Essay_markdown_final

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Set up

Data importing (Following Course Book "Assessment Data")

```
library(ggplot2)
library(plyr)
library(gdata)
```

```
##
## Attaching package: 'gdata'

## The following object is masked from 'package:stats':
##
##     nobs

## The following object is masked from 'package:utils':
##
##     object.size

## The following object is masked from 'package:base':
##
##     startsWith
```

```
library(stringr)
library(data.table)
```

```
##
## Attaching package: 'data.table'

## The following objects are masked from 'package:gdata':
##
##     first, last
```

```
## Prep Osnabrugge et al.
data = fread("/Users/garamkim/Downloads/dataverse_files/uk_data.csv", encoding="UTF-8")
data$date = as.Date(data$date)

#Create time variable
```

```
data$time= NA
data$time[data$date>=as.Date("2001-01-01") & data$date<=as.Date("2001-06-30")] = "01/1"
data$time[data$date>=as.Date("2001-07-01") & data$date<=as.Date("2001-12-31")] = "01/2"
data$time[data$date>=as.Date("2002-01-01") & data$date<=as.Date("2002-06-30")] = "02/1"
data$time[data$date>=as.Date("2002-07-01") & data$date<=as.Date("2002-12-31")] = "02/2"
data$time[data$date>=as.Date("2003-01-01") & data$date<=as.Date("2003-06-30")] = "03/1"
data$time[data$date>=as.Date("2003-07-01") & data$date<=as.Date("2003-12-31")] = "03/2"
data$time[data$date>=as.Date("2004-01-01") & data$date<=as.Date("2004-06-30")] = "04/1"
data$time[data$date>=as.Date("2004-07-01") & data$date<=as.Date("2004-12-31")] = "04/2"
data$time[data$date>=as.Date("2005-01-01") & data$date<=as.Date("2005-06-30")] = "05/1"
data$time[data$date>=as.Date("2005-07-01") & data$date<=as.Date("2005-12-31")] = "05/2"
data$time[data$date>=as.Date("2006-01-01") & data$date<=as.Date("2006-06-30")] = "06/1"
data$time[data$date>=as.Date("2006-07-01") & data$date<=as.Date("2006-12-31")] = "06/2"
data$time[data$date>=as.Date("2007-01-01") & data$date<=as.Date("2007-06-30")] = "07/1"
data$time[data$date>=as.Date("2007-07-01") & data$date<=as.Date("2007-12-31")] = "07/2"
data$time[data$date>=as.Date("2008-01-01") & data$date<=as.Date("2008-06-30")] = "08/1"
data$time[data$date>=as.Date("2008-07-01") & data$date<=as.Date("2008-12-31")] = "08/2"
data$time[data$date>=as.Date("2009-01-01") & data$date<=as.Date("2009-06-30")] = "09/1"
data$time[data$date>=as.Date("2009-07-01") & data$date<=as.Date("2009-12-31")] = "09/2"
data$time[data$date>=as.Date("2010-01-01") & data$date<=as.Date("2010-06-30")] = "10/1"
data$time[data$date>=as.Date("2010-07-01") & data$date<=as.Date("2010-12-31")] = "10/2"
data$time[data$date>=as.Date("2011-01-01") & data$date<=as.Date("2011-06-30")] = "11/1"
data$time[data$date>=as.Date("2011-07-01") & data$date<=as.Date("2011-12-31")] = "11/2"
data$time[data$date>=as.Date("2012-01-01") & data$date<=as.Date("2012-06-30")] = "12/1"
data$time[data$date>=as.Date("2012-07-01") & data$date<=as.Date("2012-12-31")] = "12/2"
data$time[data$date>=as.Date("2013-01-01") & data$date<=as.Date("2013-06-30")] = "13/1"
data$time[data$date>=as.Date("2013-07-01") & data$date<=as.Date("2013-12-31")] = "13/2"
data$time[data$date>=as.Date("2014-01-01") & data$date<=as.Date("2014-06-30")] = "14/1"
data$time[data$date>=as.Date("2014-07-01") & data$date<=as.Date("2014-12-31")] = "14/2"
data$time[data$date>=as.Date("2015-01-01") & data$date<=as.Date("2015-06-30")] = "15/1"
data$time[data$date>=as.Date("2015-07-01") & data$date<=as.Date("2015-12-31")] = "15/2"
data$time[data$date>=as.Date("2016-01-01") & data$date<=as.Date("2016-06-30")] = "16/1"
data$time[data$date>=as.Date("2016-07-01") & data$date<=as.Date("2016-12-31")] = "16/2"
data$time[data$date>=as.Date("2017-01-01") & data$date<=as.Date("2017-06-30")] = "17/1"
data$time[data$date>=as.Date("2017-07-01") & data$date<=as.Date("2017-12-31")] = "17/2"
data$time[data$date>=as.Date("2018-01-01") & data$date<=as.Date("2018-06-30")] = "18/1"
data$time[data$date>=as.Date("2018-07-01") & data$date<=as.Date("2018-12-31")] = "18/2"
data$time[data$date>=as.Date("2019-01-01") & data$date<=as.Date("2019-06-30")] = "19/1"
data$time[data$date>=as.Date("2019-07-01") & data$date<=as.Date("2019-12-31")] = "19/2"

data$time2 = data$time
data$time2 = str_replace(data$time2, "/", "_")

data$stage = 0
data$stage[data$m_questions==1]= 1
data$stage[data$u_questions==1]= 2
data$stage[data$queen_debate_others==1]= 3
data$stage[data$queen_debate_day1==1]= 4
data$stage[data$pm_questions==1]= 5
```

Inspecting data and selecting some parts of data for the research

```r
# Packages
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.3     v readr     2.1.4
## v forcats   1.0.0     v tibble    3.2.1
## v lubridate 1.9.3     v tidyr     1.3.0
## v purrr     1.0.2
## -- Conflicts ---------------------------------------- tidyverse_conflicts() --
## x dplyr::arrange()     masks plyr::arrange()
## x dplyr::between()     masks data.table::between()
## x dplyr::combine()     masks gdata::combine()
## x purrr::compact()     masks plyr::compact()
## x dplyr::count()       masks plyr::count()
## x dplyr::desc()        masks plyr::desc()
## x dplyr::failwith()    masks plyr::failwith()
## x dplyr::filter()      masks stats::filter()
## x dplyr::first()       masks data.table::first(), gdata::first()
## x lubridate::hour()    masks data.table::hour()
## x dplyr::id()          masks plyr::id()
## x lubridate::isoweek() masks data.table::isoweek()
## x purrr::keep()        masks gdata::keep()
## x dplyr::lag()         masks stats::lag()
## x dplyr::last()        masks data.table::last(), gdata::last()
## x lubridate::mday()    masks data.table::mday()
## x lubridate::minute()  masks data.table::minute()
## x lubridate::month()   masks data.table::month()
## x dplyr::mutate()      masks plyr::mutate()
## x lubridate::quarter() masks data.table::quarter()
## x dplyr::rename()      masks plyr::rename()
## x lubridate::second()  masks data.table::second()
## x dplyr::starts_with() masks tidyr::starts_with(), gdata::starts_with()
## x dplyr::summarise()   masks plyr::summarise()
## x dplyr::summarize()   masks plyr::summarize()
## x purrr::transpose()   masks data.table::transpose()
## x lubridate::wday()    masks data.table::wday()
## x lubridate::week()    masks data.table::week()
## x lubridate::yday()    masks data.table::yday()
## x lubridate::year()    masks data.table::year()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```r
library(readr)
library(tidytext)
library(quanteda)
```

```
## Package version: 3.3.1
## Unicode version: 14.0
## ICU version: 71.1
## Parallel computing: 8 of 8 threads used.
## See https://quanteda.io for tutorials and examples.
```

```r
library(textdata)
```

```r
#Filtering data columns
colnames(data)
```

```
##  [1] "id_speech"               "id_mp"
##  [3] "period"                  "last_name"
##  [5] "first_name"              "date"
##  [7] "pm_questions"            "queen_debate_day1"
##  [9] "queen_debate_others"     "m_questions"
## [11] "u_questions"             "other_debate"
## [13] "leader"                  "prime_minister"
## [15] "senior_minister"         "shadow"
## [17] "cabinet"                 "chair"
## [19] "government"              "female"
## [21] "age"                     "electoral_cycle"
## [23] "party"                   "linear_trend"
## [25] "words"                   "text"
## [27] "emotive_count"           "neutral_count"
## [29] "emotive_rhetoric"        "emotive_rhetoric_log"
## [31] "emotive_words"           "top_topic"
## [33] "anew_rescaled"           "emotive_rhetoric_liwc"
## [35] "positive_count"          "negative_count"
## [37] "emotive_positive"        "emotive_negative"
## [39] "emotive_count_250_8"     "neutral_count_250_8"
## [41] "emotive_rhetoric_250_8"  "emotive_count_300_10"
## [43] "neutral_count_300_10"    "emotive_rhetoric_300_10"
## [45] "emotive_count_a1"        "neutral_count_a1"
## [47] "emotive_rhetoric_a1"     "emotive_count_a2"
## [49] "neutral_count_a2"        "emotive_rhetoric_a2"
## [51] "time"                    "time2"
## [53] "stage"
```

```r
data <- data %>%
  select(last_name, first_name, date, female, age, party, text)
head(data)
```

```
##    last_name first_name       date female   age                party
##       <char>     <char>     <Date>  <int> <int>               <char>
## 1:   dalyell        tam 2001-06-13      0    69               Labour
## 2:     young     george 2001-06-13      0    60          Conservative
## 3:      cook      robin 2001-06-13      0    55               Labour
## 4:     hague    william 2001-06-13      0    40          Conservative
## 5:   kennedy    charles 2001-06-13      0    42     Liberal Democrats
## 6:   trimble      david 2001-06-13      0    57 Ulster Unionist Party
##
##
## 1:
## 2:
## 3:
## 4: On behalf of all my right hon and hon Friends on the Opposition Benches I offer our sincerest con
## 5:
## 6:
```

