

# Kydland Prescott (1990) Replication

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```
fredr_set_key("2d4104c35bfc5185ef631b380c2f78dd")
rgdp <- fredr(
  series_id = "GDPC1",
  frequency = "q",
  observation_start = as.Date("1954-01-01"),
  observation_end = as.Date("2018-07-01")
)
rgdp <- rgdp[,-2]
names(rgdp) <- c("date", "rgdp")
rc <- fredr(
  series_id = "PCECC96",
  frequency = "q",
  observation_start = as.Date("1954-01-01"),
  observation_end = as.Date("2018-07-01")
)
rc <- rc[,-2]
names(rc) <- c("date", "rc")

I <- fredr(
  series_id = "GPDIC1",
  frequency = "q",
  observation_start = as.Date("1954-01-01"),
  observation_end = as.Date("2018-07-01")
)
I <- I[,-2]
names(I) <- c("date", "I")

m2 <- fredr(
  series_id = "M2SL",
  frequency = "q",
  observation_start = as.Date("1954-01-01"),
  observation_end = as.Date("2018-07-01")
)
m2 <- m2[,-2]
names(m2) <- c("date", "m2")

cpix <- fredr(
  series_id = "CPIAUCSL",
  frequency = "q",
  observation_start = as.Date("1954-01-01"),
  observation_end = as.Date("2018-07-01")
)
cpix <- cpix[,-2]
names(cpix) <- c("date", "cpi")

N <- N <- read_excel("us_total_hrs_emp.xlsx",
```

```

    sheet = "Hours", range = "a6:b400")
N<- N[ -(1:6),]
N$Sector <- str_replace_all(N$Sector, "Q1", "-01-01" )
N$Sector <- str_replace_all(N$Sector, "Q2", "-04-01" )
N$Sector <- str_replace_all(N$Sector, "Q3", "-07-01" )
N$Sector <- str_replace_all(N$Sector, "Q4", "-10-01" )
names(N) <- c("date", "N")
N$date <- as.Date(N$date)
data <- left_join(rgdp, rc, by = "date")
data <- left_join(data, I, by = "date")
data <- left_join(data, m2, by = "date")
data <- left_join(data, cpix, by = "date")
data <- left_join(data, N, by = "date")
data$N <- as.numeric(data$N)

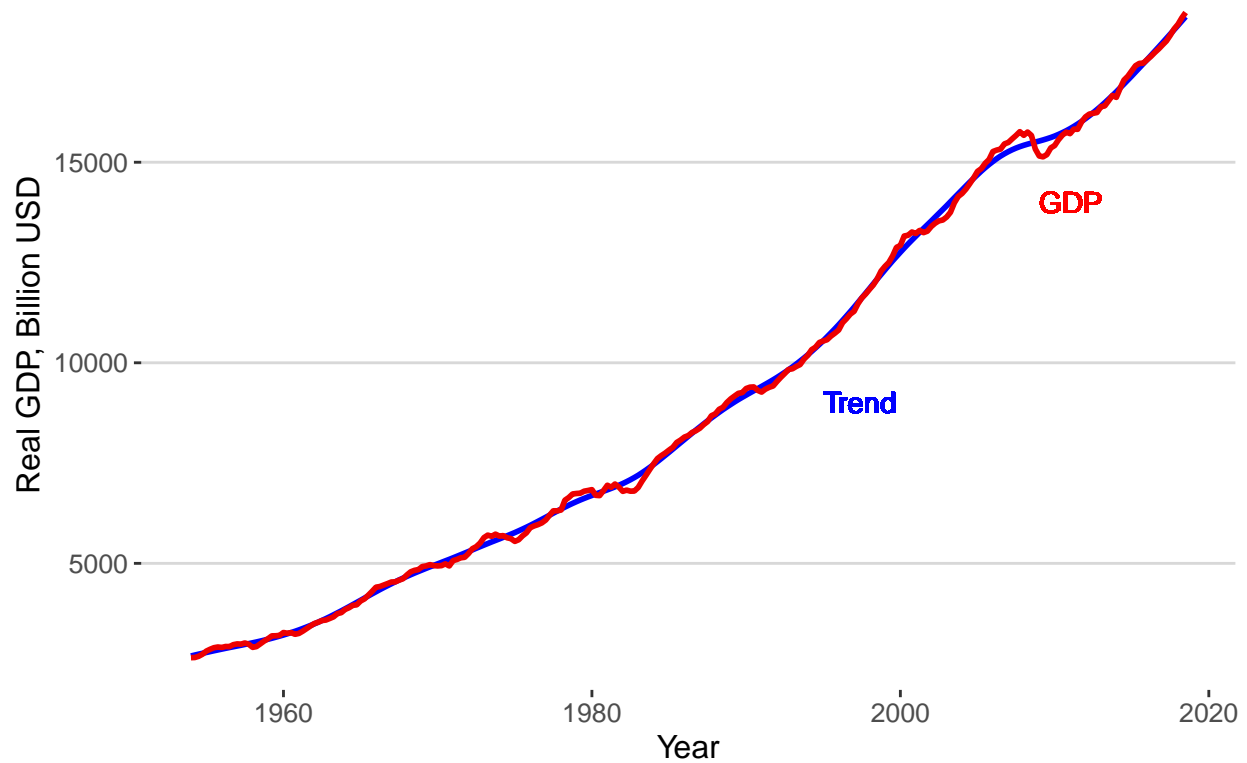
data %>%
  mutate(pr = rgdp/N) %>%
  mutate(cpim1 = lag(cpi)) %>%
  mutate(inf = ((cpi - cpim1)/cpim1 *100 )) -> data

data$y_t <- hpfilter(data$rgdp, freq = 1600)$trend
data$rc_t <- hpfilter(data$rc, freq = 1600)$trend
data$I_t <- hpfilter(data$I, freq = 1600)$trend
a <- rep(NA, 20)
data$m2_t <- c(a, hpfilter(data$m2[21:259], freq = 1600)$trend)
data$cpi_t <- hpfilter(data$cpi, freq = 1600)$trend
data$N_t<- hpfilter(data$N, freq = 1600)$trend
data$pr_t <- hpfilter(data$pr, freq = 1600)$trend

