HuberMokate_28April

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Overview

Minimum Wage is a piece of federal economic policy that sets a floor for wage work in the United States. Originally brought into law during the Great Depression in the 1930's, the aim was to create "minimum standard of living necessary for health, efficiency and general well-being, without substantially curtailing employment". [source]

Ever since its creation, there has been vigorous debate across the US political spectrum as to what the value of a minimum wage should be or there should be one at all. As the "Fight for 15" political movement rises to prominence on the national level, some economists argue that $15/hour simply isn't ambitious enough or a reflection of the economy as a whole. The Center for Economic and Policy Research (CEPR) claims, "Until 1968, the minimum wage not only kept pace with inflation, it rose in step with productivity growth. The logic is straightforward; we expect that wages in general will rise in step with productivity growth. For workers at the bottom to share in the overall improvement in society's living standards, the minimum wage should also rise with productivity." (https://cepr.net/this-is-what-minimum-wage-would-be-if-it-kept-pace-with-productivity)

This analysis will examine that claim through our own analysis of the numbers, looking to see what the value of the minimum wage would be if, from its inception, minimum wage was increased according to those two variables. Access to data to produce our own analysis is fairly straightforward, The US Bureau of Labor and Statistics (BLS) has tracked two key productivity measurements since 1948—a raw productivity rate (measuring output per hour) and a multifactor productivity rate (measuring output per unit of combined inputs) [(https://www.bls.gov/bls/productivity.htm)]. We will be using the raw productivity rate since we were able to access cleaned data

The value of inflation of the US dollar is important to factor in because it imbeds purchasing power of the dollar into what the minimum wage includes. For example, a study by Pew Research demonstrates that the minimum wage in 1973, $4.03/hr, has the same purchasing power of $23.68 in August 2018 — more than three times the actual minimum wage [https://www.pewresearch.org/facttank/2018/08/07/for-most-us-workers-real-wages-have-barely-budged-for-decades/].

Citations: https://cepr.net/this-is-what-minimum-wage-would-be-if-it-kept-pace-with-productivity/ https://www.bls.gov/bls/productivity.htm https://www.pewresearch.org/fact-tank/2018/08/07/for-most-us-workers-real-wages-have-barely- budged-for-decades https://www.forbes.com/advisor/personal-finance/minimumwage-debate/ https://democracyjournal.org/magazine/29/minimum-wage-catching-up-to-productivity/ https://www.nytimes.com/2020/06/18/business/coronavirus-minimum-wage-increase.html https://www.cnn.com/interactive/2019/business/us-minimum-wage-by-year/index.html

Guide to key datasets

1. main_set = includes all calculations and multiplies and is un-pivoted (wide)

2. main_dataset_final = includes all calculations and multiplies and is pivoted (long) by dollar value calculations each year
3. wage_values_graph = graphed findings of cacluations
4. table = table for values in years when minimum wage changed

Load Libraries

Gather and Clean Original Data

Add in data from the Economic Policy Institute containing columns for hourly compensation and net productivity by year (1948 through 2018).

```
#Source: https://www.epi.org/productivity-pay-gap/
net_productivity_dataset <- read_csv("Data_HourlyCompensation_NetProd.csv")

net_productivity_dataset <-
  net_productivity_dataset %>%
  select(Year, `Net Productivity`) %>%
  transmute(year = Year,
            net_productivity = `Net Productivity`)
```

Add in data from the US Department of Labor containing raw minimum wage by year.

```
#Source: https://www.dol.gov/agencies/whd/minimum-wage/history/chart#fn4
min_wage_dataset <- read_csv("FederalMinimumWage.csv")

min_wage_dataset <-
  min_wage_dataset %>%
  transmute(year = as.numeric(format(as.Date(mdy(effective_date)), "%Y")),
            raw_min_wage =
              as.numeric(str_replace_all(fed_min_wage, "\\$", "")))

# min_wage_dataset %>%
#   complete(year)

# Transmute year, we have to do some work to parse out the year value
# Transmute raw_min_wage, we want to remove the $ sign.

# NOTE: At this point, the minimum wage dataset only contains years in which
# the minimum wage was adjusted by Congress. We will address this as we
# combine datasets.
```

Useful Q & A about what CPI is and how to interpret: https://www.bls.gov/cpi/questions-and-answers.htm#Question_15