Defining research data by filtering research words

```
# Filtering data containing immigration related words
# Define the keywords to search for
immig_words <- c('immigration', 'immigrant', 'asylum')
visa_words <- "\\b(UK)?visas?\\b"
all_words <- paste0(c(paste0(immig_words, collapse = "|"), visa_words), collapse = "|")

# lower case text with keywords
tidy_data_notoken <- data %>%
  mutate(desc = tolower(text)) %>%
  filter(grepl(all_words, desc))

# arrange the data by party and count the number of speech
tidy_data_notoken %>%
  group_by(party) %>%
  summarise(count = n()) %>%
  arrange(desc(count))
```

```
## # A tibble: 9 x 2
##   party                      count
##   <chr>                      <int>
## 1 Conservative                7230
## 2 Labour                      6251
## 3 Scottish National Party     1104
## 4 Liberal Democrats            954
## 5 Others                       105
## 6 Democratic Unionist Party     67
## 7 Plaud Cymru                   63
## 8 Green                         21
## 9 Ulster Unionist Party         14
```

1. Word frequency of data

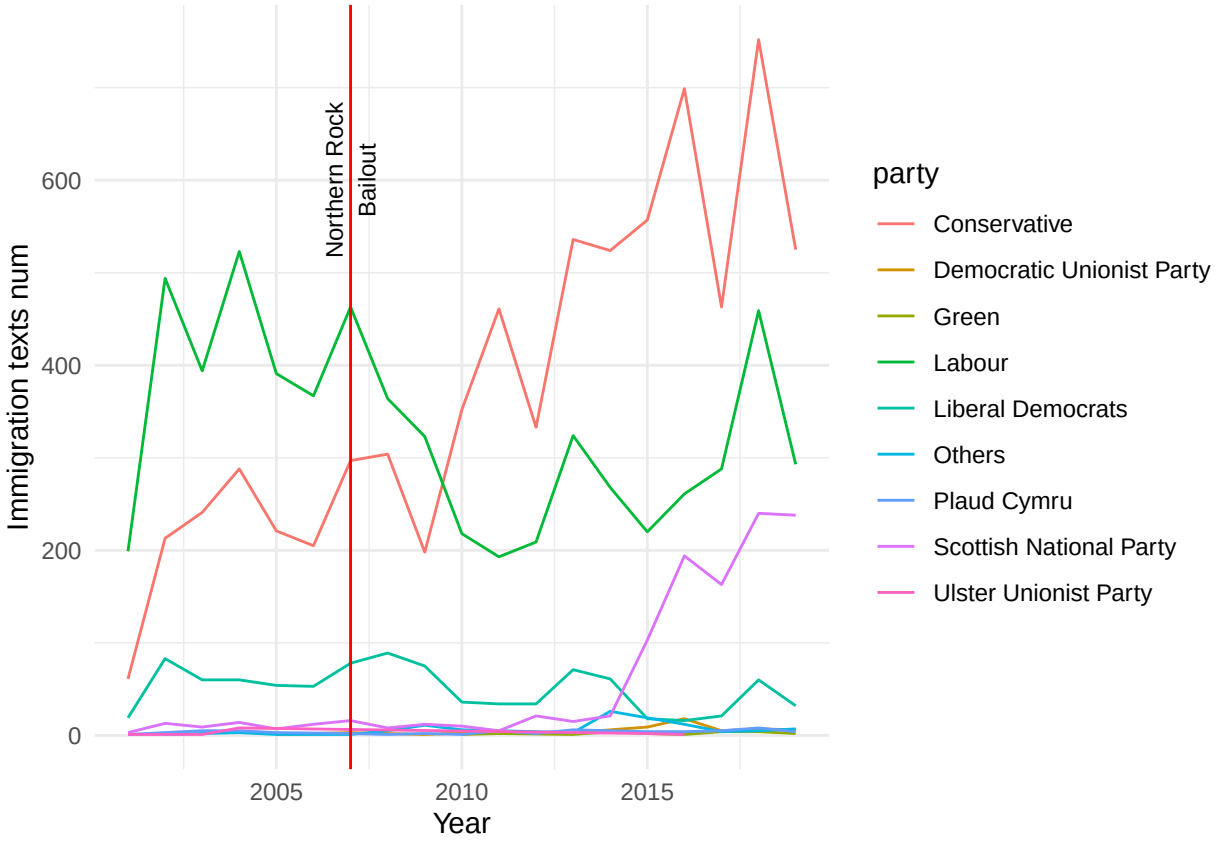
Making 'Year' column

```
# Make 'Year' using 'date'
tidy_data_notoken$Year <- format(as.Date(tidy_data_notoken$date), "%Y")
data$Year <- format(as.Date(data$date), "%Y")

# Count the number of text by year and party
text_count <- tidy_data_notoken %>%
  group_by(Year, party) %>%
  summarise(n = n(), .groups = 'drop')

text_count$Year <- as.numeric(as.character(text_count$Year)) # Make 'Year' Column of numeric character.
```

A Simple descriptive plot - The number of immigration related texts by party

```
# Plotting counts of immigration texts by party
ggplot(text_count, aes(x = Year, y = n, group = party, color = party)) +
```

```
  geom_line() +
  labs(y = "Immigration texts num", x = "Year") +
  theme_minimal() +
  geom_vline(xintercept = as.numeric(format(as.Date("2007-09-14"), "%Y")), col="red") +
  annotate("text", x = as.numeric(format(as.Date("2007-09-14"), "%Y")), y = 600, label="Northern Rock\nB
```

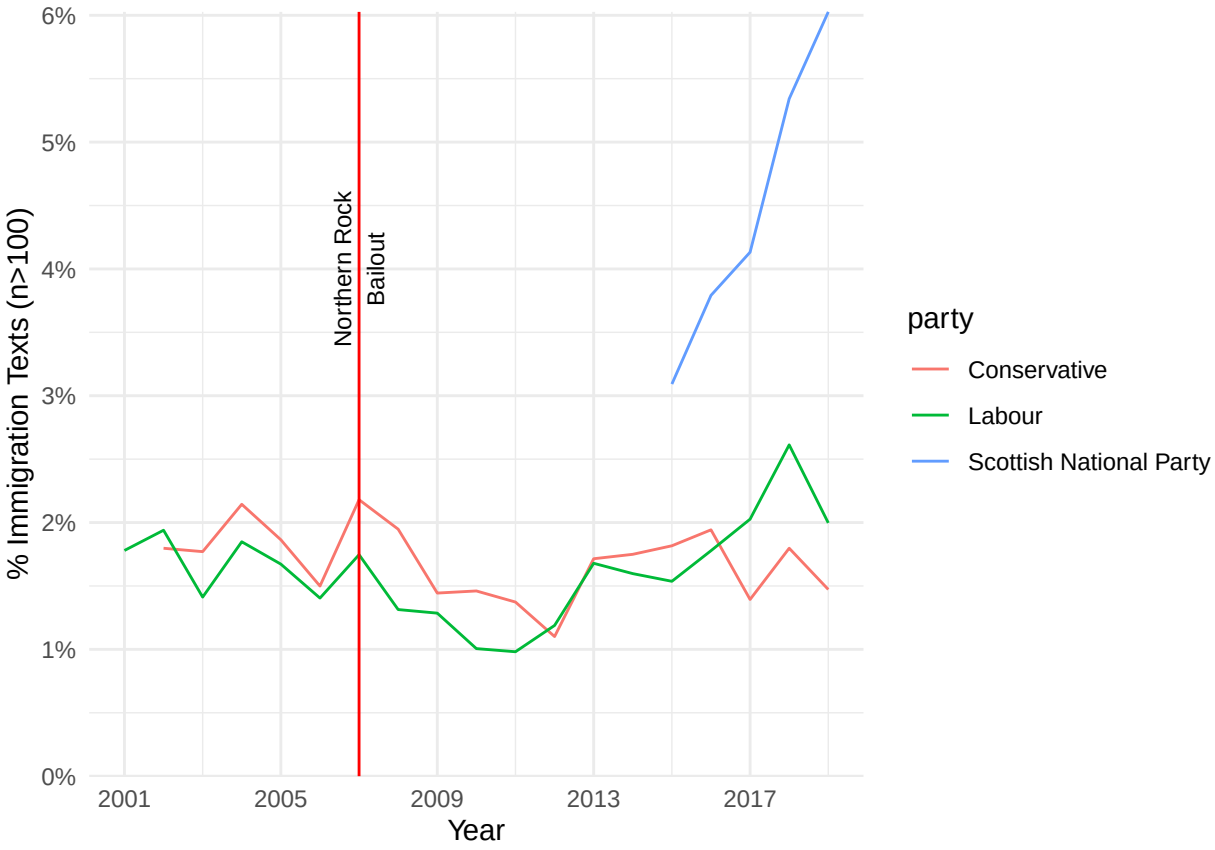


Dividing the number of immigration texts by the total number of texts

```
# Count the total number of texts in data by year and party
data_count <- data %>%
  group_by(Year, party) %>%
  summarise(total_n = n(), .groups = 'drop')

# Merge the counts and calculate the ratio
ratio_count <- merge(text_count, data_count, by = c("Year", "party"))
ratio_count$ratio <- with(ratio_count, n / total_n)

# Only counts more than 100 texts
filtered_ratio_count <- ratio_count %>%
  filter(n > 100)

filtered_ratio_count$Year <- as.numeric(as.character(filtered_ratio_count$Year))
```

