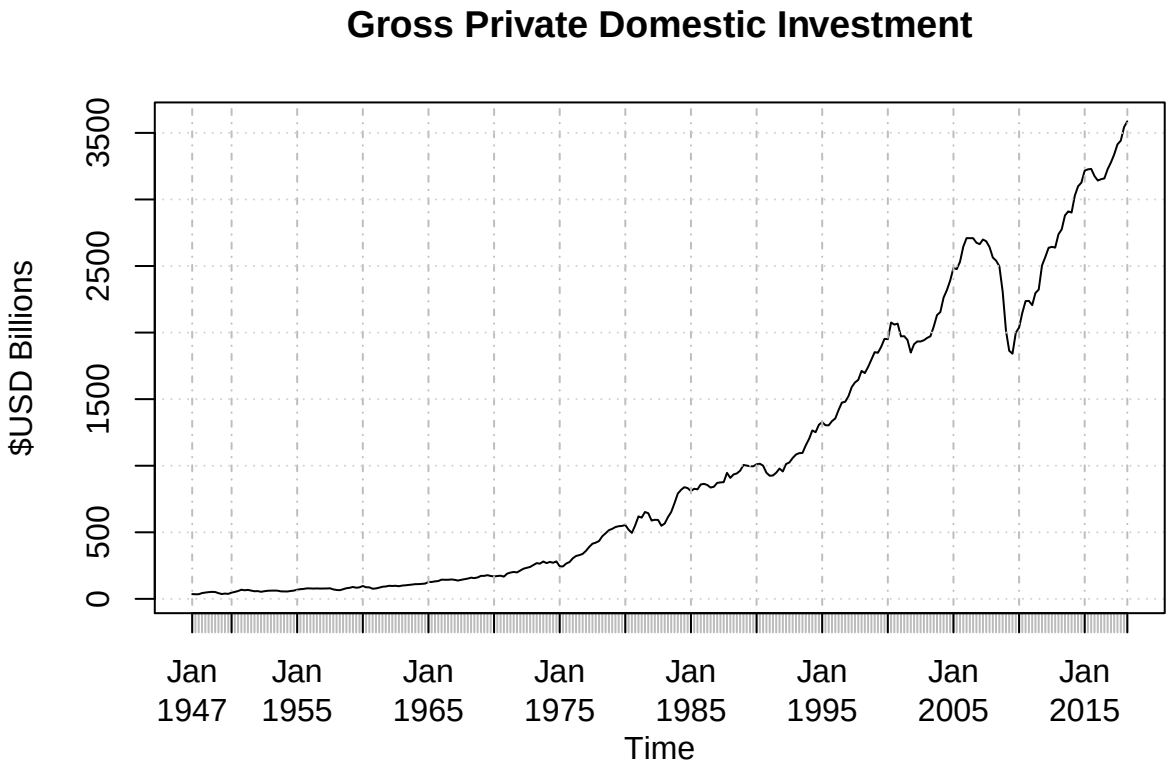
```
getSymbols('GPDI',src='FRED')
```

```
## [1] "GPDI"
```

```
summary(GPDI)
```

```
##       Index                GPDI
##  Min.   :1947-01-01   Min.   :  34.51
##  1st Qu.:1964-10-24   1st Qu.: 117.87
##  Median :1982-08-16   Median : 616.58
##  Mean   :1982-08-16   Mean   :1023.86
##  3rd Qu.:2000-06-08   3rd Qu.:1907.93
##  Max.   :2018-04-01   Max.   :3586.65
```

```
plot(GPDI,main='Gross Private Domestic Investment',ylab='$USD Billions',xlab='Time')
```



- Government Purchases (G): Goods and services bought by federal, state, and local governments. FRED Code: Government Consumption Expenditures and Gross Investment (GCE).

