Hamilton-Leff Filter

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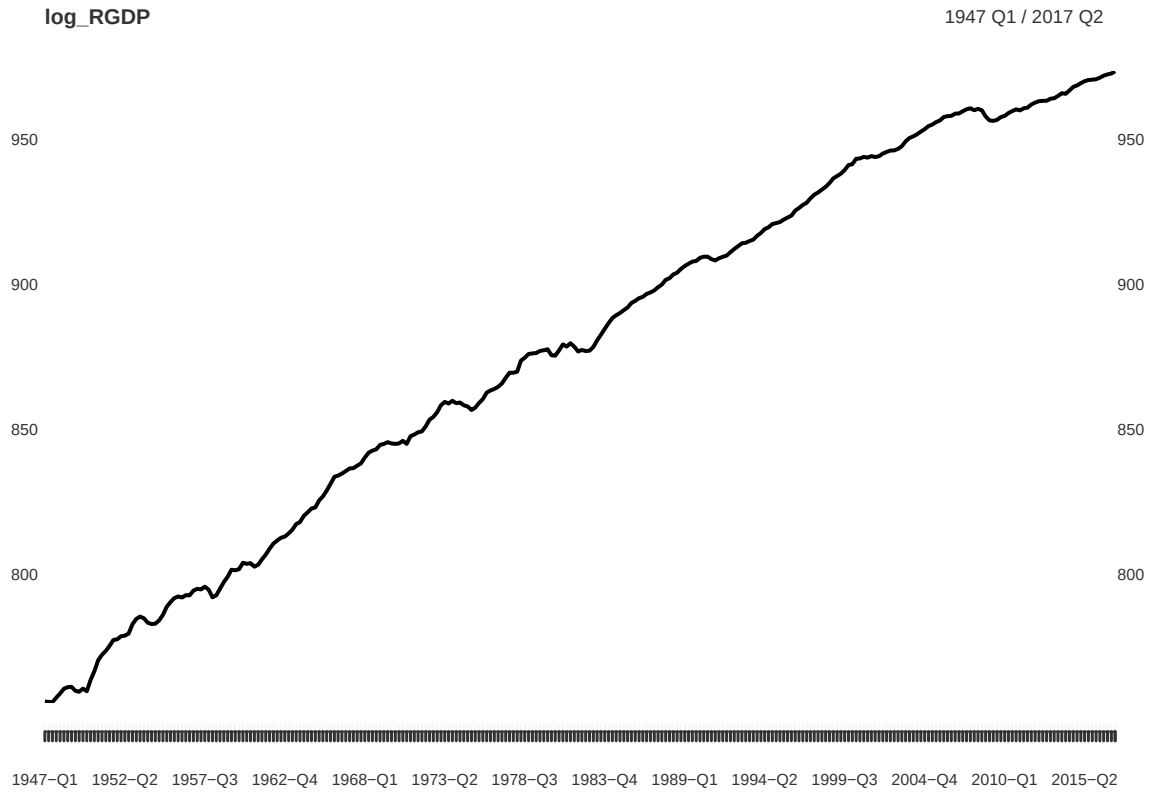
Contents

```
library(knitr)
library(xts)
library(HLfilter)
# Real GDP
Real_Gross_Domestic_Product <- "https://research.stlouisfed.org/fred2/data/GDPC96.txt"
RGDP <- as.xts(read.zoo(Real_Gross_Domestic_Product, skip = 12, index.column = 1,
                        header = TRUE, format = "%Y-%m-%d", FUN = as.yearqtr))



### Employment Rate ###
Total_nonfarm_Payrolls   <- "https://fred.stlouisfed.org/data/PAYEMS.txt"