A ratio plot of a number of immigration related texts by total texts

```r
#Plotting the ratios of immigration related texts
ggplot(filtered_ratio_count, aes(x = Year, y = ratio, group = party, color = party)) +
  geom_line() +
  labs(y = "% Immigration Texts (n>100)", x = "Year") +
  scale_y_continuous(labels = scales::percent_format(), expand = c(0, 0), limits = c(0, NA)) +
  scale_x_continuous(breaks = seq(min(filtered_ratio_count$Year), max(filtered_ratio_count$Year), by = 4
  theme_minimal() +
  geom_vline(xintercept = as.numeric(format(as.Date("2007-09-14"), "%Y")), col="red") +
  annotate("text", x = as.numeric(format(as.Date("2007-09-14"), "%Y")), y = 0.04, label="Northern Rock\n
```



Tokenisation and processing stop words

```r
# Tokenisation & removing stop words
tidy_data <- tidy_data_notoken %>%
  unnest_tokens(word, desc) %>%
  filter(str_detect(word, "[a-z]")) %>%
  filter(!word %in% stop_words$word)

tidy_data <- tidy_data %>%
  arrange(date)
tidy_data$order <- 1:nrow(tidy_data) # Make orders of each word
```

```r
# Common tokens
word_count <- tidy_data %>%
  count(word, sort = T)
```

```r
show(word_count)
```

```
##                word     n
##              <char> <int>
##     1:      people 27644
##     2:         hon 26615
##     3:  government 26551
##     4: immigration 19105
##     5:    minister 14229
##    ---
## 39501:    énarques     1
## 39502:      ørsted     1
## 39503:         þæt     1
## 39504:    šefcovic     1
## 39505:      štefan     1
```

```r
# Common tokens by year
word_count_year <- tidy_data %>%
  group_by(Year) %>%
  count(word, sort = T)

show(word_count_year)
```

```
## # A tibble: 226,043 x 3
## # Groups:   Year [19]
##    Year  word            n
##    <chr> <chr>       <int>
##  1 2018  government   2122
##  2 2018  people       2060
##  3 2015  people       2058
##  4 2018  immigration  2046
##  5 2004  government   2007
##  6 2002  people       1883
##  7 2018  hon          1851
##  8 2004  hon          1826
##  9 2002  hon          1792
## 10 2007  hon          1792
## # i 226,033 more rows
```

```r
# Comon tokens by party
word_count_party <- tidy_data %>%
  group_by(party) %>%
  count(word, sort = T)

show(word_count_party)
```

```
## # A tibble: 98,986 x 3
## # Groups:   party [9]
##    party        word            n
##    <chr>        <chr>       <int>
##  1 Labour       people      12163
```

```
##  2 Conservative government  12117
##  3 Labour       hon         12010
##  4 Conservative hon         11848
##  5 Conservative people      11229
##  6 Labour       government   9743
##  7 Conservative immigration  9001
##  8 Labour       immigration  7336
##  9 Conservative minister     6290
## 10 Conservative country      6258
## # i 98,976 more rows
```

2. Sentiment Analysis Using 'NRC' Sentiment Dictionary

1)Total sentiment of immigration related texts

Getting NRC sentiment dictionary and tidying data by calculating sentiment ratio

```
get_sentiments("nrc")
```

```
## # A tibble: 13,872 x 2
##    word        sentiment
##    <chr>       <chr>
##  1 abacus      trust
##  2 abandon     fear
##  3 abandon     negative
##  4 abandon     sadness
##  5 abandoned   anger
##  6 abandoned   fear
##  7 abandoned   negative
##  8 abandoned   sadness
##  9 abandonment anger
## 10 abandonment fear
## # i 13,862 more rows
```

```
# Make nrc sentiment tables of data
nrc_data <- tidy_data %>%
  inner_join(get_sentiments("nrc"), by = "word") %>%
  count(date, sentiment) %>%
  spread(key = sentiment, value = n, fill = 0) %>%
  mutate(ratio = negative / (positive+1)) # Calculating negative/positive ratio. Adding 1 to avoid the
```

```
## Warning in inner_join(., get_sentiments("nrc"), by = "word"): Detected an unexpected many-to-many rel
## i Row 6 of 'x' matches multiple rows in 'y'.
## i Row 5657 of 'y' matches multiple rows in 'x'.
## i If a many-to-many relationship is expected, set 'relationship =
##   "many-to-many"' to silence this warning.
```

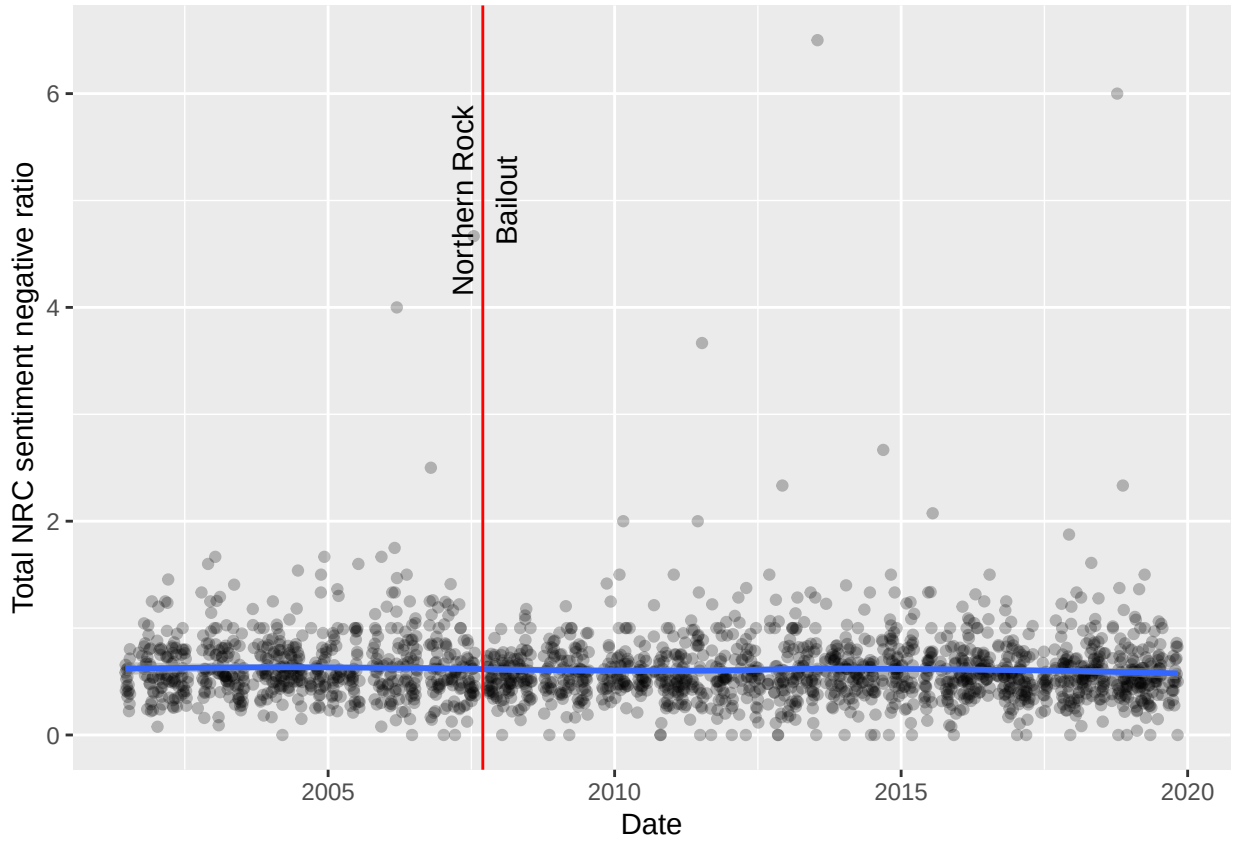
```
# Check sentiments
colnames(nrc_data)
```

```
##  [1] "date"         "anger"        "anticipation" "disgust"      "fear"
##  [6] "joy"          "negative"     "positive"     "sadness"      "surprise"
## [11] "trust"        "ratio"
```

Plotting the total negative ratio

```
# Total sentiment of text including immigration related words plot (Using negative ratio)
nrc_data %>%
  ggplot(aes(date, ratio)) +
  geom_point(alpha=0.25) +
  geom_smooth(method="loess", alpha=0.5) +
  labs(y = "Total NRC sentiment negative ratio", x = "Date") +
  geom_vline(xintercept = as.numeric(as.Date("2007-09-14")), col="red") +
  annotate("text", x = as.Date("2007-09-24"), y = 5, label="Northern Rock\nBailout", angle=90, color =
```

```
## `geom_smooth()` using formula = 'y ~ x'
```



There is no time when particularly negative emotions are revealed. Rather, negative feelings toward immigrants are less visible after the financial crisis.