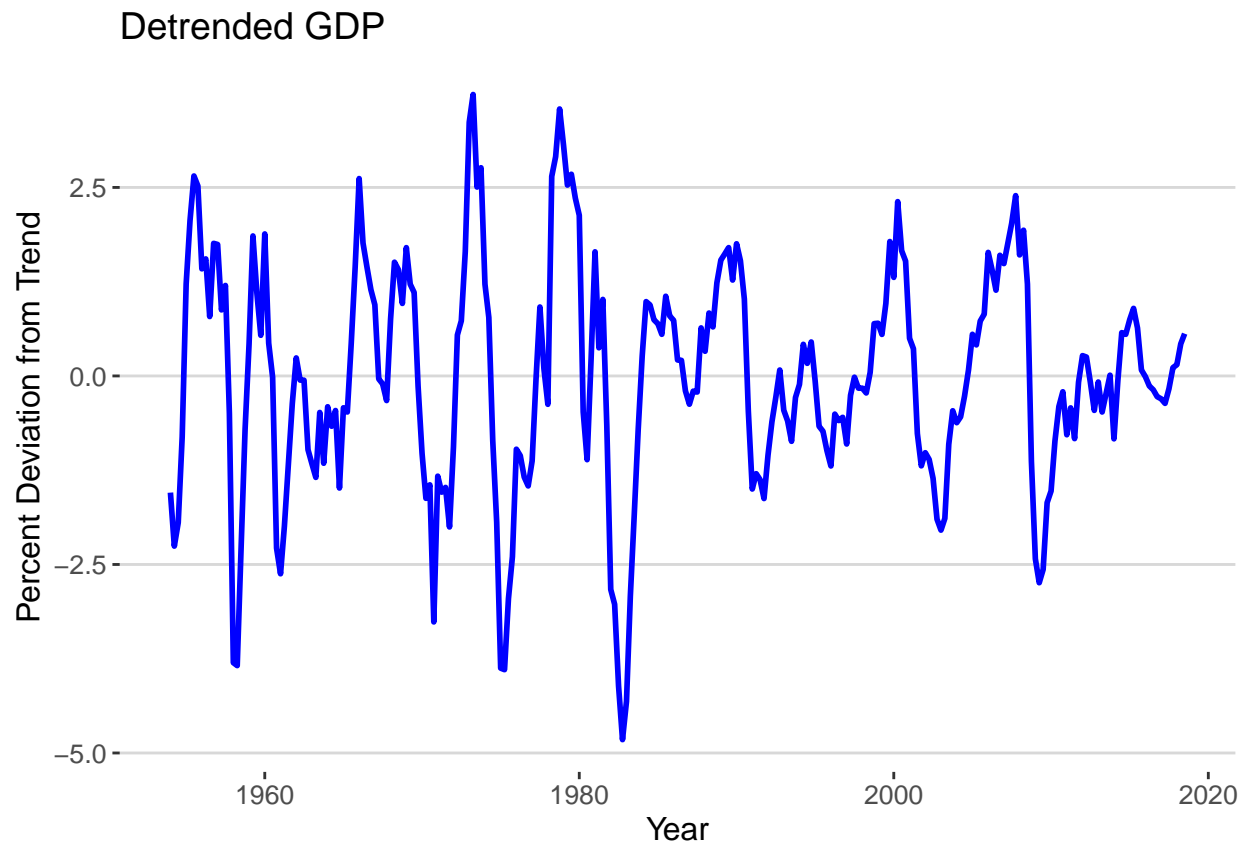
ggplot(data) +
  geom_line(aes(date, y_t), color = "blue", size = 1) +
  geom_line(aes(date, rgdp), color = "red2", size = 1) +
  theme_hc() +
  xlab("Year") +
  ylab("Real GDP, Billion USD") +
  ggtitle("Real GDP vs. Trend Real GDP") +
  geom_text(x = 15000, y = 14000, label = "GDP", color = "red") +
  geom_text(x = 10000, y = 9000, label = "Trend", color = "blue")

```

## Real GDP vs. Trend Real GDP

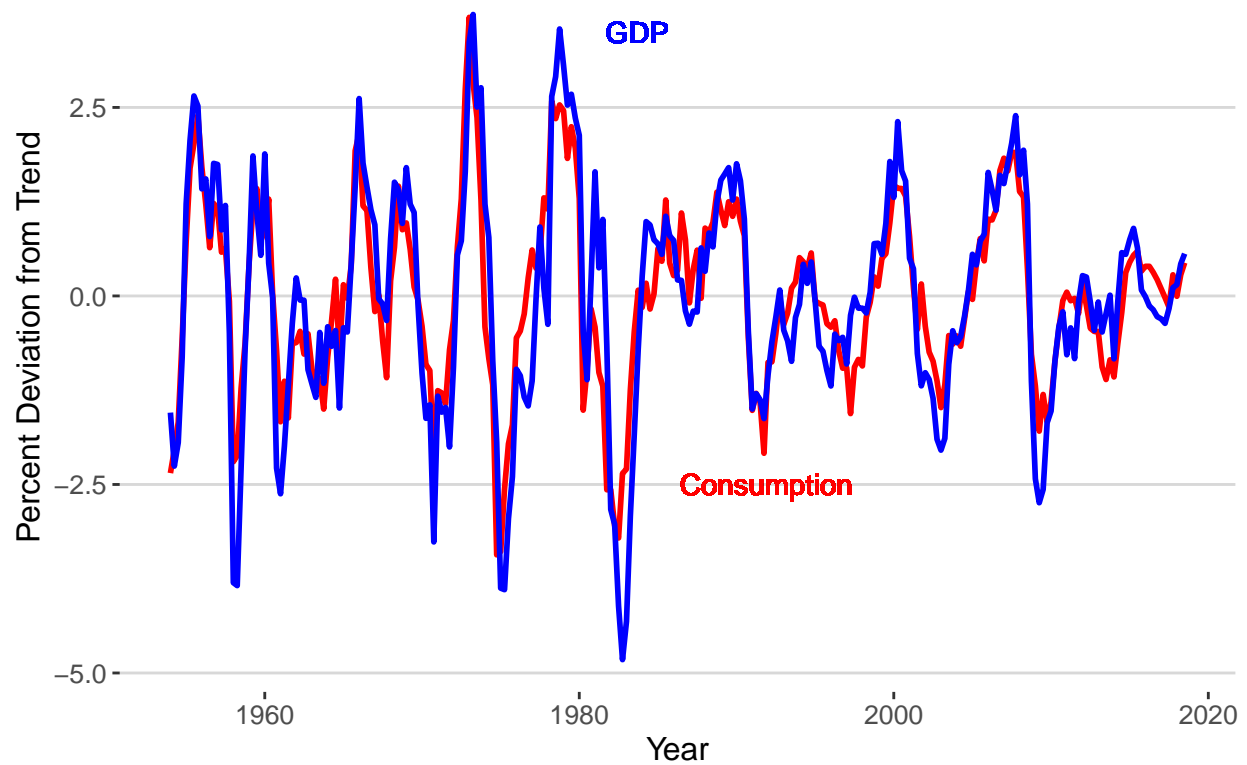