Pull in inflation data from the Bureau of Labor Statistics that details the annual average CPI for the years in our scope. Data download is made possible via an API.

```
# Get "seriesId" from BLS website.This refers to the CPI for all items
# for urban consumers, which is considered the standard for economic
# analysis.
#
# bls_seriesid <- "CUSR0000SA0"
```

```
#
# # BLS API only allows for 10 years of data to be gathered at a time.
# # Therefore, calculate the number of iterations through a for loop
# # needed to capture all data.
#
# num_decades <- round((2018 - 1948) / 10) + 1
#
# # Set initial values for start and end year. In the for loop, we will update
# # these values after gathering the data.
# start_year <- 1948
# end_year <- 1957
#
#
# # Declare inflation_dataset in Global context, update in for-loop
# inflation_dataset
#
# for (i in 1:num_decades) {
#
#   if (i != 1) {
#
#     start_year <- end_year + 1
#     end_year <- start_year + 9
#
#     if (as.numeric(end_year) > 2018) {
#       #This is the final year that we want in the dataset.
#       end_year <- 2018
#     }
#   }
#
#   print(start_year)
#   print(end_year)
#
#   decade_dataset <- bls_api(seriesid = bls_seriesid,
#                         startyear = as.character(start_year),
#                         endyear = as.character(end_year),
#                         annualaverage=TRUE)
#   if (i != 1) {
#     inflation_dataset <- bind_rows(inflation_dataset, decade_dataset)
#   } else {
#     inflation_dataset <- decade_dataset
#   }
# }

# write_csv(inflation_dataset, "Inflation_Dataset")

inflation_dataset <- read_csv("Inflation_Dataset")

# The BLS provides us with monthly CPI values for every year since 1948. We
# need to average these values to create an annual CPI value.

inflation_dataset <-
  inflation_dataset %>%
  group_by(year) %>%
```

```
  summarize(annual_avg_cpi = mean(value))

# Note: In order to calculate inflation between two years, we will use the
# following formula (source: BLS):
#   inflation = ((SecondPeriodCPI - PreviousPeriodCPI) / PreviousPeriodCPI)
```

Pull in and tidy dataset with data relating to who was president each year. This will be used in our table at the end (we do not join until then)

```
presidents <- read_csv('presidents.csv') %>%
  cSplit("President Name,Years In Office,Number,Party", ",") %>% # split values into separate columns
  rename(president = "President Name,Years In Office,Number,Party_1", # rename columns
         years = "President Name,Years In Office,Number,Party_2",
         number = "President Name,Years In Office,Number,Party_3",
         party = "President Name,Years In Office,Number,Party_4") %>%
  separate(years, c("start_year", "end_year"), sep = "-") %>% # separate years values
  mutate(end_year = ifelse(president == "William H. Harrison", 1841, end_year)) %>% # fill in some misc
  mutate(end_year = ifelse(president == "Donald Trump", 2021, end_year)) %>%
  pivot_longer(cols = c(start_year, end_year), # pivot so that years are a column
               names_to = "start_end",
               values_to = "year",
               values_transform = list("year"=as.numeric)) %>%
  select(1, 3, 5) # select only rows we want
```

Combine and Tidy Data

Join datasets

```
#First, combine inflation and min_wage datasets
main_dataset <-
  full_join(min_wage_dataset, inflation_dataset)

#Now, add in the net productivity
main_dataset <-
  full_join(main_dataset, net_productivity_dataset)
```

Tidy main dataset

```
# ensure that year is arrange chronologically and fill minimum wage values down so that all years have
# filter year since our scope is only for 1948 through 2018
main_dataset <-
  main_dataset %>%
  arrange(year) %>%
  fill(raw_min_wage, .direction = "down") %>%
  filter(year >= 1948)
```

Create calculations

Generate a productivity multiplier representing productivity changes year over year. This will be used to calculate a new minimum wage value that is productivity-adjusted.

```r
# We will be using a for loop to calculate this column

# need to create the column with the specified type and length
main_dataset$prod_multiplier <- vector("numeric", nrow(main_dataset))

# loops through the main dataset and takes the difference in percentage year to year, divides this by 1
for (i in 1:nrow(main_dataset)) {

  main_dataset$prod_multiplier[i] <-  {
    if (i == 1) {
      1
    }
    else {
      1 + ((main_dataset$net_productivity[i] -
                          main_dataset$net_productivity[i-1]) / 100)
    }
  }
}
```