2) Negative ratio plots by party

Calculating NRC sentiment negative ratios of texts which contain immigration related words *by party*

```r
# Arranging data by party and calculate the ratio of negative sentiment.
nrc_data_party <- tidy_data %>%
  inner_join(get_sentiments("nrc"), by = "word") %>%
  group_by(party, date) %>%
  count(sentiment) %>%
  spread(key = sentiment, value = n, fill = 0) %>%
  mutate(ratio = negative/(positive+1)) %>%
  ungroup()
```

```
## Warning in inner_join(., get_sentiments("nrc"), by = "word"): Detected an unexpected many-to-many rel
## i Row 6 of `x` matches multiple rows in `y`.
## i Row 5657 of `y` matches multiple rows in `x`.
## i If a many-to-many relationship is expected, set `relationship =
##   "many-to-many"` to silence this warning.
```

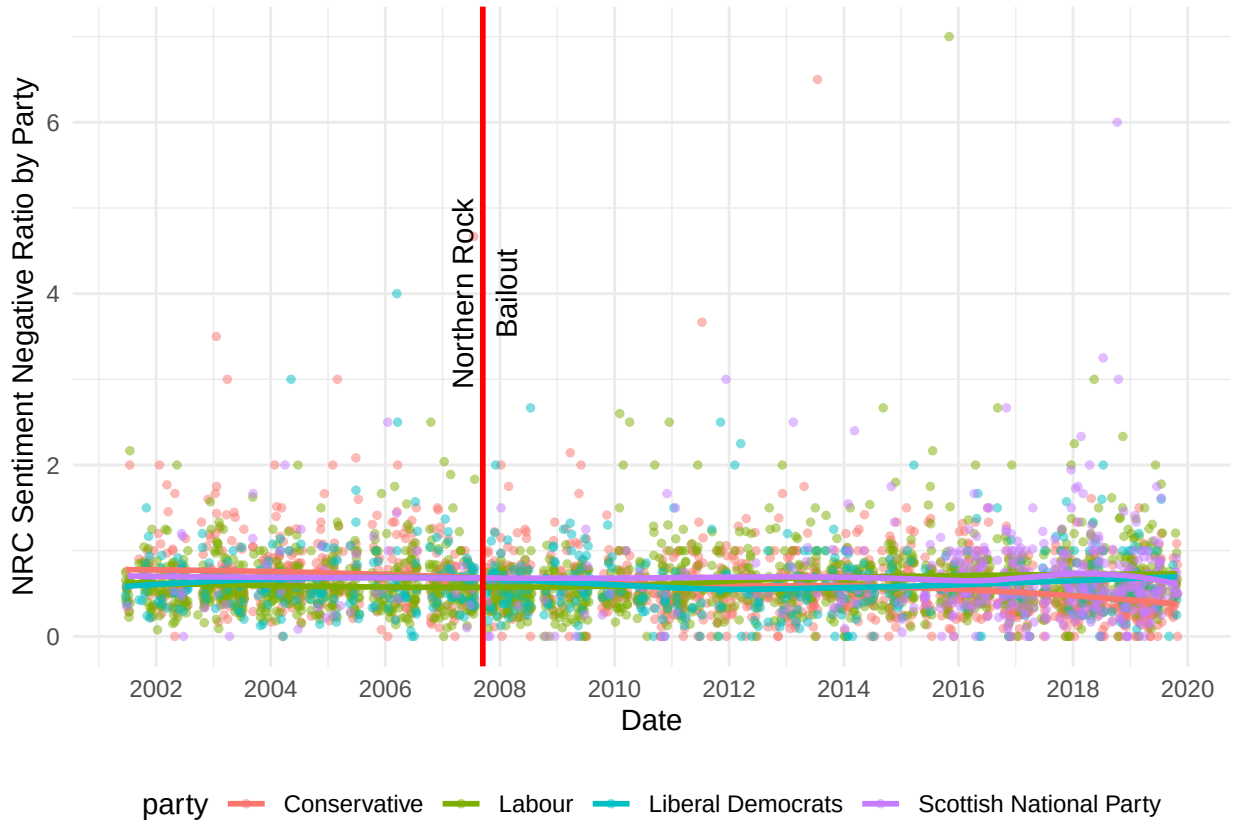
```r
filtered_nrc_data_party <-nrc_data_party %>%
  group_by(party) %>%
  filter(n() > 100) %>% # party with more than 100 related words
  ungroup()
```

Plotting a negative ratio plot of party. Points indicate the actual scores while smooth lines show the trends.

```r
# A negative sentiment ratio plot of four parties
filtered_nrc_data_party %>%
  ggplot(aes(date, ratio, color = party)) +
  geom_point(alpha=0.5, size = 1) +
  geom_smooth(method="loess", se = F, alpha=0.7, size = 1) +
  scale_x_date(date_breaks = "2 years", date_labels = "%Y") +
  labs(y = "NRC Sentiment Negative Ratio by Party", x = "Date") +
  geom_vline(xintercept = as.numeric(as.Date("2007-09-14")), col="red", size = 1) +
  annotate("text", x = as.Date("2007-09-24"), y = 4, label="Northern Rock\nBailout", angle=90, color =
  theme_minimal() +
  theme(legend.position = "bottom")
```

```
## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
## i Please use `linewidth` instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

```
## `geom_smooth()` using formula = 'y ~ x'
```

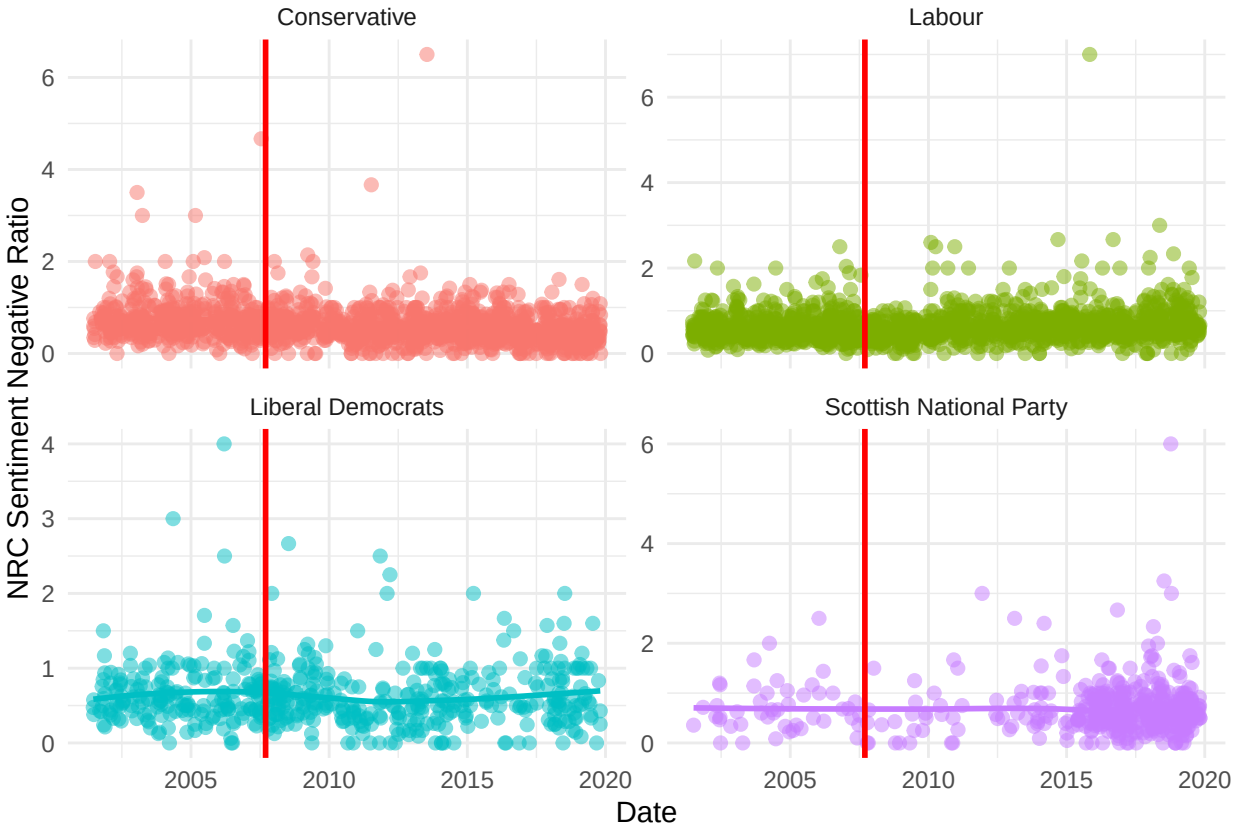


Similar to the overall sentiment plot, there is no period when the proportion of negative words appears prominently.

Make the plot above readable, dividing plots by party

```
# Faceting by party
filtered_nrc_data_party %>%
  ggplot(aes(x = date, y = ratio, color = party)) +
  geom_point(alpha = 0.5, size = 2) +
  geom_smooth(method = "loess", se = FALSE, alpha = 0.7, size = 1) +
  labs(y = "NRC Sentiment Negative Ratio", x = "Date") +
  facet_wrap(~party, scales = "free_y") +
  geom_vline(xintercept = as.numeric(as.Date("2007-09-14")), col = "red", size = 1) +
  theme_minimal() +
  theme(legend.position = "none")
```

```
## `geom_smooth()` using formula = 'y ~ x'
```



Similar to the overall sentiment plot, there is no period when the proportion of negative words appears prominently.

3) Sentiments counts by party

What is the most common sentiment? Summing up scores of sentiments by party to compare.