Employment_Establishment <- as.xts(read.zoo(Total_nonfarm_Payrolls , sep = "", skip = 42, index.column =
                                            header = TRUE, format = "%Y-%m-%d", FUN = as.yearmon))
```

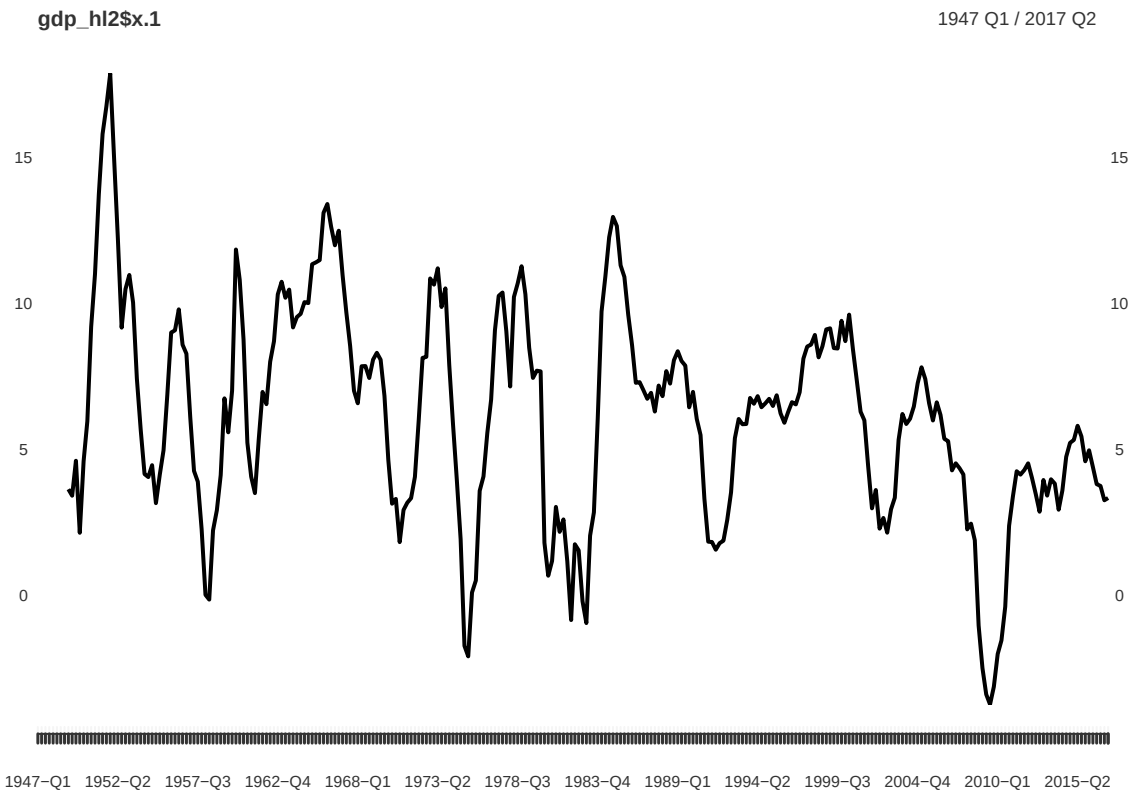
```
HL_filter_lm <- function(x) {

        DF <- merge(lag.xts(x, k = -8, na.pad = TRUE),
                    x,
                    lag.xts(x, k = 1, na.pad = TRUE),
                    lag.xts(x, k = 2, na.pad = TRUE),