```
cycle <- function(x, y){  
  (log(x) - log(y)) * 100  
}  
  
data$y_c <- cycle(data$rgdp, data$y_t)  
data$rc_c <- cycle(data$rc, data$rc_t)  
data$I_c <- cycle(data$I, data$I_t)  
data$m2_c <- cycle(data$m2, data$m2_t)  
data$cpi_c <- cycle(data$cpi, data$cpi_t)  
data$N_c <- cycle(data$N, data$N_t)  
data$pr_c <- cycle(data$pr, data$pr_t)  
  
ggplot(data) +  
  geom_line(aes(date, y_c), color = "blue", size = 1) +  
  theme_hc() +  
  xlab("Year") +  
  ylab("Percent Deviation from Trend") +  
  ggtitle("Detrended GDP ")
```



```
ggplot(data) +
  geom_path(aes(date, rc_c), color = "Red", size = 1) +
  geom_path(aes(date, y_c), color = "Blue", size = 1) +
  xlab("Year") +
  ylab("Percent Deviation from Trend") +
  ggtitle("Real Consumption and Real GDP Trend Lines") +
  geom_text(x = 5000, y = 3.5, label = "GDP", color = "blue") +
  geom_text(x = 8000, y = -2.5, label = "Consumption", color = "red") +
  theme_hc()
```

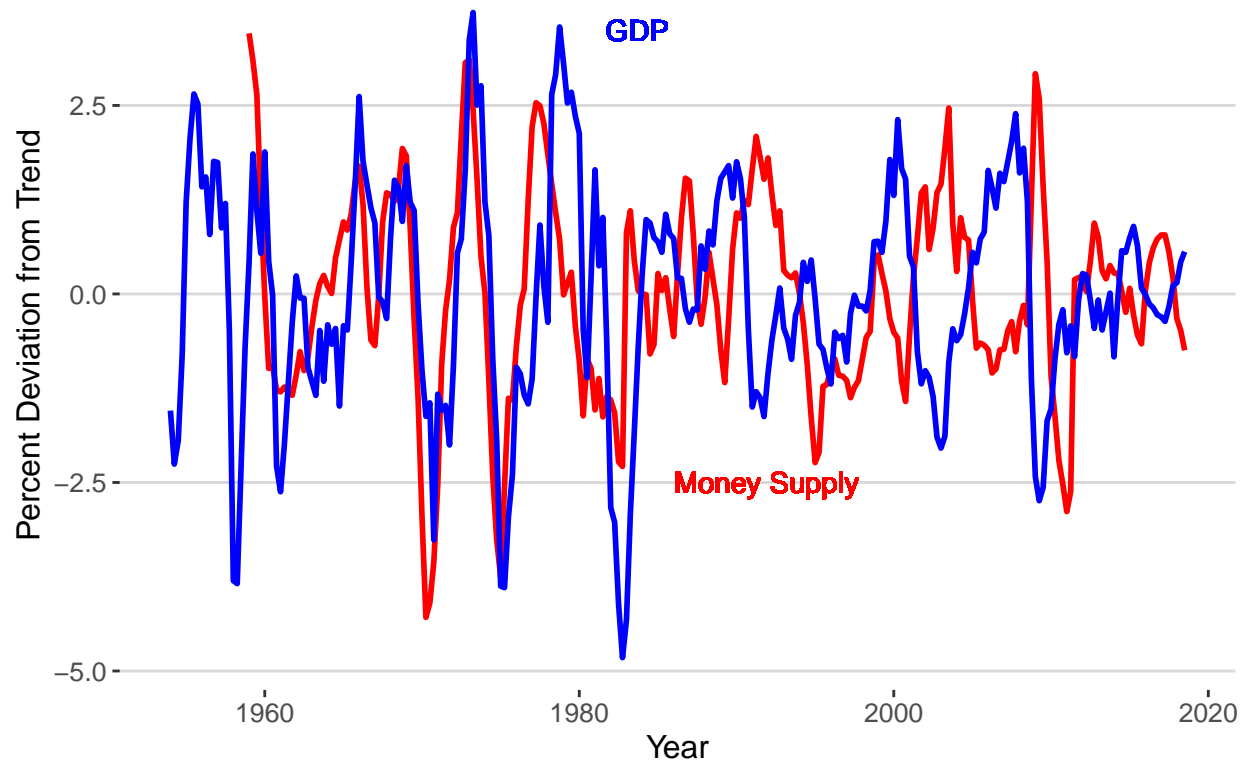
## Real Consumption and Real GDP Trend Lines