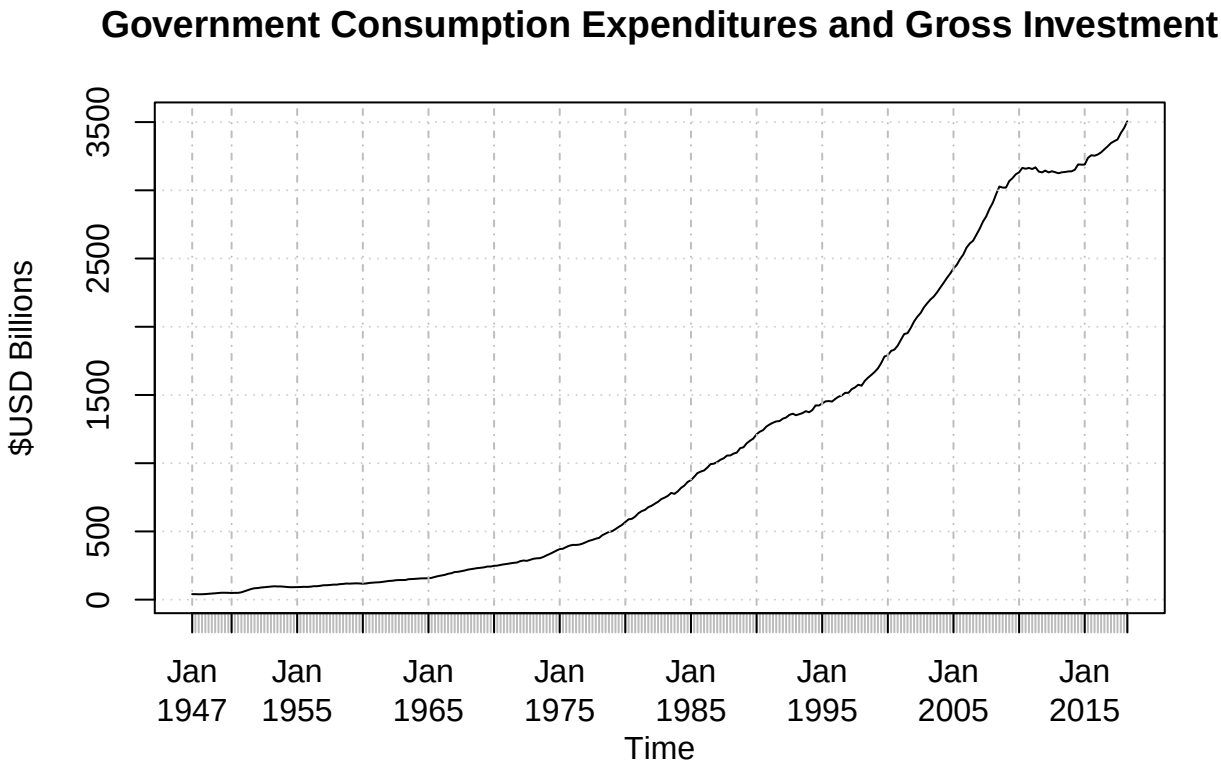
```
getSymbols('GCE',src='FRED')
```

```
## [1] "GCE"
```

```
summary(GCE)
```

```
##       Index                 GCE        
##  Min.   :1947-01-01   Min.   :  39.36  
##  1st Qu.:1964-10-24   1st Qu.: 156.37  
##  Median :1982-08-16   Median : 727.35  
##  Mean   :1982-08-16   Mean   :1137.95  
##  3rd Qu.:2000-06-08   3rd Qu.:1830.03  
##  Max.   :2018-04-01   Max.   :3505.45
```

```
plot(GCE,main='Government Consumption Expenditures and Gross Investment',ylab='$USD Billions',xlab='Tim
```



- Net Exports (NX): The difference between the value of goods and services sold to all other countries and the value of goods and services bought from all other countries (Exports - Imports). FRED Code: Net Exports of Goods and Services (NETEXP)

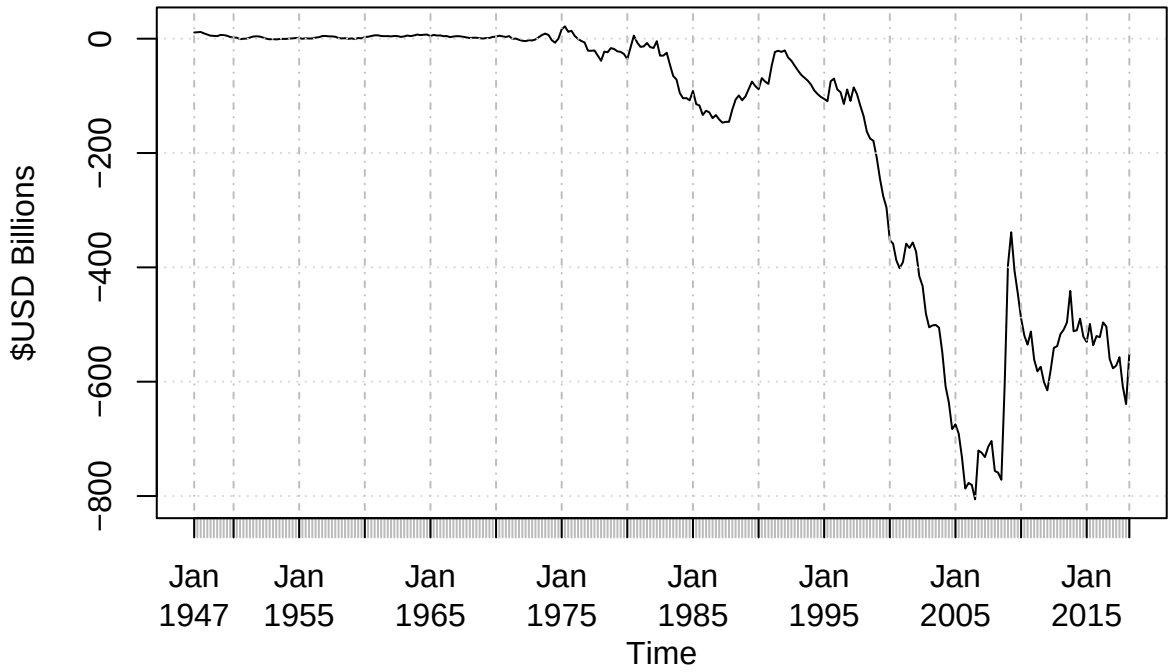
```
getSymbols('NETEXP',src='FRED')
```

```
## [1] "NETEXP"
```

```
summary(NETEXP)
```

```
##       Index                NETEXP
##  Min.   :1947-01-01   Min.   :-805.630
##  1st Qu.:1964-10-24   1st Qu.:-355.357
##  Median :1982-08-16   Median : -25.675
##  Mean   :1982-08-16   Mean   :-167.410
##  3rd Qu.:2000-06-08   3rd Qu.:   1.935
##  Max.   :2018-04-01   Max.   :  21.582
```

```
plot(NETEXP,main='Net Exports of Goods and Services',ylab='$USD Billions',xlab='Time')
```



- Nominal Gross Domestic Product (GDP): Measures the total income of everyone in the economy. FRED Code: Gross Domestic Product (GDP)