                    lag.xts(x, k = 3, na.pad = TRUE))

        colnames(DF) <- c("x8", "x", "x_1", "x_2", "x_3")

        HL_filter <- lm(x8 ~ x + x_1 + x_2 + x_3, data = DF)

        HL_filter

}

HL_filter <- function(x) {

        DF <- merge(x,
                    lag.xts(x, k = 8, na.pad = TRUE),
                    lag.xts(x, k = 9, na.pad = TRUE),
                    lag.xts(x, k = 10, na.pad = TRUE),
                    lag.xts(x, k = 11, na.pad = TRUE))

        colnames(DF) <- c("x", "x_8", "x_9", "x_10", "x_11")

        HL_filter <- lm(x ~ x_8 + x_9 + x_10 + x_11, data = DF)

        HL_fit <- as.xts(unname(HL_filter$fitted.values),
                         order.by = as.yearqtr(names(HL_filter$fitted.values)))
```

```
        HL_resid <- as.xts(unname(HL_filter$residuals),
                           order.by = as.yearqtr(names(HL_filter$residuals)))

        merge(DF$x, DF$x-DF$x_8, HL_fit, HL_resid)

}
```

```
library(HLfilter)
log_RGDP <- 100*log(RGDP)

gdp_hl <- HL_filter_lm(log_RGDP)
gdp_hl2 <- HL_filter(log_RGDP)

plot(log_RGDP, grid.col = "white")
```




```
plot(gdp_hl2$x.1, grid.col = "white")
```




```
lines(gdp_hl2$HL_resid, col = "red")
```

```
## Warning in as_numeric(H): NAs introduced by coercion

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```
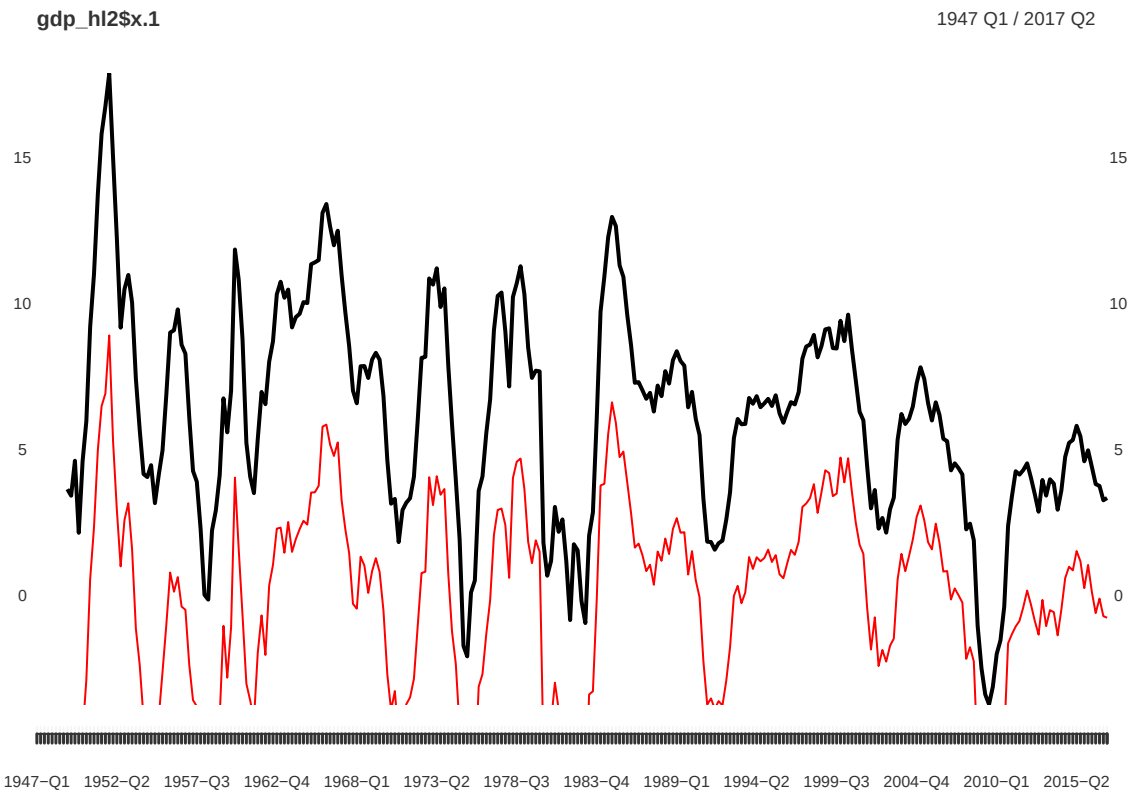
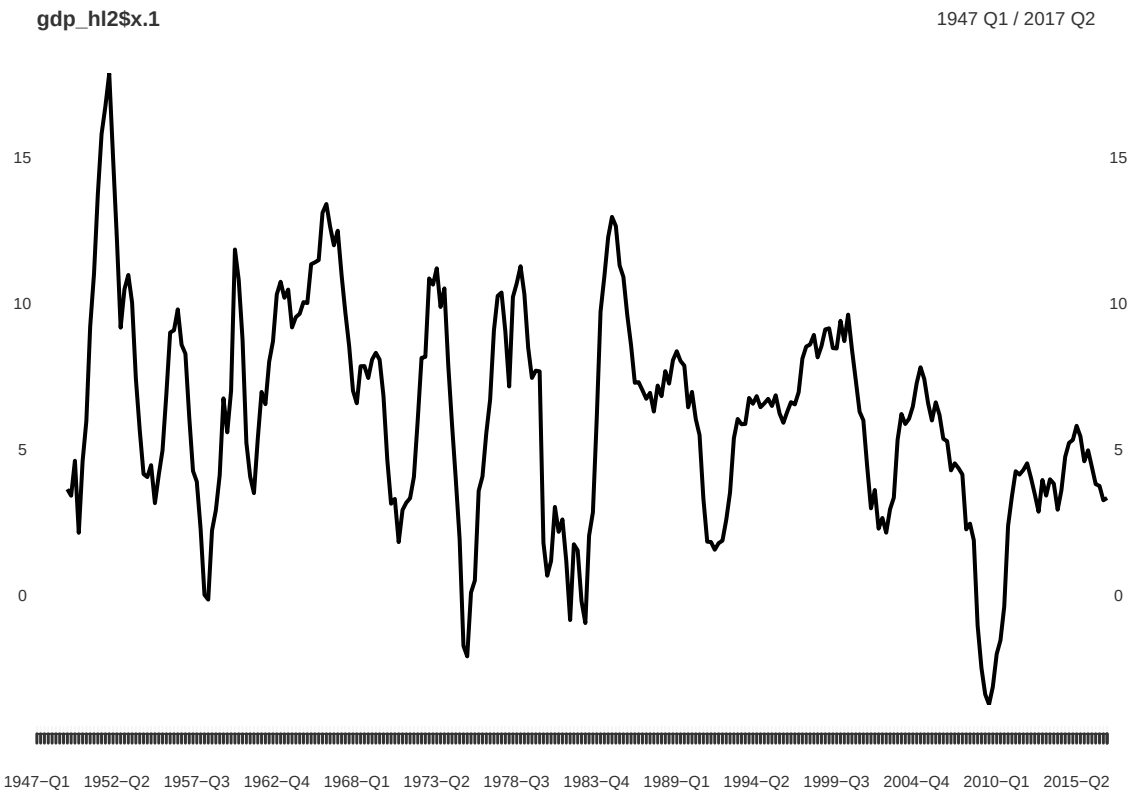
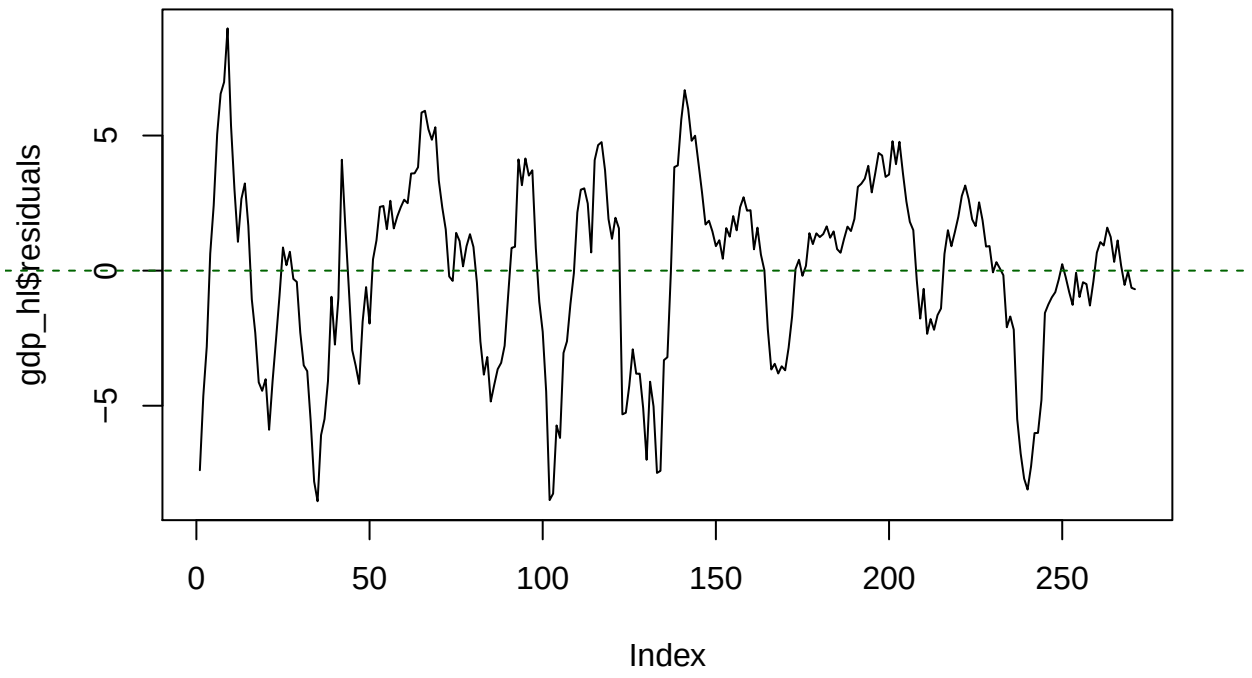



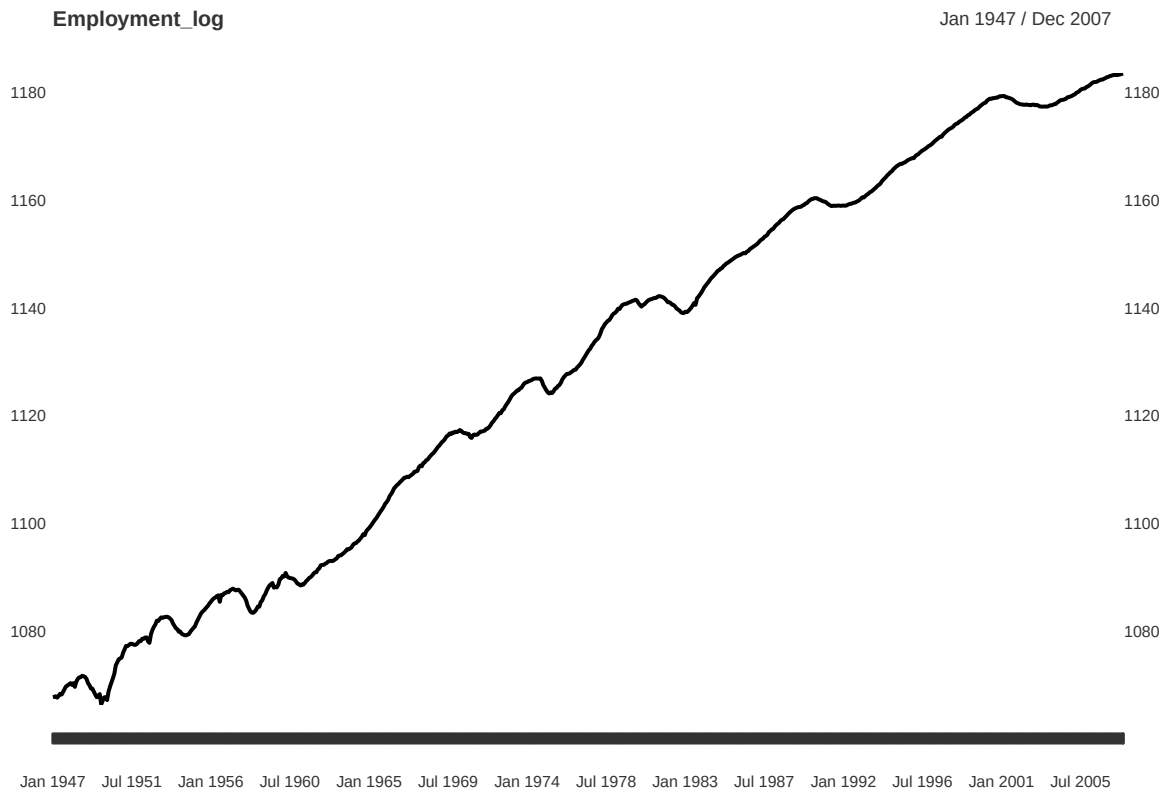

```