```
# Total sentiment word counts by party
dominant_senti_nrc_party <-filtered_nrc_data_party %>%
  group_by(party) %>%
  summarise(across(c(anger, anticipation, disgust, fear, joy, sadness, surprise, trust, negative, positi
```

```
## Warning: There was 1 warning in `summarise()`.
## i In argument: `across(...)`.
## i In group 1: `party = "Conservative"`.
## Caused by warning:
## ! The `...` argument of `across()` is deprecated as of dplyr 1.1.0.
## Supply arguments directly to `.fns` through an anonymous function instead.
##
##   # Previously
##   across(a:b, mean, na.rm = TRUE)
##
##   # Now
##   across(a:b, \(x) mean(x, na.rm = TRUE))
```

```r
show(dominant_senti_nrc_party)
```

```
## # A tibble: 4 x 11
##   party   anger anticipation disgust  fear   joy sadness surprise trust negative
##   <chr>   <dbl>        <dbl>   <dbl> <dbl> <dbl>   <dbl>    <dbl> <dbl>    <dbl>
## 1 Conser~ 33439        52127   17861 56500 36474   32322    17703 99258    84545
## 2 Labour  35105        53846   18420 57405 38456   34318    18408 97785    85101
## 3 Libera~  5625         9303    2963  9620  5875    5778     3149 15899    14675
## 4 Scotti~  4637         7398    2523  8180  4986    5388     2638 12649    12877
## # i 1 more variable: positive <dbl>
```

The large number of sentiment counts is generated by the Conservatives and Labor parties.

4) Sentiment changes by party

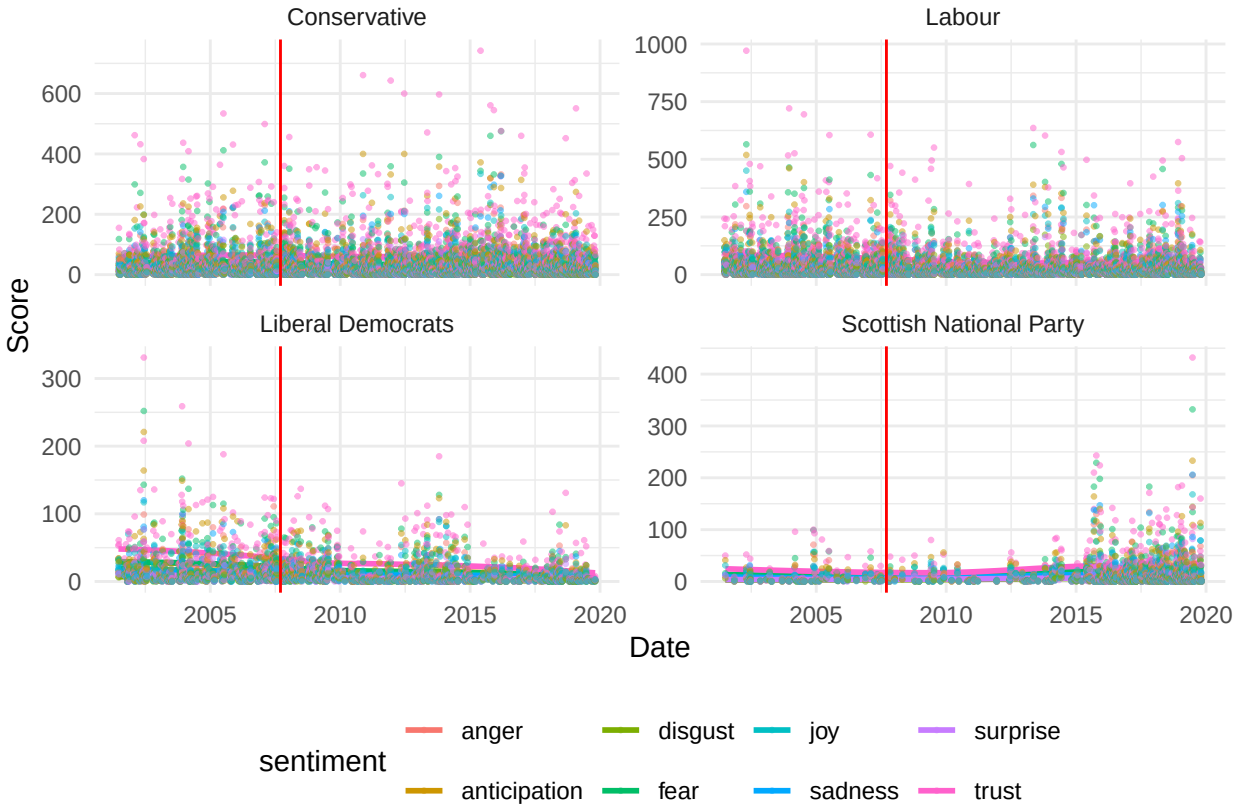
Beyond negative/positive ratio, focusing on specific sentiments trends by party.

```r
# Combining all sentiments into one column
long_nrc_data <- filtered_nrc_data_party %>%
  pivot_longer(cols = c(anger, fear, trust, sadness, disgust, anticipation, surprise, joy), names_to =
```

Faceting plots to compare the sentiment changes of each party

```r
# Plotting specific sentiment changes by party
long_nrc_data %>%
  ggplot(aes(x = date, y = score, color = sentiment)) +
  geom_smooth(method = "loess", se = F, alpha = 1, size = 1) +
  geom_point(alpha = 0.5, size = 0.5) +
  facet_wrap(~ party, scales = "free_y") +
  labs(x = "Date", y = "Score") +
  theme_minimal() +
  geom_vline(xintercept = as.numeric(as.Date("2007-09-14")), col = "red") +
  theme_minimal() +
  theme(legend.position = "bottom")
```

```
## `geom_smooth()` using formula = 'y ~ x'
```

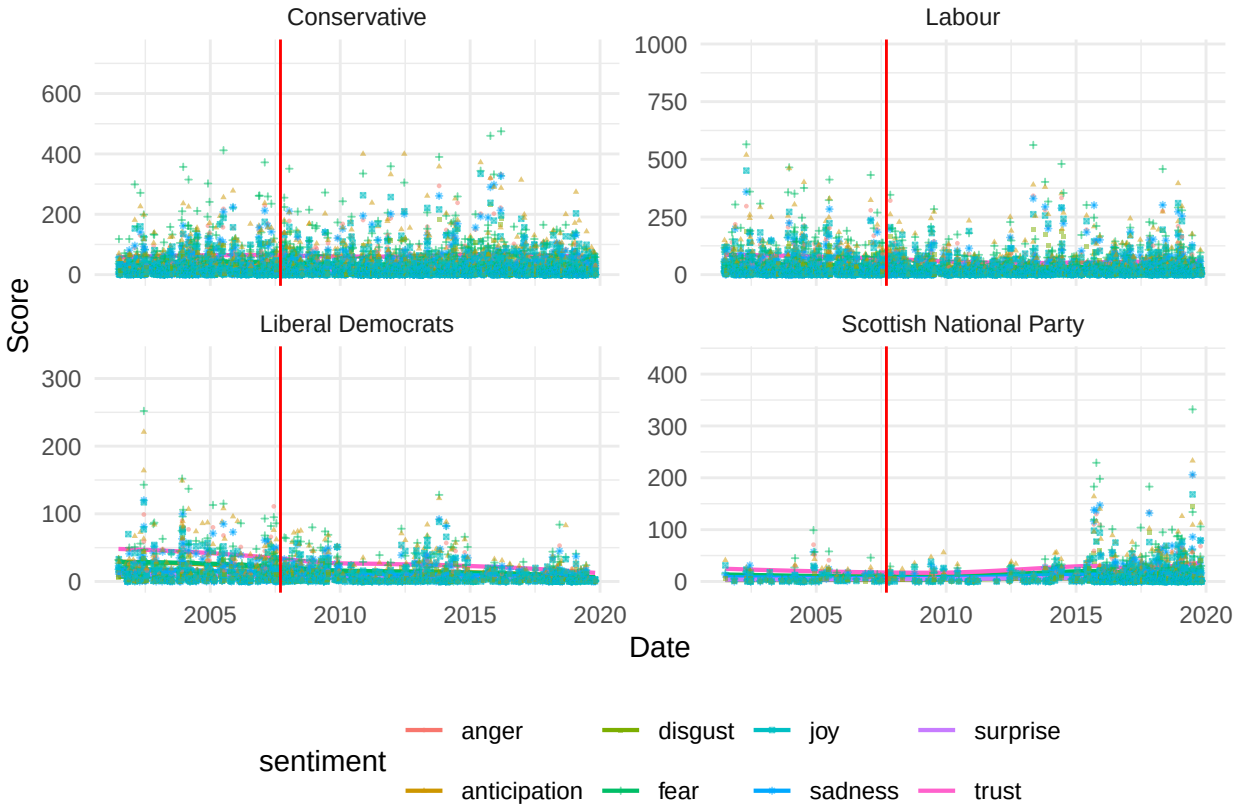


The smooth line in each plot shows a relatively steady and unchanged shape.

To make sentiment points recognizable, adjusting the shapes of points by sentiment and plotting