Here, we want to convert all dollar amounts in our dataset to 2018 dollars. This will make all the values more readable to our audience.

```r
main_dataset$min_wage_2018_adjusted <- vector("numeric", nrow(main_dataset))

# pull the value for annual average cpi in 2018 and store it in this variable
cpi_for_2018 <- main_dataset[[71,3]]

# loops through rows in main dataset and annual average cpi to a new variable "cpi_for_year"
# creates new variables for a base that assigns the raw minimum wage to the first row (1948) and the mi
# creates new variables for inflation rate that uses the formula for inflation - (CPIx+1 - CPIx ) / CPI

for (i in 1:nrow(main_dataset)) {

  cpi_for_year <- main_dataset$annual_avg_cpi[i]

  # Get previous minimum wage value, which we will then multiply
  # by the inflation percentage between the two years.
  base_min_wage_for_year <- ifelse(i == 1,
                                   main_dataset$raw_min_wage[i],
                                   main_dataset$min_wage_2018_adjusted[i-1])

  if (i == 1) {
  # We use the formula to get inflation and turn it into a decimal.
  # Formula: (CPIx+1 - CPIx ) / CPIx, where:
  # CPIx is Consumer Price Index of Initial Year

  inflation_rate <- ((cpi_for_2018 - cpi_for_year) / cpi_for_year)

  # Multiply the base minimum wage rate (what it was in previous year) by
  # the inflation rate to get an inflation-adjusted value.
  main_dataset$min_wage_2018_adjusted[i] <- inflation_rate * base_min_wage_for_year

  } else {
```

```
    perc_cpi_increase_year_over_year <- cpi_for_year /
      main_dataset$annual_avg_cpi[i - 1]

    main_dataset$min_wage_2018_adjusted[i] <- perc_cpi_increase_year_over_year *
      base_min_wage_for_year

  }
}
```

Create column that divides the average CPI each year by the CPI for 2018 (found above) and multiples by 100

```
# calculate purchasing power
main_dataset$cpi_change_from_2018 <- (main_dataset$annual_avg_cpi / cpi_for_2018) * 100
# 1 dollar today = 10 cents in 1948
# money in 1948 had 90% less purchasing power

#applying purchasing power
main_dataset$min_wage_purchasing_power <- (cpi_for_2018 / main_dataset$annual_avg_cpi) * main_dataset$ra
# minimum wage was the highest as far as purchasing power goes in the 1970's at ~$10.
```

Calculate the productivity-and-inflation-based minimum wage in 2018 dollars

```
# Now that minimum wage is in 2018 dollars, we multiple it by raw percentages
# to get the productivity-and-inflation-based minimum wage. All is in 2018
# dollars.

# need to create the column with the specified type and length
main_dataset$min_wage_prod_adjusted <- vector("numeric", nrow(main_dataset))

# loop through each row in the dataset to return adjusted minimum wage multiplied by the productivity m
for (i in 1:nrow(main_dataset)) {

  main_dataset$min_wage_prod_adjusted[i] <-
    ifelse(i==1,
           (main_dataset$min_wage_2018_adjusted[1] *
             main_dataset$prod_multiplier[i]),
           (main_dataset$min_wage_prod_adjusted[i-1] *
                         main_dataset$prod_multiplier[i]))

}
```

Graph

Pivot columns for graph

```
# Here, we remove unnecessary columns and pivot longer to facilitate graphing
# our data

main_dataset_final <-
  main_dataset %>%
```

```
  pivot_longer(cols = c(raw_min_wage,
                        min_wage_2018_adjusted,
                        min_wage_prod_adjusted,
                        min_wage_purchasing_power),
               names_to = "Type",
               values_to = "Dollars") %>%
  select(year, "Type", "Dollars") # only want several columns relevant for the graph
```

Create a theme

We create a theme will the following qualities:

1. Includes the minimal theme included in R
2. Assigns the Georgia font to graph text
3. Specifies that the title is bold, size 16, and seagreen
4. Specifies that the subtitle is italic, size 14, and royalblue4
5. Specifies that the axis text is size 12 and navyblue
6. Eliminate axis lines and ticks
7. Rotate x axis values 90 degrees so that entire value is visible and axis is cleaner
8. Specifies that the legend title is bold, size 12, and seagreen
9. Specifies that the legend text is size 12 and navyblue

```
wage_theme <-
  theme_minimal() +
  theme(
    #text = element_text(family = "Georgia"),
    plot.title = element_text(face = "bold", size = 16, color = "seagreen"),
    plot.subtitle = element_text(face = "italic", size = 14, color = "royalblue4"),
    axis.title = element_text(size = 14, face = "bold", color = "seagreen"),
    axis.text = element_text(size = 12, color = "navyblue"),
    axis.line = element_blank(),
    axis.ticks = element_blank(),
    axis.text.x = element_text(angle = 90),
    legend.title = element_text(size = 12, face = "bold", color = "seagreen"),
    legend.text = element_text(size = 12, color = "navyblue"))
```

Create column in un-pivoted dataset to identify years that the minimum wage changed

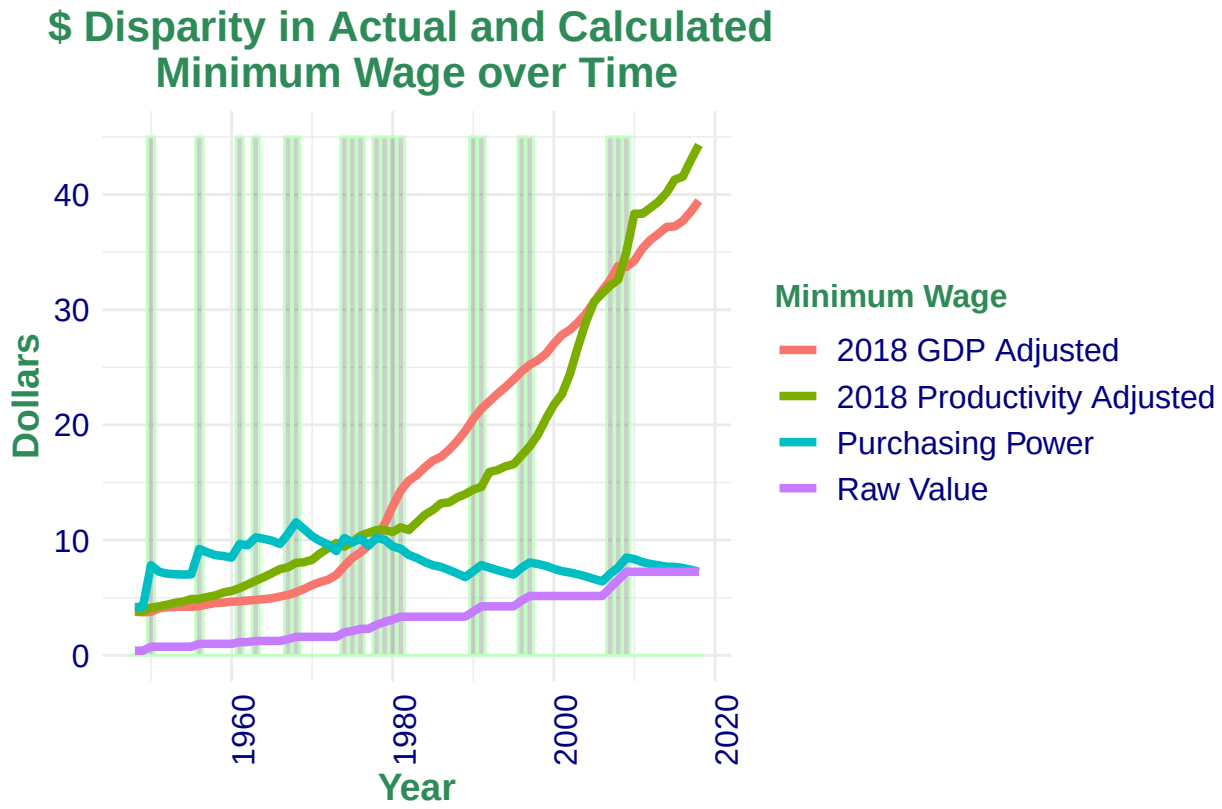
```
# need to create the column with the specified type and length
main_dataset$wage_change <- vector("numeric", nrow(main_dataset))

# loops through rows in main_dataset and returns 0 if they did not change from the previous year (row)
for (i in seq(nrow(main_dataset))) {
  if (i == 1) {
    main_dataset$wage_change[i] <- 0
  } else {
    if (main_dataset$raw_min_wage[i] == main_dataset$raw_min_wage[i - 1]) {
    main_dataset$wage_change[i] <- 0 # do not want these values to show up when graphed
    }
    else {
    main_dataset$wage_change[i] <- 45 # assign value of 45 so that it will align with our other graph w
```

```
    }
  }
}
```