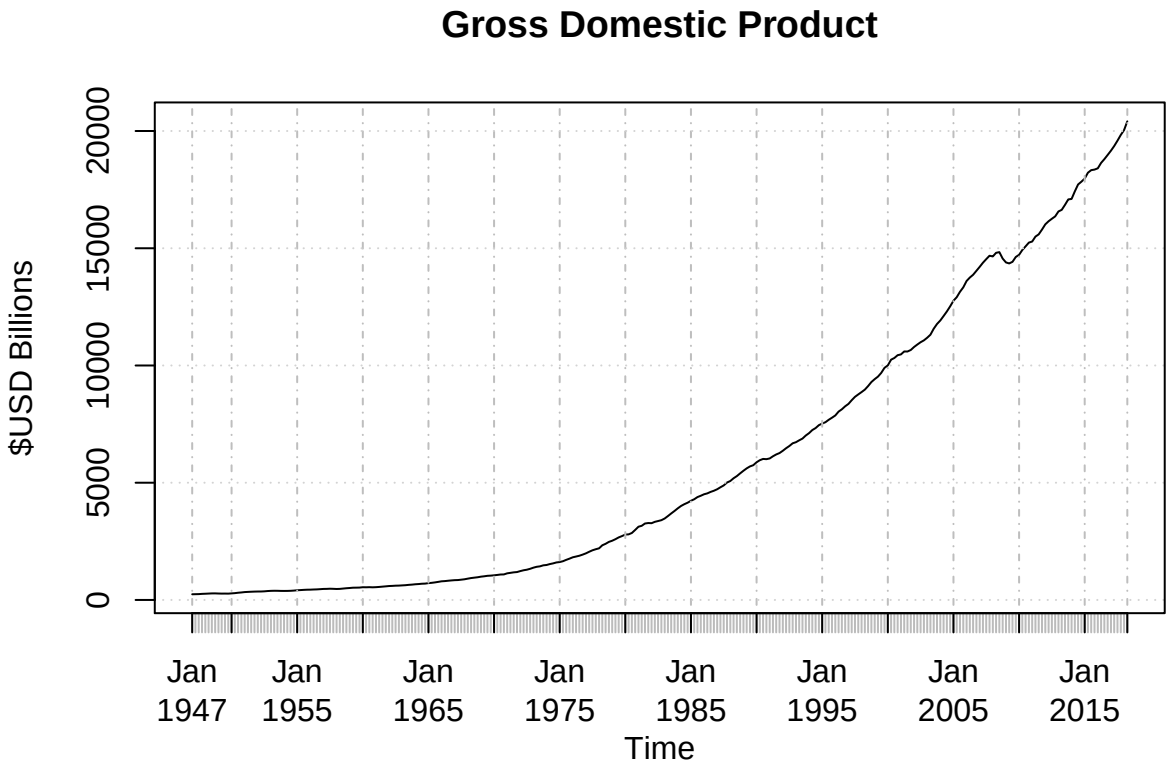
```
getSymbols('GDP',src='FRED')
```

```
## [1] "GDP"
```

```
summary(GDP)
```

```
##       Index                 GDP
##  Min.   :1947-01-01   Min.   :  243.2
##  1st Qu.:1964-10-24   1st Qu.:  702.4
##  Median :1982-08-16   Median : 3384.4
##  Mean   :1982-08-16   Mean   : 5880.1
##  3rd Qu.:2000-06-08   3rd Qu.:10301.8
##  Max.   :2018-04-01   Max.   :20411.9
```

```
plot(GDP,main='Gross Domestic Product',ylab='$USD Billions',xlab='Time')
```



- Real GDP: Measures the total income of everyone in the economy (adjusted for the level of prices). FRED Code: Real Gross Domestic Product (GDPC1)

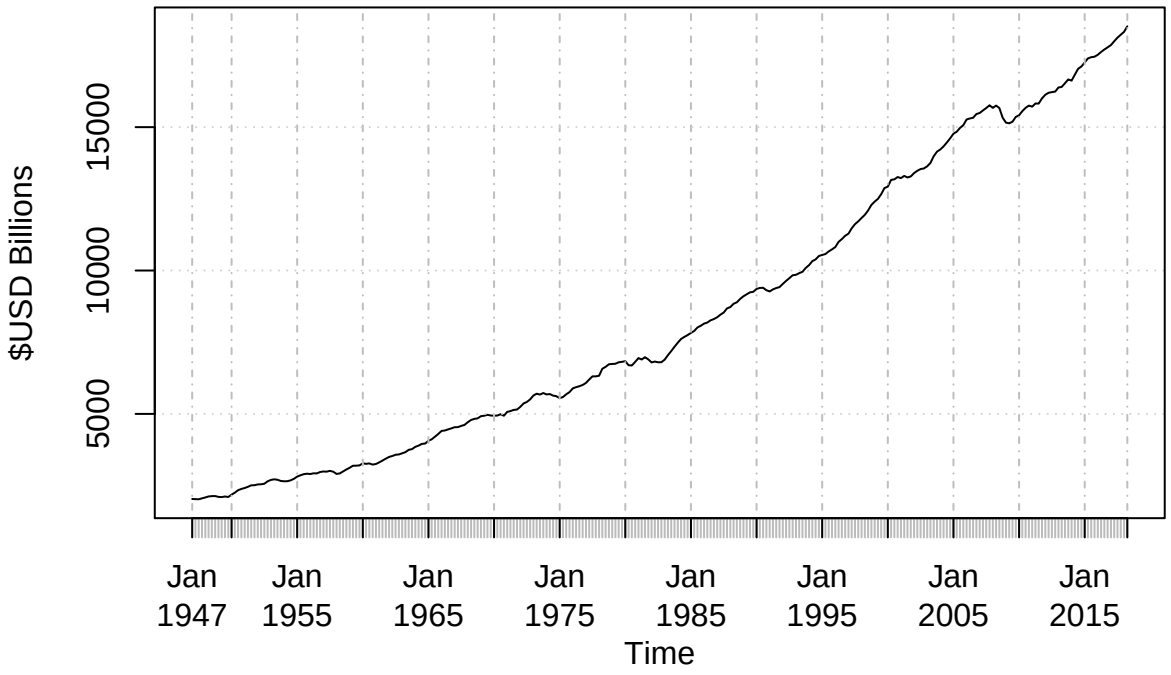
```
getSymbols('GDPC1',src='FRED')
```

```
## [1] "GDPC1"
```

```
summary(GDPC1)
```

```
##       Index                GDPC1
##  Min.   :1947-01-01   Min.   : 2023
##  1st Qu.:1964-10-24   1st Qu.: 3990
##  Median :1982-08-16   Median : 6925
##  Mean   :1982-08-16   Mean   : 8466
##  3rd Qu.:2000-06-08   3rd Qu.:13174
##  Max.   :2018-04-01   Max.   :18515
```

```
plot(GDPC1,main='Real Gross Domestic Product',ylab='$USD Billions',xlab='Time')
```