```
# Shaping sentiment points differently
shape_mapping <- c("anger" = 17, "disgust" = 18, "fear" = 19, "sadness" = 8, "trust" = 21, "anticipatio

long_nrc_data %>%
  ggplot(aes(x = date, y = score, color = sentiment)) +
  geom_smooth(method = "loess", se = F, alpha = 0.75, size = 0.75) +
  geom_point(aes(shape = sentiment), alpha = 0.5, size = 0.5) +
  facet_wrap(~ party, scales = "free_y", nrow = 2) +
  labs(x = "Date", y = "Score") +
  geom_vline(xintercept = as.numeric(as.Date("2007-09-14")), col = "red") +
  theme_minimal() +
  theme(legend.position = "bottom")
```

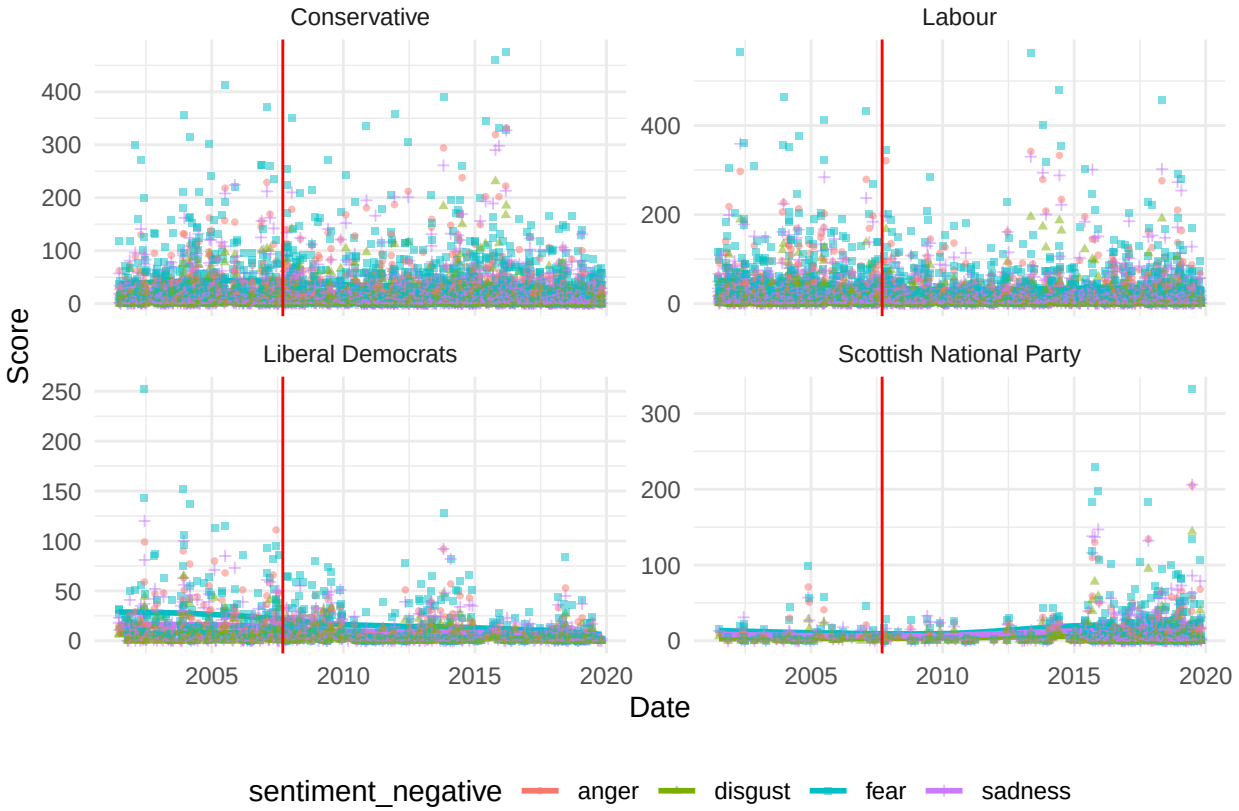
```
## `geom_smooth()` using formula = 'y ~ x'

## Warning: The shape palette can deal with a maximum of 6 discrete values because more
## than 6 becomes difficult to discriminate
## i you have requested 8 values. Consider specifying shapes manually if you need
##   that many have them.

## Warning: Removed 8132 rows containing missing values or values outside the scale range
## (`geom_point()`).
```



Selecting negative sentiments to confirm sentiment changes

```
# Specifying negative feelings only
long_nrc_data_neg <- filtered_nrc_data_party %>%
  pivot_longer(cols = c(anger, fear, sadness, disgust), names_to = "sentiment_negative", values_to = "s

# Plots of specific negative sentiments by party
long_nrc_data_neg %>%
  ggplot(aes(x = date, y = score, color = sentiment_negative)) +
  geom_smooth(method = "loess", se = F, alpha = 0.75, size = 1) +
  geom_point(aes(shape = sentiment_negative), alpha = 0.5, size = 1) +
  facet_wrap(~ party, scales = "free_y", nrow = 2) +
  labs(x = "Date", y = "Score") +
  geom_vline(xintercept = as.numeric(as.Date("2007-09-14")), col = "red") +
  theme_minimal() +
  theme(legend.position = "bottom")
```

```
## `geom_smooth()` using formula = 'y ~ x'
```



Regarding negative sentiments, the Conservative party presents more diverse and fluctuated points than other parties. However, the general smooth lines stay steady.

5) Random sample sentiment

To compare with sentiment trends of immigration related text, make a random sample of 10000 and do sentiment analysis

```
# Random sampling
data_sample <- data %>%
  sample_n(10000)

# tidy sample
tidy_samp <- data_sample %>%
  mutate(desc = tolower(text)) %>%
  unnest_tokens(word, desc) %>%
  filter(str_detect(word, "[a-z]")) %>%
  filter(!word %in% stop_words$word) %>%
  arrange(date)

tidy_samp$order <- 1:nrow(tidy_samp)

# Applying NRC dictionary and calculating total negative ratio
samp_nrc_data <- tidy_samp %>%
  inner_join(get_sentiments("nrc"), by = "word") %>%
  count(date, sentiment) %>%
```

```
  spread(key = sentiment, value = n, fill = 0) %>%
  mutate(ratio = negative / (positive+1))
```

```
## Warning in inner_join(., get_sentiments("nrc"), by = "word"): Detected an unexpected many-to-many rel
## i Row 2 of `x` matches multiple rows in `y`.
## i Row 5503 of `y` matches multiple rows in `x`.
## i If a many-to-many relationship is expected, set `relationship =
##   "many-to-many"` to silence this warning.
```

```
#Applying NRC dictionary and calculating negative ratio by party
samp_nrc_party <- tidy_samp %>%
  inner_join(get_sentiments("nrc"), by = "word") %>%
  group_by(party, date) %>%
  count(sentiment) %>%
  spread(key = sentiment, value = n, fill = 0) %>%
  mutate(ratio = negative / (positive+1)) %>%
  ungroup()
```

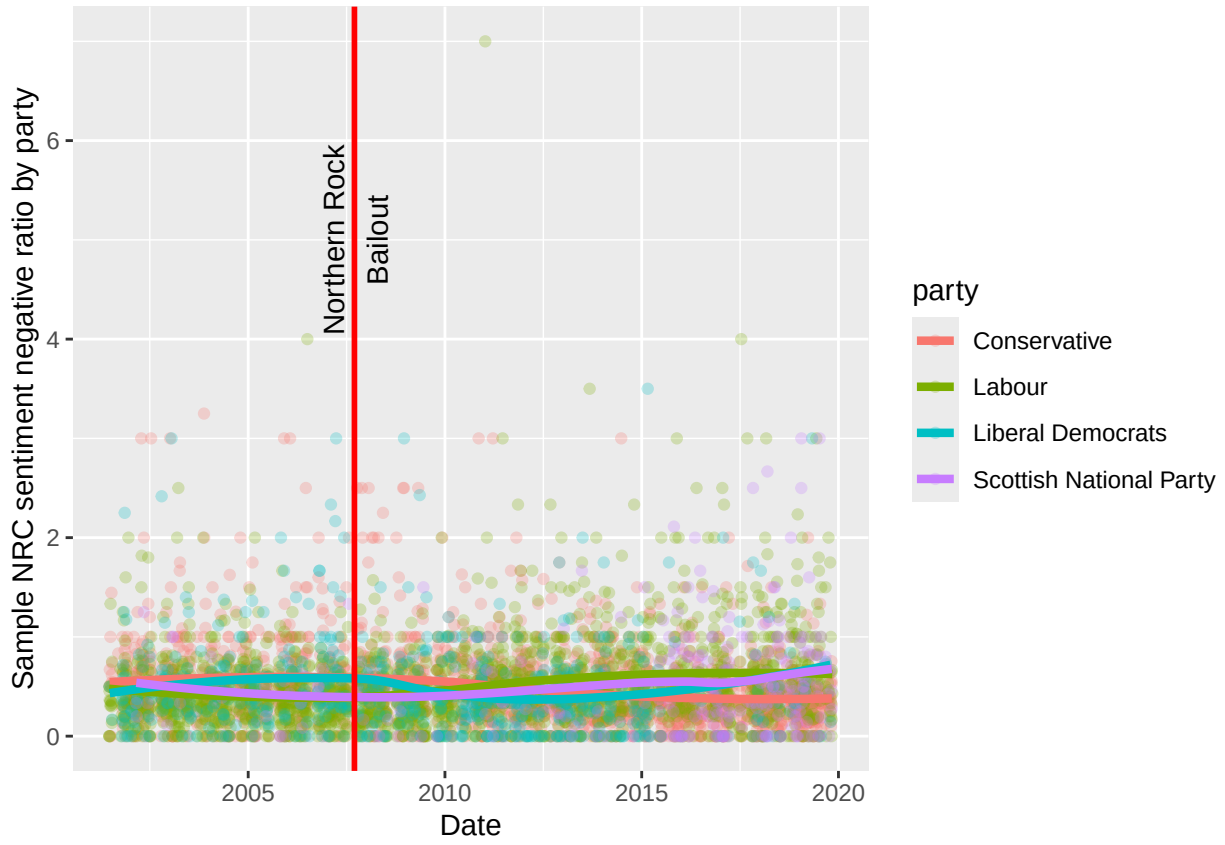
```
## Warning in inner_join(., get_sentiments("nrc"), by = "word"): Detected an unexpected many-to-many rel
## i Row 2 of `x` matches multiple rows in `y`.
## i Row 5503 of `y` matches multiple rows in `x`.
## i If a many-to-many relationship is expected, set `relationship =
##   "many-to-many"` to silence this warning.
```