Create Graph to show changed the different minimum wage values that we calculated as well as raw minimum wage

Create two parts of the graph: year when minimum wage changed as a background bar graph with high transparency and a line graph for the various minimum wage values



Year when the federal minimum wage changed shown in green

Interpret Graph

——> general question: are the legend values descriptive enough? should we rename or add footnotes?

As discussed in the overview, the current discussions surrounding minimum wage increases are very polarizing, with impassioned beliefs of pros and cons from proponents and opponents of the measure. Key arguments made against raising minimum wage are that the increase could lead to inflation and job losses, and negatively impact businesses. Conversely, proponents raise points about the increased costs of living and claim that the current rate is not sufficient income.

Independent of these arguments, our calculations seek to mathematically assess how minimum wage over time has related to important economic factors: purchasing power and worker productivity. In doing this, we can provide color about what how minimum wage has changed contextually from 1940 to 2018. The findings of our calculations are visually presented through the graph, which allows us to easily identify how actual raw minimum wage relates to the identified economic factors year over year.

2018 GDP Adjusted Versus Raw Value:

The graph shows the steady shallow slope of the raw value of minimum wage over time, ending in a value of $7.25 in 2018. On the other hand, the 2018 GDP Adjusted line, which calculates minimum wage in 2018 dollars adjusted for GDP, shows a much steeper slope. The slope particularly appears to begin its sharp increase in the late 1970s and really takes off around 1981 (the first year of the Reagan administration), ending with a value of $39.45. The gap between these lines demonstrates the amount that wage has failed to increase proportionately with GDP, or net productivity. In terms of informing policy, a GDP adjusted minimum wage of almost $40 makes the "Fight for 15" appear much less radical.

2018 Productivity Adjusted Versus Raw Value:

——> general question: NOT SURE WHAT TO PUT HERE, SHOULD WE TAKE THIS OUT?

Purchasing Power Versus Raw Value:

The graph also shows what the Purchasing Power of minimum wage was over the years in 2018 values. Since the calculation is based on 2018 values, the Raw Value for minimum wage in 2018 is logically equal to its 2018 purchasing power. Though, when looking back year over year, it is clear that the purchasing power of minimum wage has historically been much higher, with the 1940 value of $4.18 representing a purchasing power of **over ten times** the minimum wage value.

These metrics highlight that minimum wage over time has failed to keep pace with the economic factors of productivity and purchasing power.

Years with Changes in Federal Minimum Wage

Another informative component of the graph is the green bars, which represent years when federal minimum wage increased. From this analysis, we can see that the longest periods where minimum wage went unchanged were from 1982-1989 (Reagan), 1997-2007 (Clinton and Bush), and from 2009-present (Obama, Trump, Biden). Further, 1974-1981 had almost annual increases in federal minimum wage. Though the increases do not appear to have kept pace with the increasing GDP those years, the increases prevented the gap from widening as much as it would have if the wage had flat-lined. The context provided from viewing historical increases in minimum wage make it clear that the unchanged federal minimum wage from 2009-2018 (and, indeed, to 2021), is an uncommonly long duration. Further, while raw minimum wage has plateaued, 2018 GDP Adjusted values continue to increase shaply and steadily.

Table

```
# Add in president data pulled in earlier
# This helps us to provide some analysis of what administrations increased wages for context, reference
p1 <-
  left_join(main_dataset, presidents)

p2 <- p1 %>%
  fill(president, .direction = "up") %>%
  fill(party, .direction = "up") # ensure that all years have party and president values, not just star

wage_with_pres <- p2[!duplicated(p2$year, fromLast = T), ] # clear out any duplicated years by taking t
```