plot(gdp_hl2$x.1, grid.col = "white")
```



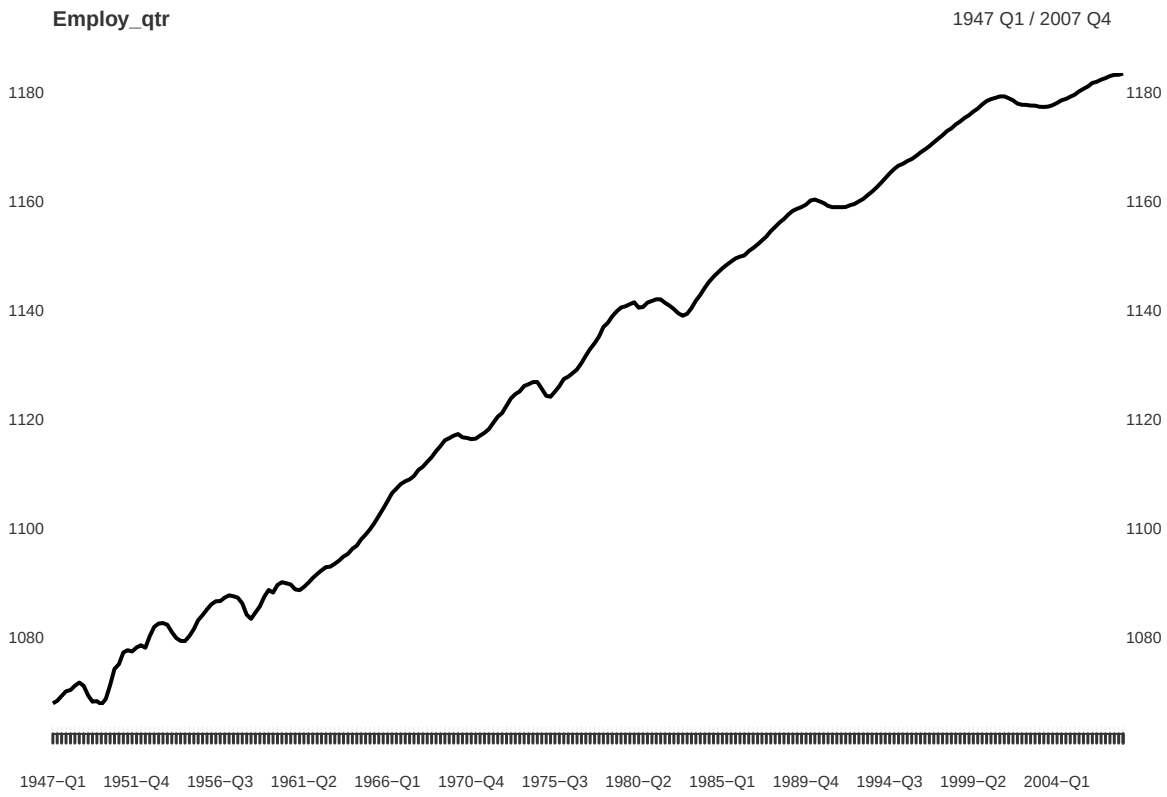

```
plot(gdp_hl$residuals, col="black", type="l")
abline(v = 1982, lty = 2, col = "darkgreen")
abline(h = 0, lty = 2, col = "darkgreen")
```



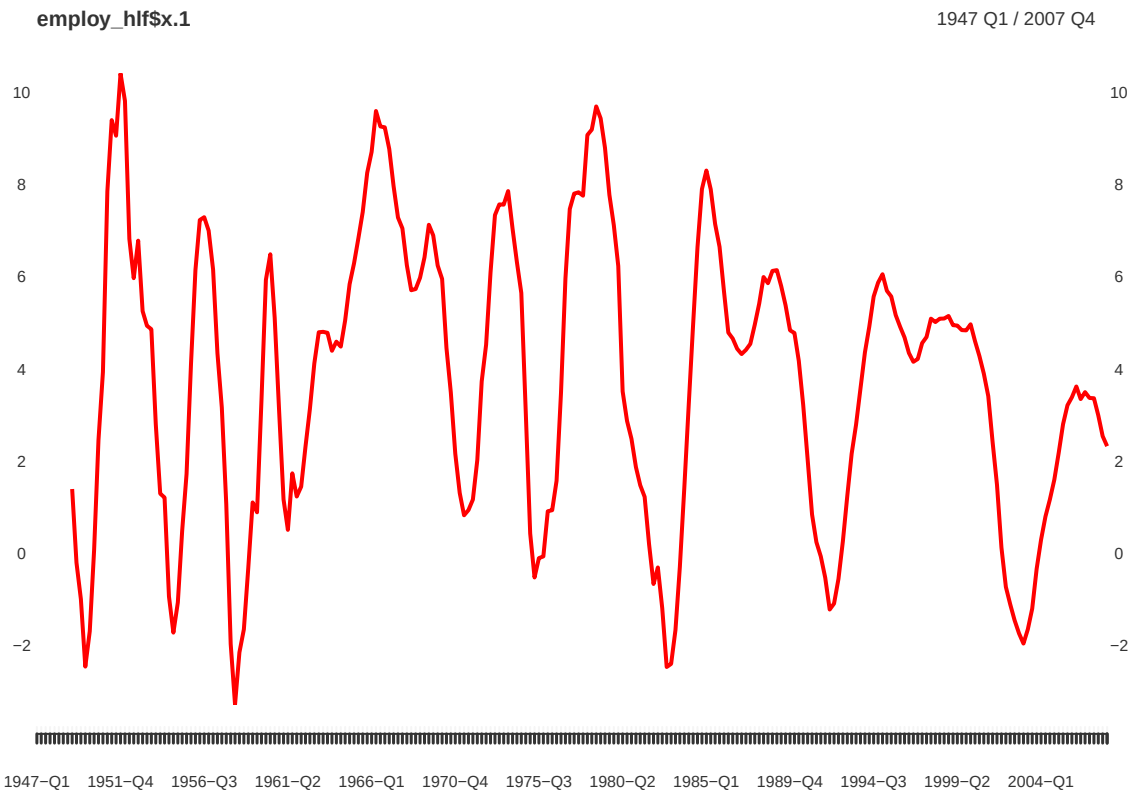

```
# household
Employment_log <- 100*(log(Employment_Establishment["1947/2007"]))
plot(Employment_log, grid.col = "white")
```




```
Employ_qtr <- to.quarterly(Employment_log, indexAt = 'yearqtr', OHLC=FALSE)
plot(Employ_qtr, grid.col = "white")