```
filtered_samp_nrc_party <- samp_nrc_party %>%
  group_by(party) %>%
  filter(n() > 100) %>%
  ungroup()
```

A plot of sample text negative sentiment ratio by party

```
filtered_samp_nrc_party %>%
  ggplot(aes(date, ratio, color = party)) +
  geom_point(alpha=0.25) +
  geom_smooth(method="loess", se = F, alpha=0.25, size = 1.5) +
  labs(y = "Sample NRC sentiment negative ratio by party", x = "Date") +
  geom_vline(xintercept = as.numeric(as.Date("2007-09-14")), col = "red", size = 1) +
  annotate("text", x = as.Date("2007-09-24"), y = 5, label="Northern Rock\nBailout", angle=90, color =
```

```
## `geom_smooth()` using formula = 'y ~ x'
```




```
  theme_minimal() +
  theme(legend.position = "bottom")
```

```
## List of 136
##  $ line                            :List of 6
##   ..$ colour       : chr "black"
##   ..$ linewidth    : num 0.5
##   ..$ linetype     : num 1
##   ..$ lineend      : chr "butt"
##   ..$ arrow        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_line" "element"
##  $ rect                            :List of 5
##   ..$ fill         : chr "white"
##   ..$ colour       : chr "black"
##   ..$ linewidth    : num 0.5
##   ..$ linetype     : num 1
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
##  $ text                            :List of 11
##   ..$ family       : chr ""
##   ..$ face         : chr "plain"
##   ..$ colour       : chr "black"
##   ..$ size         : num 11
##   ..$ hjust        : num 0.5
```

```
##   ..$ vjust        : num 0.5
##   ..$ angle        : num 0
##   ..$ lineheight   : num 0.9
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ title                          : NULL
##  $ aspect.ratio                   : NULL
##  $ axis.title                     : NULL
##  $ axis.title.x                   :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 1
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 2.75points 0points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.title.x.top               :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 0
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 2.75points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.title.x.bottom            : NULL
##  $ axis.title.y                   :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 1
##   ..$ angle        : num 90
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 2.75points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
```

```
##  $ axis.title.y.left               : NULL
##  $ axis.title.y.right              :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 1
##   ..$ angle        : num -90
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 2.75points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text                       :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : chr "grey30"
##   ..$ size         : 'rel' num 0.8
##   ..$ hjust        : NULL
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.x                     :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 1
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 2.2points 0points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.x.top                 :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 0
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 2.2points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
```

```
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.x.bottom              : NULL
##  $ axis.text.y                     :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 1
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 2.2points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.y.left                : NULL
##  $ axis.text.y.right               :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 0
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 2.2points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.theta                 : NULL
##  $ axis.text.r                     :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 0.5
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 2.2points 0points 2.2points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.ticks                      : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ axis.ticks.x                    : NULL
##  $ axis.ticks.x.top                : NULL
##  $ axis.ticks.x.bottom             : NULL
##  $ axis.ticks.y                    : NULL
##  $ axis.ticks.y.left               : NULL
```

```
##  $ axis.ticks.y.right             : NULL
##  $ axis.ticks.theta               : NULL
##  $ axis.ticks.r                   : NULL
##  $ axis.minor.ticks.x.top         : NULL
##  $ axis.minor.ticks.x.bottom      : NULL
##  $ axis.minor.ticks.y.left        : NULL
##  $ axis.minor.ticks.y.right       : NULL
##  $ axis.minor.ticks.theta         : NULL
##  $ axis.minor.ticks.r             : NULL
##  $ axis.ticks.length              : 'simpleUnit' num 2.75points
##   ..- attr(*, "unit")= int 8
##  $ axis.ticks.length.x            : NULL
##  $ axis.ticks.length.x.top        : NULL
##  $ axis.ticks.length.x.bottom     : NULL
##  $ axis.ticks.length.y            : NULL
##  $ axis.ticks.length.y.left       : NULL
##  $ axis.ticks.length.y.right      : NULL
##  $ axis.ticks.length.theta        : NULL
##  $ axis.ticks.length.r            : NULL
##  $ axis.minor.ticks.length        : 'rel' num 0.75
##  $ axis.minor.ticks.length.x      : NULL
##  $ axis.minor.ticks.length.x.top  : NULL
##  $ axis.minor.ticks.length.x.bottom: NULL
##  $ axis.minor.ticks.length.y      : NULL
##  $ axis.minor.ticks.length.y.left : NULL
##  $ axis.minor.ticks.length.y.right : NULL
##  $ axis.minor.ticks.length.theta  : NULL
##  $ axis.minor.ticks.length.r      : NULL
##  $ axis.line                      : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ axis.line.x                    : NULL
##  $ axis.line.x.top                : NULL
##  $ axis.line.x.bottom             : NULL
##  $ axis.line.y                    : NULL
##  $ axis.line.y.left               : NULL
##  $ axis.line.y.right              : NULL
##  $ axis.line.theta                : NULL
##  $ axis.line.r                    : NULL
##  $ legend.background              : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ legend.margin                  : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
##   ..- attr(*, "unit")= int 8
##  $ legend.spacing                 : 'simpleUnit' num 11points
##   ..- attr(*, "unit")= int 8
##  $ legend.spacing.x               : NULL
##  $ legend.spacing.y               : NULL
##  $ legend.key                     : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ legend.key.size                : 'simpleUnit' num 1.2lines
##   ..- attr(*, "unit")= int 3
##  $ legend.key.height              : NULL
##  $ legend.key.width               : NULL
##  $ legend.key.spacing             : 'simpleUnit' num 5.5points
##   ..- attr(*, "unit")= int 8
```

```
##  $ legend.key.spacing.x           : NULL
##  $ legend.key.spacing.y           : NULL
##  $ legend.frame                   : NULL
##  $ legend.ticks                   : NULL
##  $ legend.ticks.length            : 'rel' num 0.2
##  $ legend.axis.line               : NULL
##  $ legend.text                    :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : 'rel' num 0.8
##   ..$ hjust        : NULL
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ legend.text.position           : NULL
##  $ legend.title                   :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 0
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ legend.title.position          : NULL
##  $ legend.position                : chr "bottom"
##  $ legend.position.inside         : NULL
##  $ legend.direction               : NULL
##  $ legend.byrow                   : NULL
##  $ legend.justification           : chr "center"
##  $ legend.justification.top       : NULL
##  $ legend.justification.bottom    : NULL
##  $ legend.justification.left      : NULL
##  $ legend.justification.right     : NULL
##  $ legend.justification.inside    : NULL
##  $ legend.location                : NULL
##  $ legend.box                     : NULL
##  $ legend.box.just                : NULL
##  $ legend.box.margin              : 'margin' num [1:4] 0cm 0cm 0cm 0cm
##   ..- attr(*, "unit")= int 1
##  $ legend.box.background          : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ legend.box.spacing             : 'simpleUnit' num 11points
##   ..- attr(*, "unit")= int 8
##   [list output truncated]
```

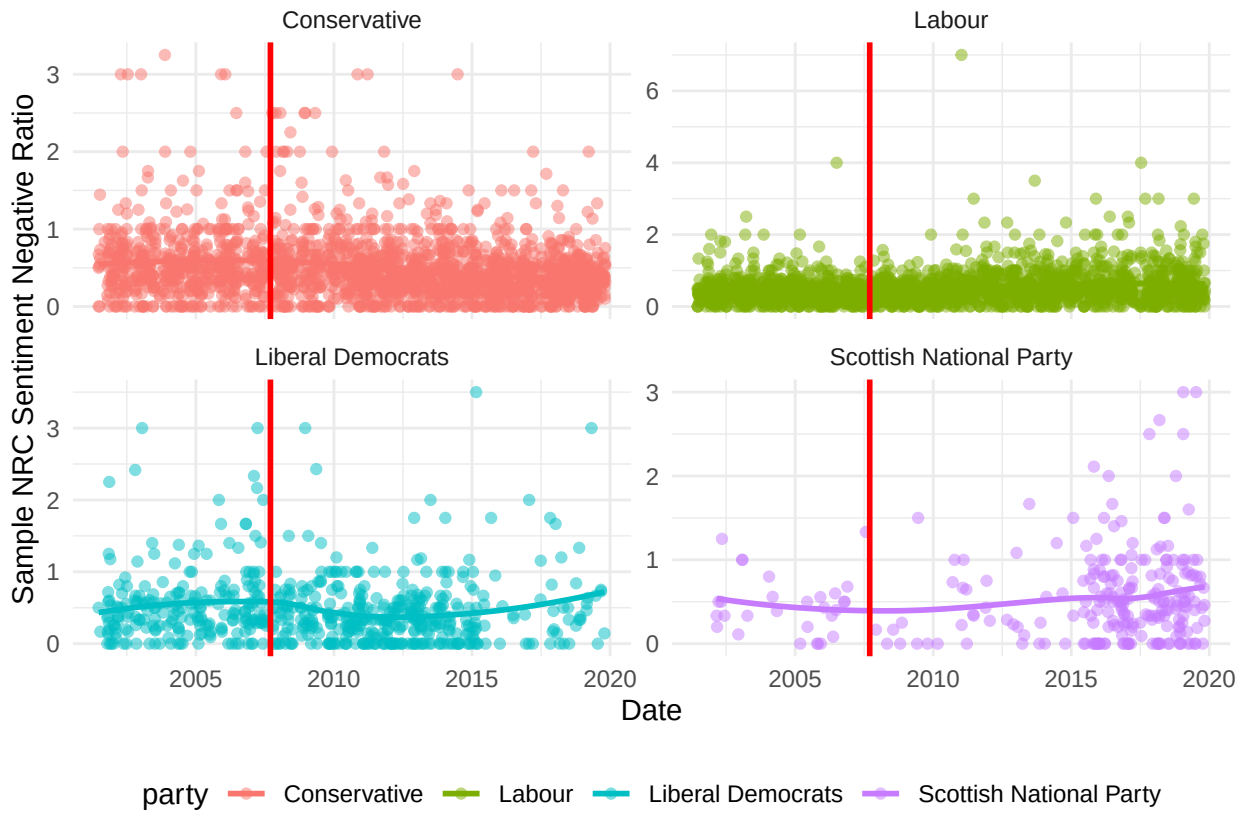
```
##  - attr(*, "class")= chr [1:2] "theme" "gg"
##  - attr(*, "complete")= logi TRUE
##  - attr(*, "validate")= logi TRUE
```

Negative sentiments of sample texts also show steady lines.

Dividing the sample sentiment plot by party