- National Income and Product Accounts Identity: GDP = C + I + G + NX

```
GDP_Pieces <- merge(PCEC,GPDI,GCE,NETEXP,all = T)
GDP_Pieces <- na.omit(GDP_Pieces)
GDP_Pieces$GDP_Aggregated <- apply(GDP_Pieces,1,sum)
compareGDP <- merge(GDP_Pieces,GDP)
compareGDP <- na.omit(compareGDP)
head(compareGDP)
```

```
##               PCEC   GPDI    GCE NETEXP GDP_Aggregated     GDP
## 1947-01-01 156.161 35.854 40.274 10.875        243.164 243.164
## 1947-04-01 160.031 34.505 40.138 11.294        245.968 245.968
## 1947-07-01 163.543 34.911 39.361 11.770        249.585 249.585
## 1947-10-01 167.672 43.250 39.534  9.289        259.745 259.745
## 1948-01-01 170.372 47.202 40.875  7.293        265.742 265.742
## 1948-04-01 174.142 50.336 42.884  5.205        272.567 272.567
```

```
tail(compareGDP)
```

```
##                PCEC     GPDI      GCE   NETEXP GDP_Aggregated      GDP
## 2017-01-01 13114.12 3278.613 3346.382 -576.562       19162.55 19162.55
## 2017-04-01 13233.19 3337.890 3359.981 -571.935       19359.12 19359.12
## 2017-07-01 13359.11 3413.909 3372.323 -557.269       19588.07 19588.07
## 2017-10-01 13579.21 3441.447 3419.089 -607.920       19831.83 19831.83
## 2018-01-01 13679.60 3543.785 3456.824 -639.161       20041.05 20041.05
## 2018-04-01 13871.62 3586.652 3505.451 -551.856       20411.87 20411.87
```

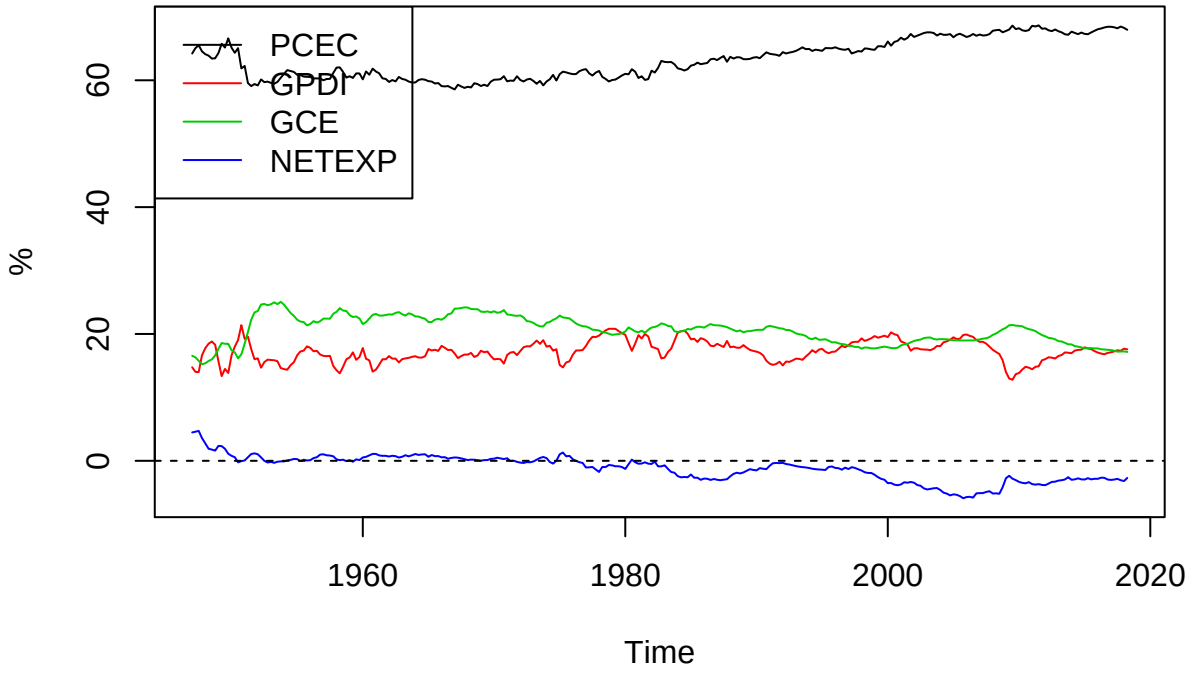
We can use the national income and product accounts identity to analyze the relative contribution of each category to GDP over time; for example consumptions realtive contribution is $\frac{\text{Consumption}_t}{\text{GDP}_t}$

```
GDP_Pieces <- merge(PCEC,GPDI,GCE,NETEXP,all = T)
GDP_Pieces <- na.omit(GDP_Pieces)
```

```
GDP_Contribution <- 100*t(apply(GDP_Pieces,1,function(x)x/sum(x)))
tail(GDP_Contribution)
```

```
##                PCEC     GPDI      GCE    NETEXP
## 2017-01-01 68.43618 17.10948 17.46313 -3.008796
## 2017-04-01 68.35633 17.24195 17.35606 -2.954344
## 2017-07-01 68.20023 17.42851 17.21621 -2.844940
## 2017-10-01 68.47181 17.35315 17.24041 -3.065375
## 2018-01-01 68.25791 17.68263 17.24872 -3.189259
## 2018-04-01 67.95861 17.57140 17.17359 -2.703603
```

```
plot(index(GDP_Pieces),GDP_Contribution[,1],ylim=c(min(GDP_Contribution),max(GDP_Contribution)),typ='l'
for(j in 2:ncol(GDP_Contribution)){
  lines(lines(index(GDP_Pieces),GDP_Contribution[,j],col=j))
}
legend('topleft',legend = colnames(GDP_Contribution),lty = 1,col=1:ncol(GDP_Contribution))
abline(h = 0,lty = 2)
```