Here, we want a table that shows all of our calculated values in years where Congress adjusted the minimum wage

```
# Create table data; we want to narrow down
table_dataset <-
  left_join(wage_with_pres, min_wage_dataset) %>%
  filter(wage_change == 45) %>%
  filter(year >= 1948) %>%
  select(year,
         president,
         raw_min_wage,
         min_wage_purchasing_power,
         min_wage_2018_adjusted,
         min_wage_prod_adjusted) %>%
  mutate("Number of Years Since Last Change" = year - lag(year, default = first(year))) %>% # calculate
  mutate(year = as.character(year))

# Convert all dollar values to currency type
table_dataset$raw_min_wage <- currency(table_dataset$raw_min_wage, digits = 2L)
table_dataset$min_wage_purchasing_power <- currency(table_dataset$min_wage_purchasing_power, digits = 2
table_dataset$min_wage_2018_adjusted <- currency(table_dataset$min_wage_2018_adjusted, digits = 2L)
table_dataset$min_wage_prod_adjusted <- currency(table_dataset$min_wage_prod_adjusted, digits = 2L)

year_footnote <- "Year congress updated minimum wage."
raw_min_wage_footnote <- "Original dollar amounts."
purchasing_power_footnote <- "What is this equivalent to in 2018 dollars?"
actual_min_wage_footnote <- "Min wage if it was adjusted for inflation."
productivity_min_wage_footnote <- "Min wage with productivity."

table <-
  table_dataset %>%
  kable(col.names = c("Year[note]",
                      "President",
                      "Raw Minimum Wage[note]",
                      "Purchasing Power[note]",
                      "Actual Minimum Wage[note]",
                      "Productivity Minimum Wage[note]",
                      "Number of Years Since Last Change"),
      align = "ccccccc",
      caption = "Minimum Wage",
      format.args = list(big.mark = ","),
      digits = c(0, 2, 2, 2, 2)) %>%
  kable_paper(font_size = 10,
              html_font = "Georgia",
              full_width = T) %>%
  kable_styling(latex_options = "striped") %>%
  add_footnote(c(year_footnote,
                 raw_min_wage_footnote,
                 purchasing_power_footnote,
                 actual_min_wage_footnote,
                 productivity_min_wage_footnote)) %>%
  row_spec(0, bold = T, color = "red") %>% # make column headers green
  column_spec(7, color = c(rep("black", 13), "red", "black", "black", "black", "red", rep("black", 19)))
  column_spec(1, bold = T)
```

```
table
```

Table 1: Minimum Wage

Year[a]	President	Raw Minimum Wage[b]	Purchasing Power[c]	Actual Minimum Wage[d]	Productivity Minimum Wage[e]	Number of Years Since Last Change
1950	Harry S. Truman	$0.75	$7.83	$3.78	$4.13	0
1956	Dwight D. Eisenhower	$1.00	$9.23	$4.27	$4.90	6
1961	John F. Kennedy	$1.15	$9.66	$4.70	$5.83	5
1963	Lyndon B. Johnson	$1.25	$10.25	$4.81	$6.47	2
1967	Lyndon B. Johnson	$1.40	$10.53	$5.24	$7.64	4
1968	Lyndon B. Johnson	$1.60	$11.55	$5.47	$8.03	1
1974	Gerald Ford	$2.00	$10.18	$7.75	$9.44	6
1975	Gerald Ford	$2.10	$9.80	$8.46	$9.84	1
1976	Gerald Ford	$2.30	$10.14	$8.94	$10.38	1
1978	James (Jimmy) Carter	$2.65	$10.20	$10.25	$10.87	2
1979	James (Jimmy) Carter	$2.90	$10.03	$11.40	$10.86	1
1980	James (Jimmy) Carter	$3.10	$9.45	$12.94	$10.71	1
1981	Ronald Reagan	$3.35	$9.25	$14.28	$11.11	1
1990	George H.W. Bush	$3.80	$7.30	$20.52	$14.38	9
1991	George H.W. Bush	$4.25	$7.84	$21.39	$14.60	1
1996	William (Bill) Clinton	$4.75	$7.60	$24.64	$17.35	5
1997	William (Bill) Clinton	$5.15	$8.06	$25.22	$18.13	1
2007	George W. Bush	$5.85	$7.08	$32.57	$32.10	10
2008	George W. Bush	$6.55	$7.64	$33.81	$32.61	1
2009	Barack Obama	$7.25	$8.48	$33.71	$35.01	1

[a] Year congress updated minimum wage.
[b] Original dollar amounts.
[c] What is this equivalent to in 2018 dollars?
[d] Min wage if it was adjusted for inflation.
[e] Min wage with productivity.