```
ggplot(data) +
  geom_line(aes(date, m2_c), color = "red", size = 1) +
  geom_line(aes(date, y_c), color = "blue", size = 1) +
  xlab("Year") +
  ylab("Percent Deviation from Trend") +
  ggtitle("Money Supply (M2) and Real GDP Trend Lines") +
  geom_text(x = 5000, y = 3.5, label = "GDP", color = "blue") +
  geom_text(x = 8000, y = -2.5, label = "Money Supply", color = "red") +
  theme_hc()
```

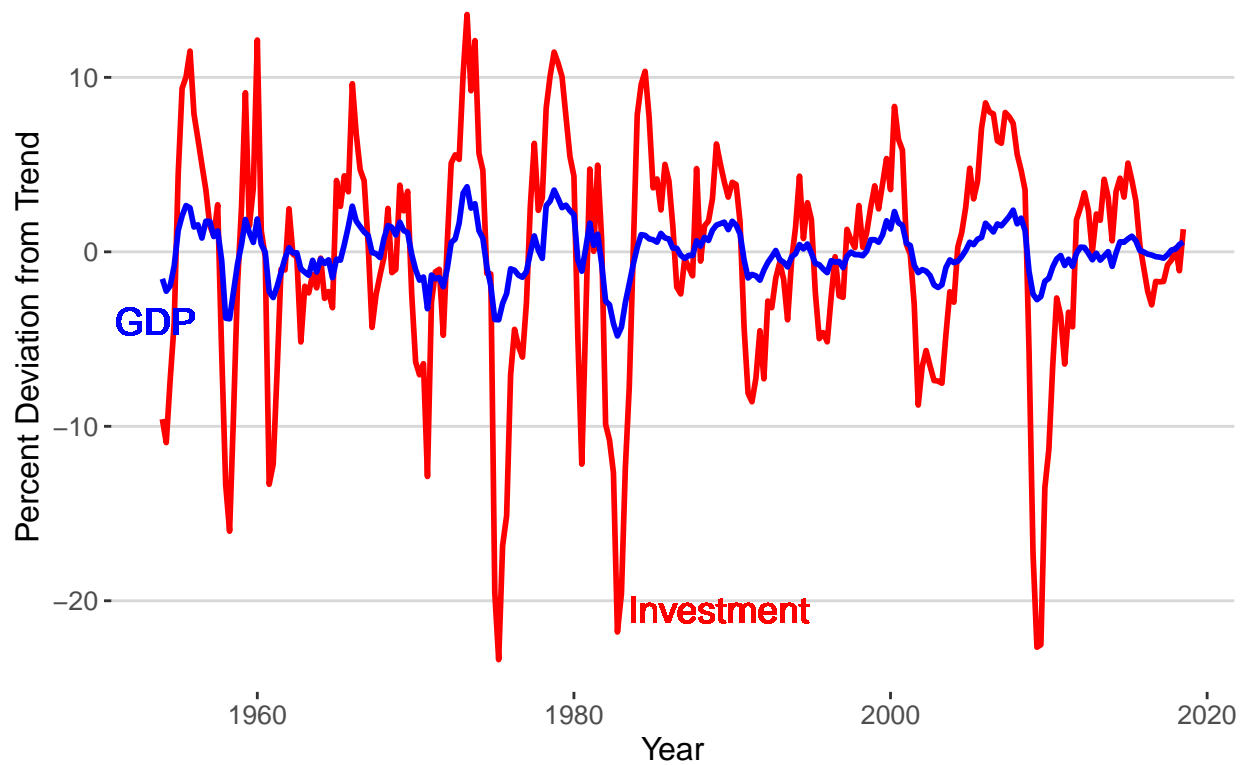
## Warning: Removed 20 rows containing missing values (geom\_path).

## Money Supply (M2) and Real GDP Trend Lines



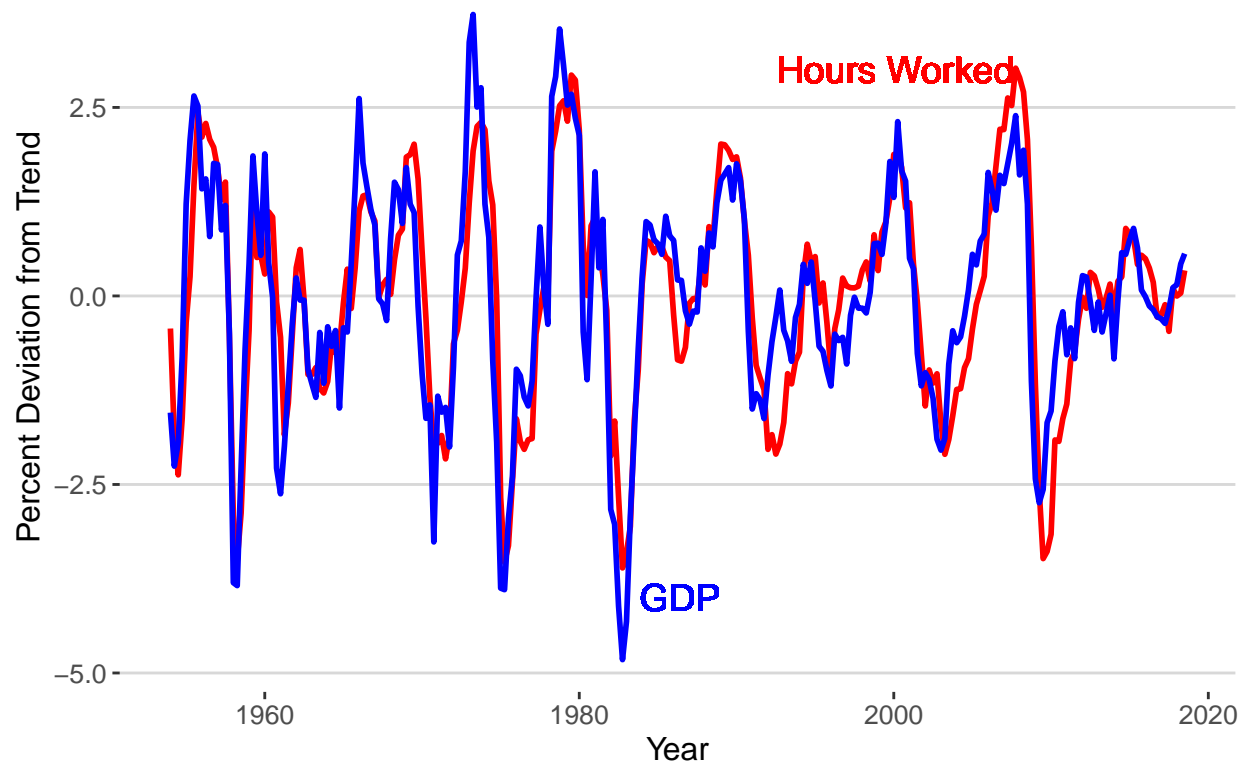
```
ggplot(data) +  
  geom_line(aes(date, I_c), color = "red", size = 1) +  
  geom_line(aes(date, y_c), color = "blue", size = 1) +  
  xlab("Year") +  
  ylab("Percent Deviation from Trend") +  
  ggtitle("Investment and Real GDP Trend Lines") +  
  geom_text(x = -6000, y = -4, label = "GDP", color = "blue", size = 5) +  
  geom_text(x = 7000, y = -20.5, label = "Investment", color = "red", size = 5) +  
  theme_hc()
```

## Investment and Real GDP Trend Lines