Since the 1950s in the United States, the realtive contributions of the components of GDP seem pretty constant with consumption making up ~67% of GDP, investment making up ~17% of GDP, goverment spending making up ~17% of GDP, and net exports making up ~-3% of GDP.

Other important definitions:

- GDP deflator: $\frac{\text{Nominal GDP}}{\text{Real GDP}}$ reflects what's happening to the overall level of prices in the economy. FRED Code: Gross Domestic Product: Implicit Price Deflator (GDPDEF)

```
getSymbols('GDPDEF',src ='FRED')
```

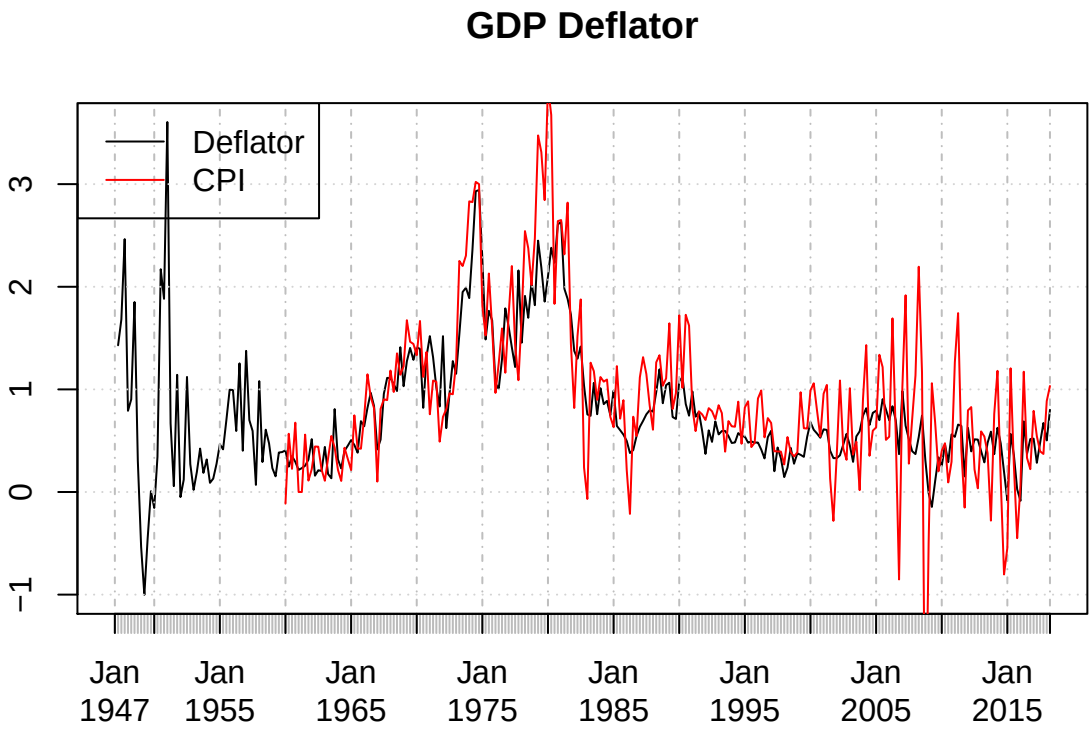
```
## [1] "GDPDEF"
```

```
head(GDPDEF)
```

```
##            GDPDEF
## 1947-01-01 11.960
## 1947-04-01 12.131
```

```
## 1947-07-01 12.335
## 1947-10-01 12.639
## 1948-01-01 12.739
## 1948-04-01 12.854
```

```
gdpDeflatorChange <- Delt(GDPDEF,type = 'arithmetic')
plot(100*gdpDeflatorChange,main='GDP Deflator')
lines(cpi.changes,col = 2)
legend('topleft',legend = c('Deflator','CPI'),col = 1:2,lty = 1)
```