```




```
employ_hlm <- HL_filter_lm(Employ_qtr)
employ_hlf <- HL_filter(Employ_qtr)

plot(employ_hlf$x.1, col = "red", grid.col = "white")
```




```
lines(employ_hlf$HL_resid, col = "black")
```

```
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```
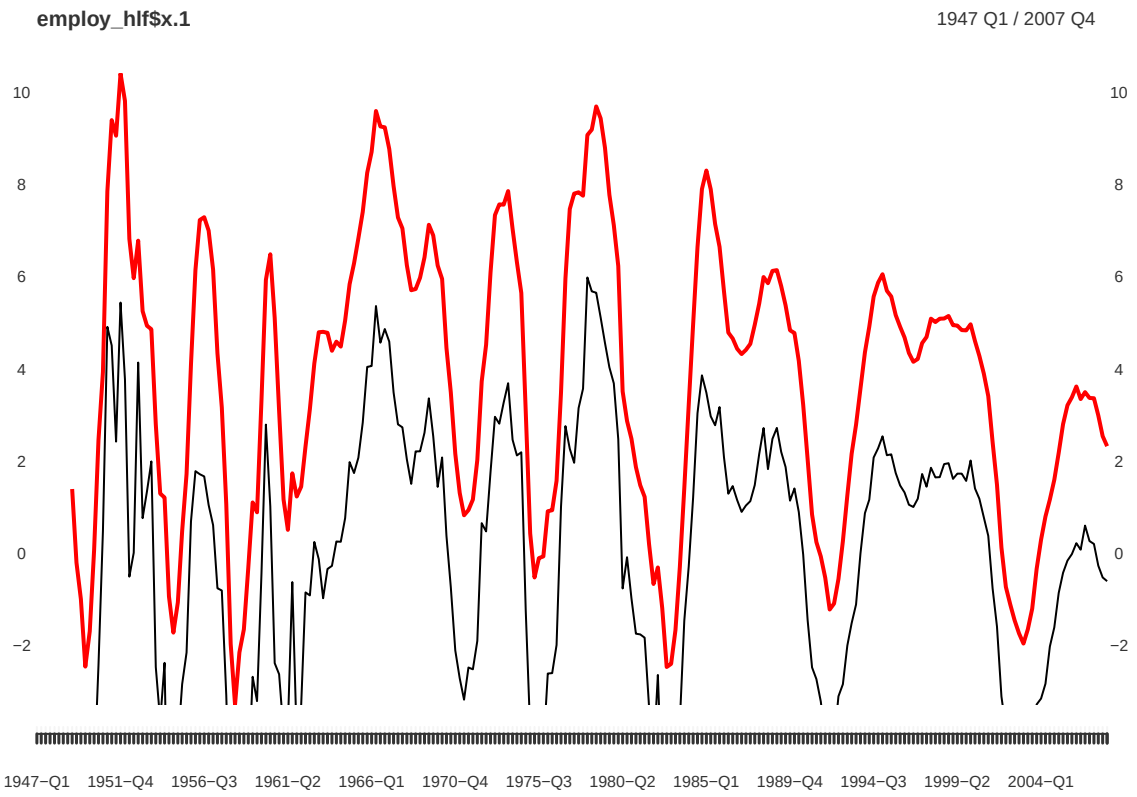
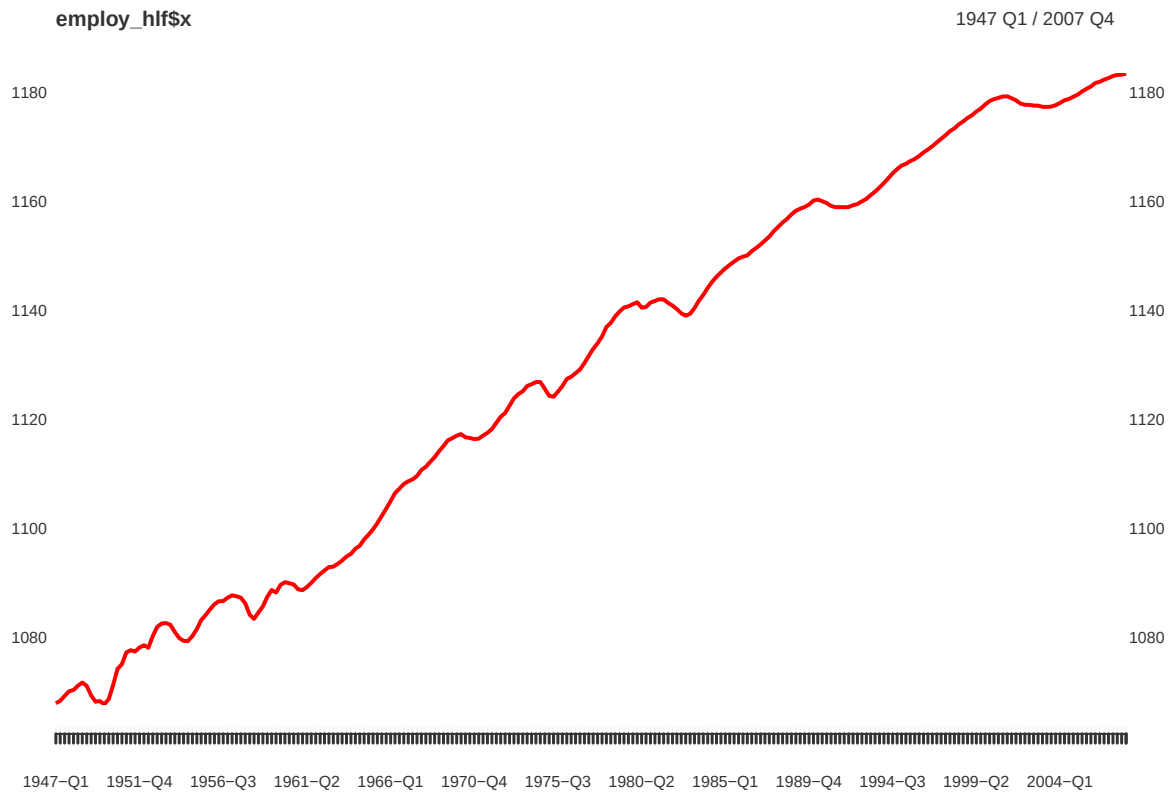




```
plot(employ_hlf$x, col = "red", grid.col = "white")
```




```
lines(employ_hlf$HL_fit, col = "black")
```

```