```
ggplot(data) +
  geom_line(aes(date, N_c), color = "red", size = 1) +
  geom_line(aes(date, y_c), color = "blue", size = 1) +
  xlab("Year") +
  ylab("Percent Deviation from Trend") +
  ggtitle("Hours Worked and Real GDP Trend Lines") +
  geom_text(x = 6000, y = -4, label = "GDP", color = "blue", size = 5) +
  geom_text(x = 11000, y = 3, label = "Hours Worked", color = "red", size = 5) +
  theme_hc()
```

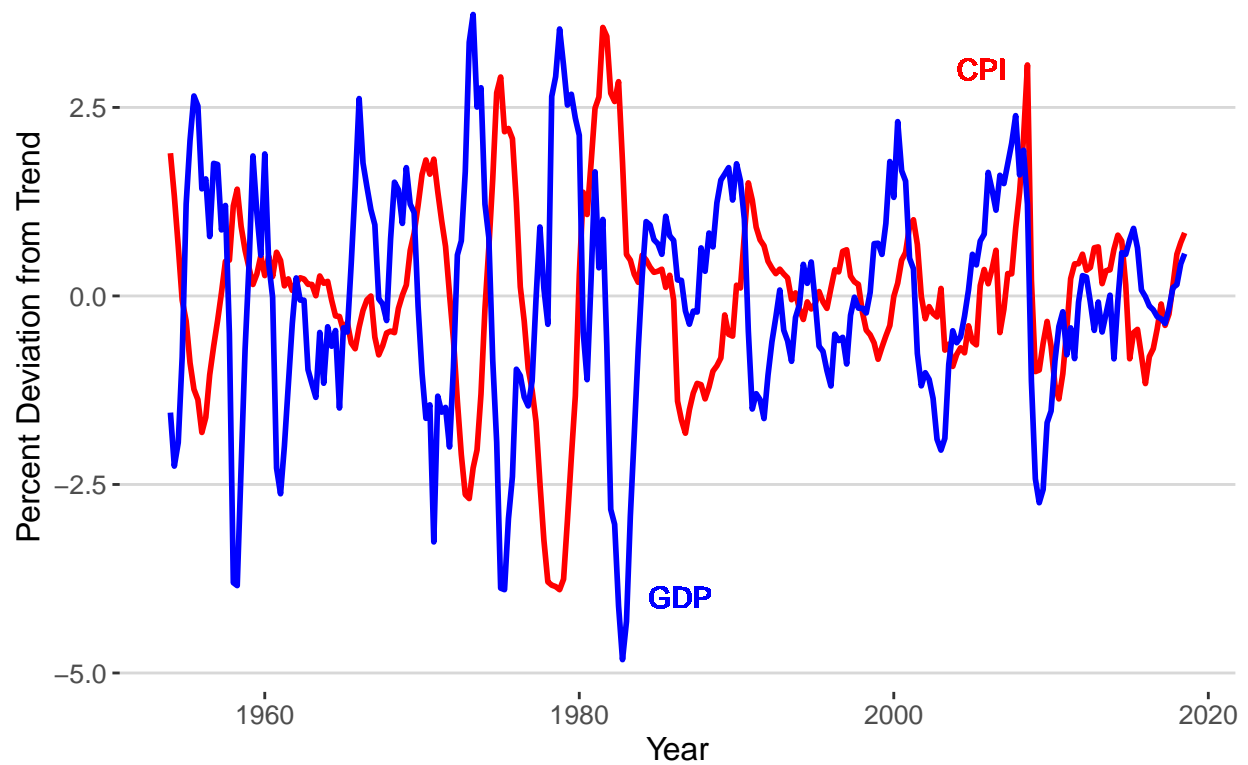
# Hours Worked and Real GDP Trend Lines