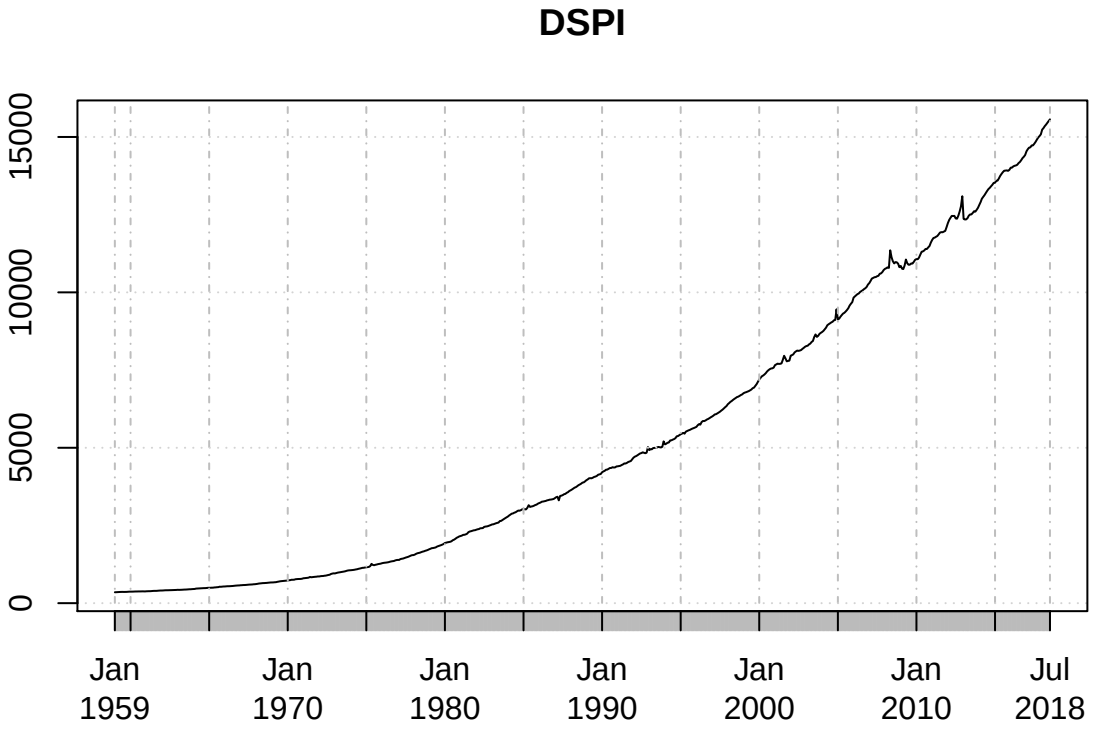


- Gross National Product (GNP): measures the total income earned by Nationals. GDP = GDP + Factor Payments from Abroad - Factor payments to Abroad.
- Personal Income = National income - Indirect business taxes - Corporate profits - Social insurance contribution - Net Interest + Dividends + Government transfers to individuals + Personal interest income.
- Disposable Personal Income = the amount households and noncorporate businesses have available to spend after satisfying their tax obligations to the government. FRED Code: Disposable Personal Income (DSPI)

```
getSymbols('DSPI',src = 'FRED')
```

```
## [1] "DSPI"
```

```
plot(DSPI)
```



Classical Model

Supply: Total Production of Goods and Services

Factors of production are the inputs used to produce goods and services. The two most important factors of production are capital, K, and labor, L. We begin by taking the economy's factors of production as given:

$$K = \bar{K}$$
$$L = \bar{L}$$

The factors of production are inputed into a *production function* which leads to output:

$$Y = F(K, L)$$

Most production functions have **constant returns to scale**:

$$zY = F(zK, zL)$$

Given that we are assuming K and L are fixed $\rightarrow Y = \bar{Y}$ is also fixed. The distribution of national income is determined by factor prices. Factor prices are the amounts paid to the factors of production. In an economy where the two factors of production are capital and labor, the two factor prices are the wage workers earn and the rent the owners of capital collect.

In general we assume that firms are competitive (small relative to the market; therefore having little to no impact of market prices). The assumption of competitive firms implies that prices are assumed to be exogenous market conditions. A firms profit is therefore given by:

$$Profit = PY - WL - RK = PF(K, L) - WL - RK$$

where P are the prices that they sell Y output, W is the wage paid to L labor, and R is the rent paid to use capital K. Given P, W, and R the firm is tasked with determing how much labor and capital to utilize. In general we assume that production functions satisfy the Inada conditions with respect to the production factors:

$$F'(x) > 0$$
$$F''(x) < 0$$
$$lim_{x \to 0} F'(x) = +\infty$$
$$lim_{x \to +\infty} F'(x) = 0$$

The Inada conditions along with the assumption of competitive firms implies that firms continue to hire labor/capital up until the point it is no longer profitable to do so (the real factor price):

$$\frac{\partial Profit}{\partial L} : P * MPL = W \to MPL = \frac{W}{P} = \text{Real wage}$$
$$\frac{\partial Profit}{\partial K} : P * MPK = R \to MPK = \frac{R}{P} = \text{Real rental price of captial}$$

To determing what the marginal product of capital/labor is we need to determine a production function. Paul Douglas and Charles Cobb created the Cobb-Douglas production function to model the empirical result that the ratio of labor income to total income has remained constant over time:

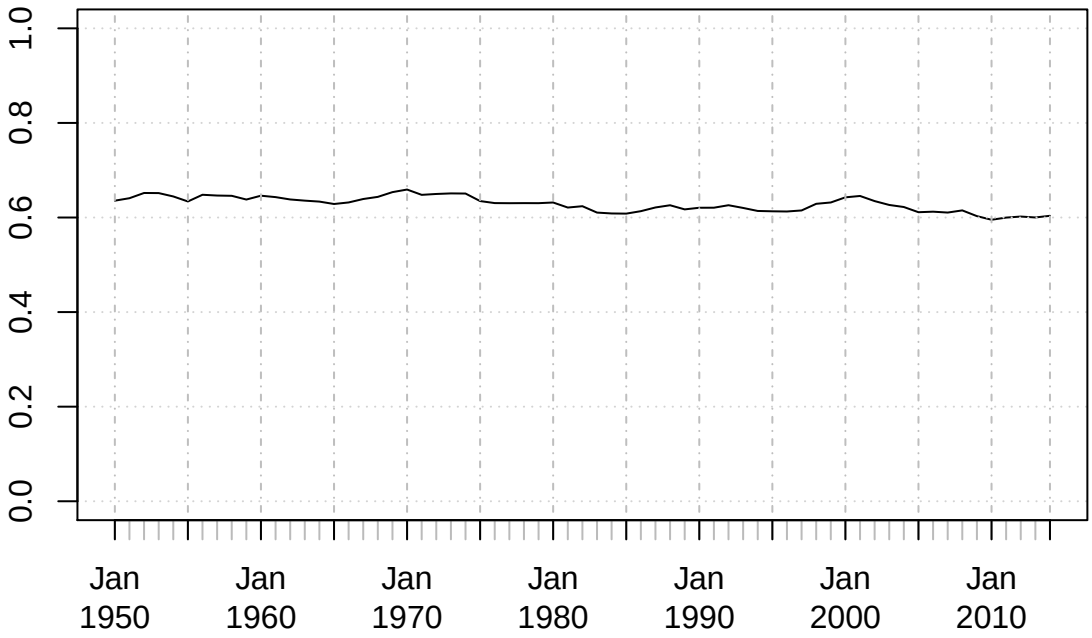
```
getSymbols('LABSHPUSA156NRUG',src='FRED')
```

```
## [1] "LABSHPUSA156NRUG"
```

```
head(LABSHPUSA156NRUG)
```

```
##            LABSHPUSA156NRUG
## 1950-01-01        0.6356340
## 1951-01-01        0.6408135
## 1952-01-01        0.6518782
## 1953-01-01        0.6516480
## 1954-01-01        0.6445312
## 1955-01-01        0.6339187
```

```
plot(LABSHPUSA156NRUG,ylim=c(0,1))
```



Cobb showed that this function has the following form:

$$F(K, L) = AK^{\alpha}L^{1-\alpha}$$

Given the explicit statment of the production function we can derive the marginal products of capital and labor by taking partial derivatives with respect to each variable:

$$\frac{\partial F(K, L)}{\partial K} = \alpha A(\frac{L}{K})^{1-\alpha} = \alpha\frac{Y}{K}$$
$$\frac{\partial F(K, L)}{\partial L} = (1-\alpha)A(\frac{K}{L})^{\alpha} = (1-\alpha)\frac{Y}{L}$$

Demand: Total Demand of Goods and Services

Falling back on our national income accounts identity, we know that $Y = C + I + G + NX$. If we continue our journey of trying to model a simple economy and assume that the economy is closed we have that $NX = 0$. Therefore we simply have that $Y = C + I + G$.

Consumption

We make the simplistic assumption that consumption is equal to some proportion of disposable income (after tax income). $C = C * (Y - T)$, where C is the marginal propensity to consume. For every dollar of disposable income the consumer in our model will consume C cents and save $1 - C$ cents.

Investment

We allow for both consumers and firms to purchase investment goods. A firm uses investments to finance items such as purcahses of plants and equipment and consumers use investments to finance items such as homes or cars. We assume that investment is inversely related to real interest rates (the cost of borrowing + inflation (Fisher Equation)). $I = I(r)$.

Government

G in our national income accounts identity refers to spending conducted by the goverment (Federal, state, and local). All aspects of government spending are included in G except for government transfers (welfare, social security, etc.). To keep our classical example simple, we will assume that government spending is fixed ($G = \bar{G}$) and balanced ($T = \bar{T} = G$)

Putting it all together

Assuming fixed capital and labor:

$$\bar{Y} = F(\bar{K}, \bar{L})$$

$$\bar{Y} = C + I + G$$

Assuming consumption is a fraction of disposable income and fixed/balanced government spending:

$$C = C(\bar{Y} - \bar{T})$$

Assuming investment is inversly related to the rate of borrowing:

$$I = I(r)$$

Assuming fixed/balanced government spending:

$$G = \bar{G}$$

$$T = \bar{T}$$

Therefore we have:

$$\bar{Y} = C(\bar{Y} - \bar{T}) + I(r) + \bar{G}$$

Given that everything is fixed except for investment which is a function of interest rates, we have that if supply equals demand, the interest rate will adjust to make the demand for goods and services equal to the supply.

Supply and Demand of Loanable Funds

If we restate our the national accounts identity we can see a relationship between savings and investment:

$$Y = C + I + G$$

$$Y - C - G = I$$

$$NationalSavings = Y - C - G$$

$$PrivateSavings = Y - T - C$$

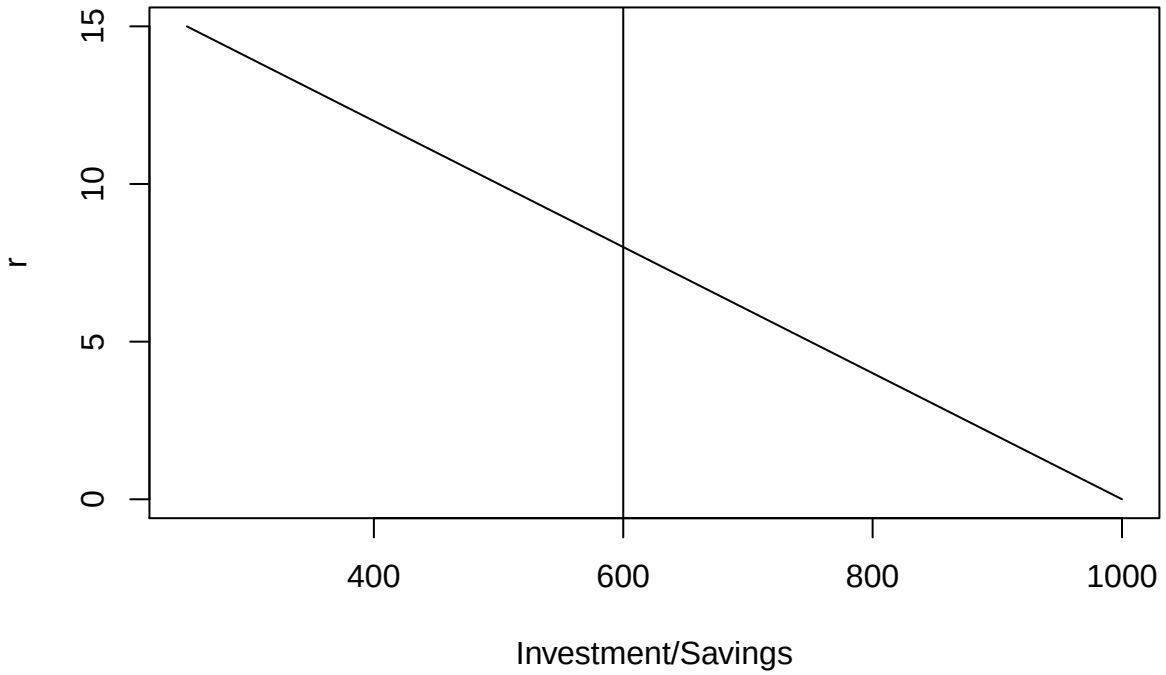
$$PublicSavings = T - G$$

$$(Y - T - C) + (T - G) = I$$

Savings is essentially the supply of funds avaialable for investment. Going back to our simple neoclassical model:

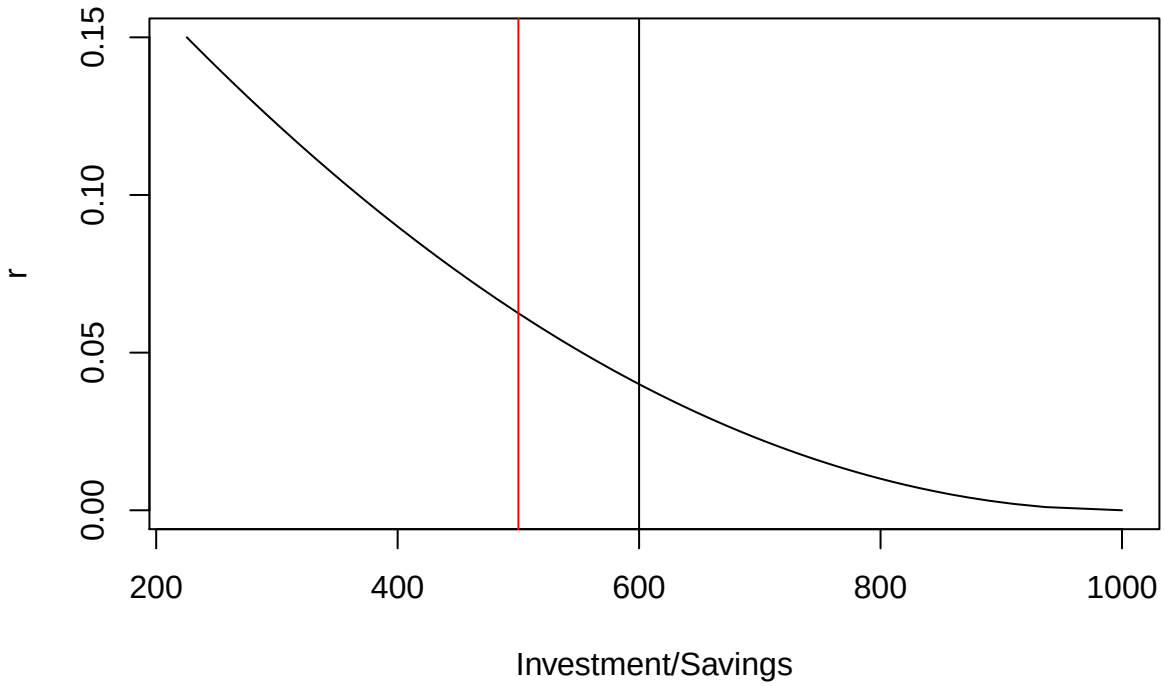
$$\bar{Y} - C(\bar{Y} - \bar{T}) - \bar{G} = \bar{S} = I(r)$$

```
r <- seq(0,15,by=0.01)
investment <-  1000-50*r
plot(investment,r,typ='l',xlab='Investment/Savings',ylab='r')
s <- 600
abline(v = s)
```



We can use this simple framework to actually get some pretty powerful comparitive statics. For instance, what happens in this simple economy is Government spending increases?

```
r <- seq(0,.15,by=0.001)
investment <-  1000-2000*sqrt(r)#Made it up..
plot(investment,r,typ='l',xlab='Investment/Savings',ylab='r')
s1 <- 600
s2 <- 500
abline(v = s1)
abline(v = s2,col = 2)
```


r
0.00
0.05
0.10
0.15
200
400
600
800
1000
Investment/Savings