## Warning in as_numeric(H): NAs introduced by coercion

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```
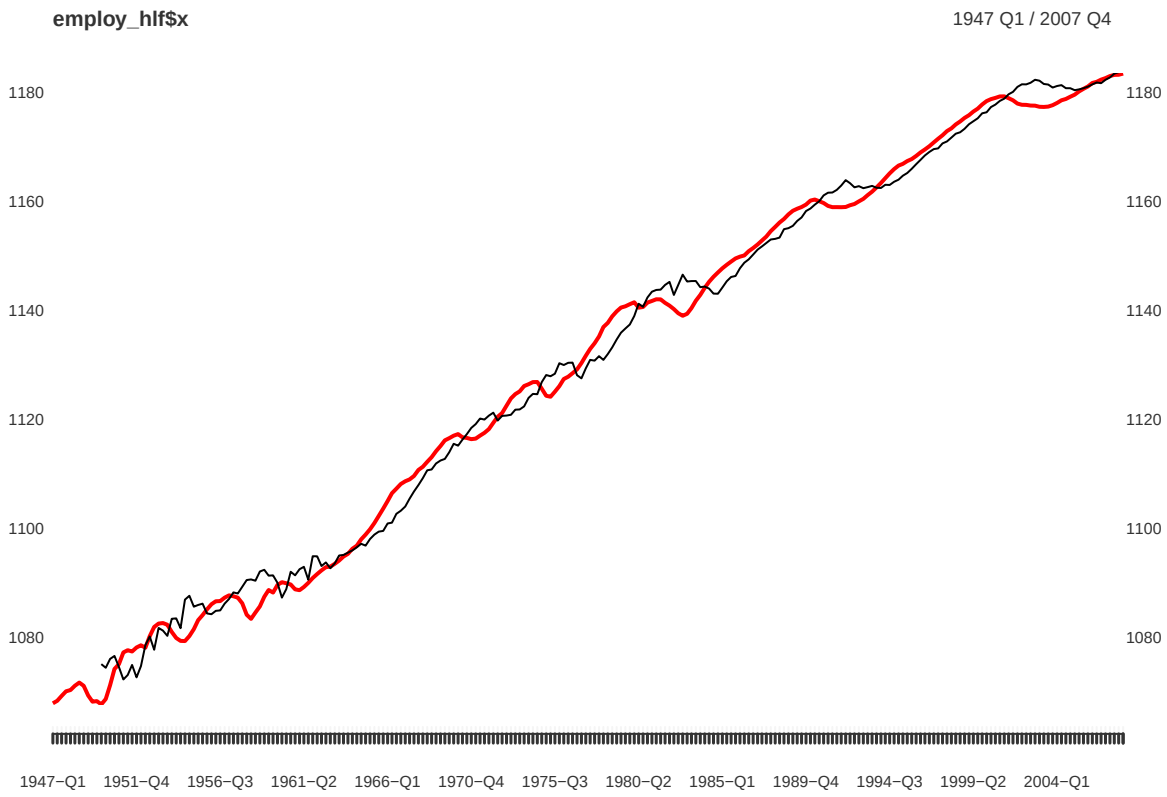
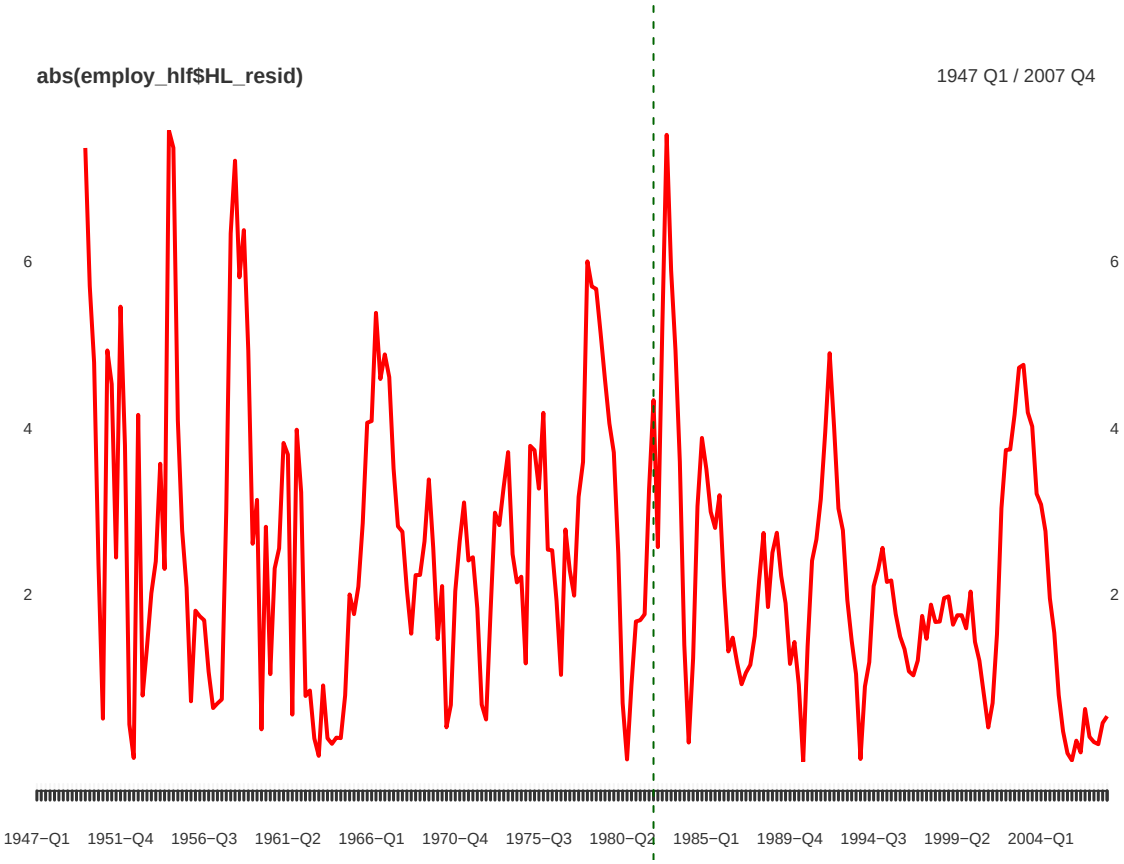




```
plot(abs(employ_hlf$HL_resid), index(employ_hlf), col = "red", grid.col = "white")
abline(v = .index(employ_hlf["1982"])[1], lty = 2, col = "darkgreen")
```


abs(employ_hlf$HL_resid)
1947 Q1 / 2007 Q4
6
4
2
6
4
2
1947−Q1
1951−Q4
1956−Q3
1961−Q2
1966−Q1
1970−Q4
1975−Q3
1980−Q2
1985−Q1
1989−Q4
1994−Q3
1999−Q2
2004−Q1