```
ggplot(data) +
  geom_line(aes(date, cpi_c), color = "red", size = 1) +
  geom_line(aes(date, y_c), color = "blue", size = 1) +
  xlab("Year") +
  ylab("Percent Deviation from Trend") +
  ggtitle("CPI and Real GDP Trend Lines") +
  geom_text(x = 6000, y = -4, label = "GDP", color = "blue") +
  geom_text(x = 13000, y = 3, label = "CPI", color = "red") +
  theme_hc()
```

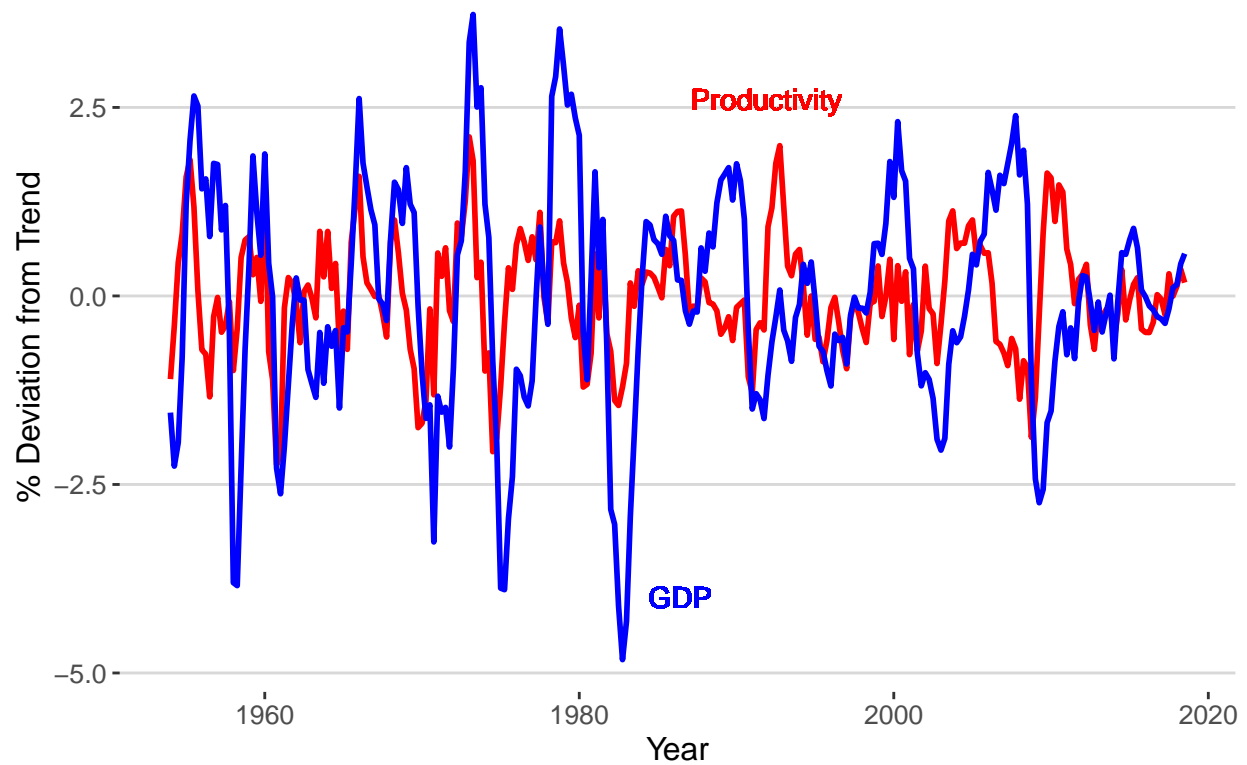


# CPI and Real GDP Trend Lines



```
ggplot(data) +
  geom_line(aes(date, pr_c), color = "red", size = 1) +
  geom_line(aes(date, y_c), color = "blue", size = 1) +
  xlab("Year") +
  ylab("% Deviation from Trend") +
  ggtitle("Productivity and Real GDP Trend Lines") +
  geom_text(x = 6000, y = -4, label = "GDP", color = "blue") +
  geom_text(x = 8000, y = 2.6, label = "Productivity", color = "red") +
  theme_hc()
```

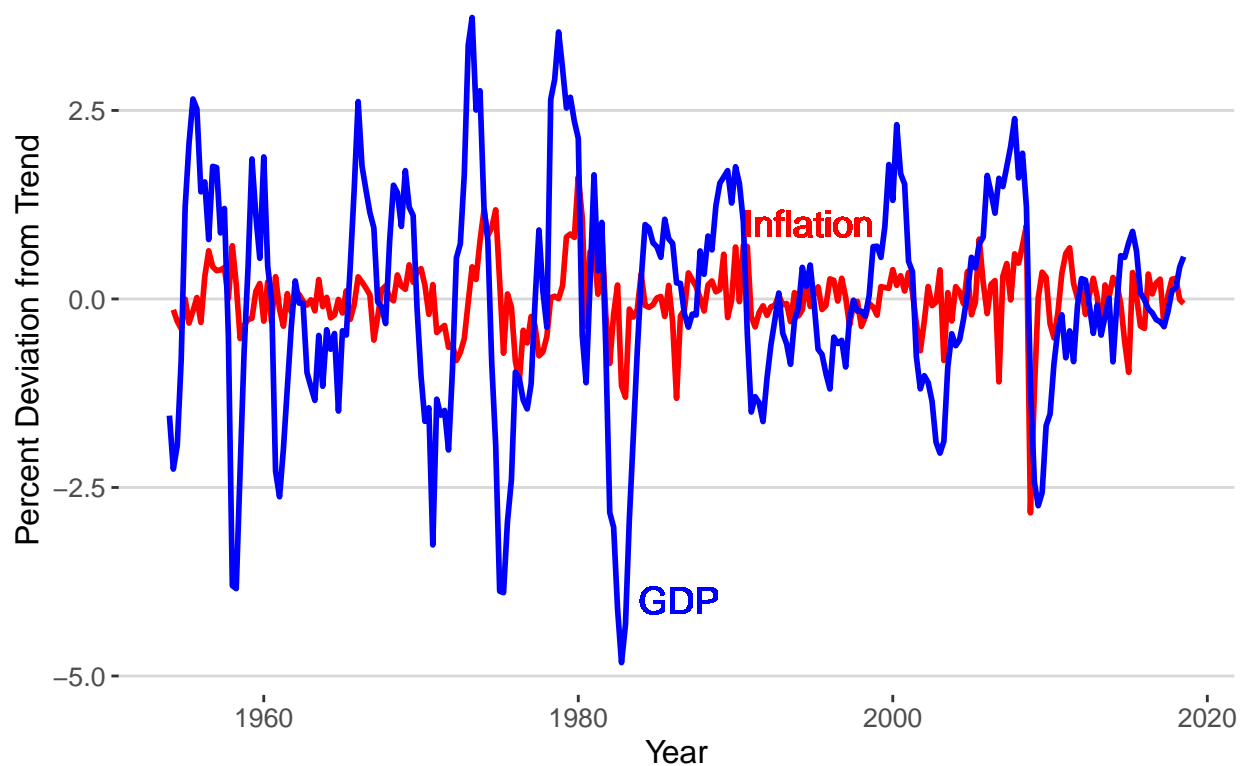
## Productivity and Real GDP Trend Lines



```
data$inf_c <- c(NA, data$inf[-1] - hpfilter(data$inf[-1], freq = 1600)$trend)
ggplot(data) +
  geom_line(aes(date, inf_c), color = "red", size = 1) +
  geom_line(aes(date, y_c), color = "blue", size = 1) +
  xlab("Year") +
  ylab("Percent Deviation from Trend") +
  ggtitle("Inflation and Real GDP Trend Lines") +
  geom_text(x = 6000, y = -4, label = "GDP", color = "blue", size = 5) +
  geom_text(x = 9000, y = 1, label = "Inflation", color = "red", size = 5) +
  theme_hc()
```

## Warning: Removed 1 rows containing missing values (geom\_path).

## Inflation and Real GDP Trend Lines



```
round(t(table1),2)
```

```
##          SD  RSD Correlation of (xt-1, GDPt)
## GDP          1.49 1.00                      0.86
## Real Consumption 1.20 0.80                      0.85
## Investment      6.69 4.48                      0.79
## Hours Worked   1.45 0.97                      0.69
## Productivity   0.77 0.52                      0.37
## CPI            1.19 0.80                     -0.56
## Inflation      0.46 0.31                      0.18
## Money Supply   1.34 0.93                      0.34
##
##          Correlation of (xt, GDPt) Correlation of (xt+1, GDPt)
## GDP          1.00                      0.86
## Real Consumption 0.88                      0.75
## Investment      0.91                      0.77
## Hours Worked   0.86                      0.89
## Productivity   0.31                      -0.02
## CPI           -0.45                     -0.32
## Inflation      0.31                      0.37
## Money Supply   0.23                      0.11
```

```
round(matrix(m, 7, 4) - KPtable, 2)
```

```
##      [,1] [,2] [,3] [,4]
## [1,] -0.22 0.01 0.00 0.01
## [2,] -0.05 0.04 0.06 0.09
## [3,] -1.61 0.00 0.00 0.02
```

```

## [4,] -0.02  0.00  0.00  0.03
## [5,] -0.11 -0.13 -0.20 -0.23
## [6,] -0.22  0.12  0.12  0.09
## [7,] -0.50 -0.27 -0.23 -0.15

total <- c(cor(data$y_c, data$cpi_c), cor(data$N_c, data$pr_c))
initial <- c(cor(data$y_c[1:148], data$cpi_c[1:148]), cor(data$N_c[1:148], data$pr_c[1:148]))
final <- c(cor(data$y_c[145:259], data$cpi_c[145:259]), cor(data$N_c[145:259], data$pr_c[145:259]))

table2 <- rbind(total, initial, final)

colnames(table2) <- c("Cor(GDP, CPI)", "Cor(Hours, Productivity)")
rownames(table2) <- c("1954-2018", "1954-1990", "1990-2018")
round(table2, 2)

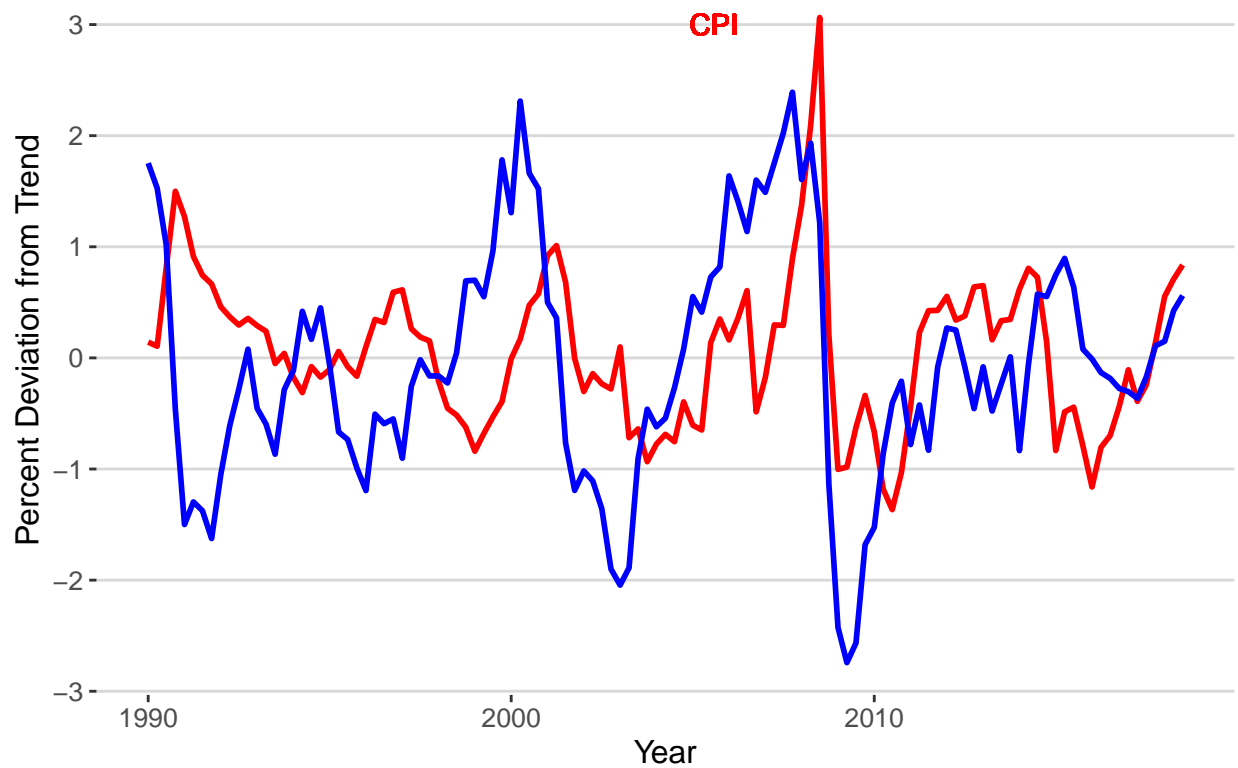
##           Cor(GDP, CPI) Cor(Hours, Productivity)
## 1954-2018          -0.45                -0.21
## 1954-1990          -0.60                -0.01
## 1990-2018           0.25                -0.59

data2 <- data[145:259,]

ggplot(data2) +
  geom_line(aes(date, cpi_c), color = "red", size = 1) +
  geom_line(aes(date, y_c), color = "blue", size = 1) +
  xlab("Year") +
  ylab("Percent Deviation from Trend") +
  ggtitle("CPI and Real GDP Trend Lines") +
  geom_text(x = 6000, y = -4, label = "GDP", color = "blue") +
  geom_text(x = 13000, y = 3, label = "CPI", color = "red") +
  theme_hc()

```

## CPI and Real GDP Trend Lines



```
data3 <- data[145:216,]  
data4 <- data[217:259,]  
  
cor(data3$cpi_c, data3$y_c)
```

```
##           [,1]  
## [1,] 0.01313638
```

```
cor(data4$cpi_c, data4$y_c)
```

```
##           [,1]  
## [1,] 0.5499115
```