```
# Faceting plots by party
filtered_samp_nrc_party %>%
  ggplot(aes(date, ratio, color = party)) +
  geom_point(alpha = 0.5) +
  geom_smooth(method = "loess", se = F, alpha = 0.7, size = 1) +
  labs(y = "Sample NRC Sentiment Negative Ratio", x = "Date") +
  facet_wrap(~party, scales = "free_y") +
  geom_vline(xintercept = as.numeric(as.Date("2007-09-14")), col = "red", size = 1) +
  theme_minimal() +
  theme(legend.position = "bottom")
```

```
## `geom_smooth()` using formula = 'y ~ x'
```



Compared to the immigration related text sentiment plots, sample sentiment plots show no significant difference.

3. Word Embedding GloVe

```
# Set up
library(text2vec)
library(stringr)
library(umap)
library(ggrepel)
```

1) Training total immigration related texts

(1) The GloVe model for total parliament speech

Training process

```
# choice parameters
WINDOW_SIZE <- 6 # context up to 6 words
DIM <- 300 # the length of the word vector
ITERS <- 100 # the maximum number of iterations
COUNT_MIN <- 10 # minimum count of words

# shuffle text
set.seed(42L) # for reproducibility
glove_text <- sample(tidy_data_notoken$desc)

# create vocab
tokens <- space_tokenizer(glove_text) # tokenizing
it <- itoken(tokens, progressbar = FALSE) # create the vocabulary object
vocab <- create_vocabulary(it) # create a vocabulary
vocab_pruned <- prune_vocabulary(vocab, term_count_min = COUNT_MIN)  # keep only words that meet count

#vectorize and create term co-occurrence matrix
vectorizer <- vocab_vectorizer(vocab_pruned)
tcm <- create_tcm(it, vectorizer, skip_grams_window = WINDOW_SIZE, skip_grams_window_context = "symmetri
                  weights = rep(1, WINDOW_SIZE))
```

Setting model parameters

```
#set model parameters
glove <- GlobalVectors$new(rank = DIM, x_max = 100, learning_rate = 0.05)

# fit model
word_vectors_main <- glove$fit_transform(tcm, n_iter = ITERS, convergence_tol = 0.001, n_threads = Rcppl

# get output
word_vectors_context <- glove$components
glove_embedding <- word_vectors_main + t(word_vectors_context)  # word vectors. combine main and contex

#save
saveRDS(glove_embedding, file = "local_glove.rds")
```

Modelling takes time. So I will use the prepared model made by same process for knitting.

```
url <- "https://github.com/RiverKim-garam/CTA24-Final-assessment/blob/main/local_glove.rds?raw=true"
glove_embedding <- readRDS(url(url, method = "libcurl"))
```

Visulalization of GloVe word embedding model by using umap.

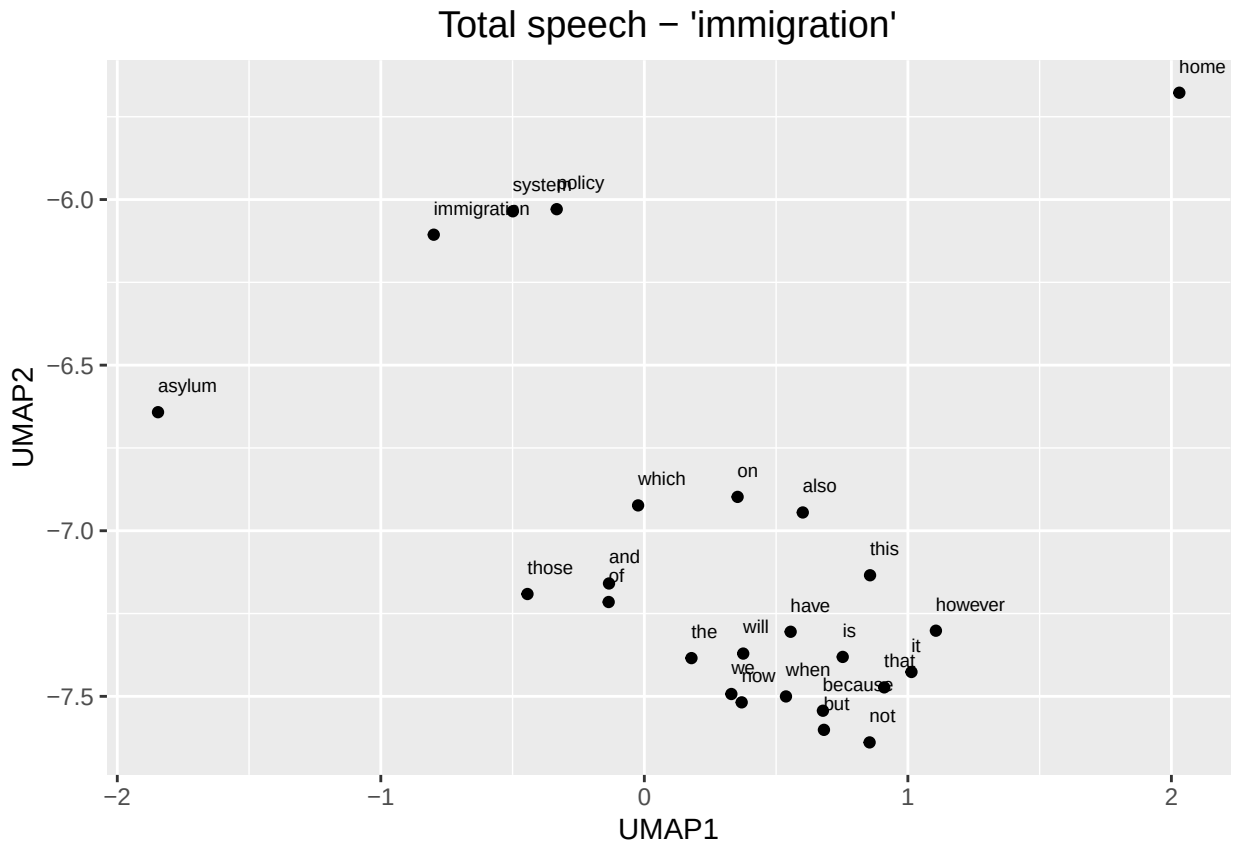
```
# GloVe dimension reduction (two dimension)
glove_umap <- umap(glove_embedding, n_components = 2, metric = "cosine", n_neighbors = 25, min_dist = 0

# Put results in a dataframe for ggplot
df_glove_umap <- as.data.frame(glove_umap[["layout"]])

# Add the labels of the words to the dataframe
df_glove_umap$word <- rownames(df_glove_umap)
colnames(df_glove_umap) <- c("UMAP1", "UMAP2", "word")
```

Plot the total word embedding of 'immigration' with the GloVe model generated above.

```
word <- glove_embedding["immigration",, drop = FALSE]
cos_sim = sim2(x = glove_embedding, y = word, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words <- df_glove_umap %>%
  inner_join(y=select, by= "word")
```

The ggplot visual for GloVe regarding total immigration related texts. Total parliament speech word embedding of words related to *immigration*

```
ggplot(selected_words, aes(x = UMAP1, y = UMAP2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(UMAP1, UMAP2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjust=0) +
  labs(title = "Total speech - 'immigration'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```

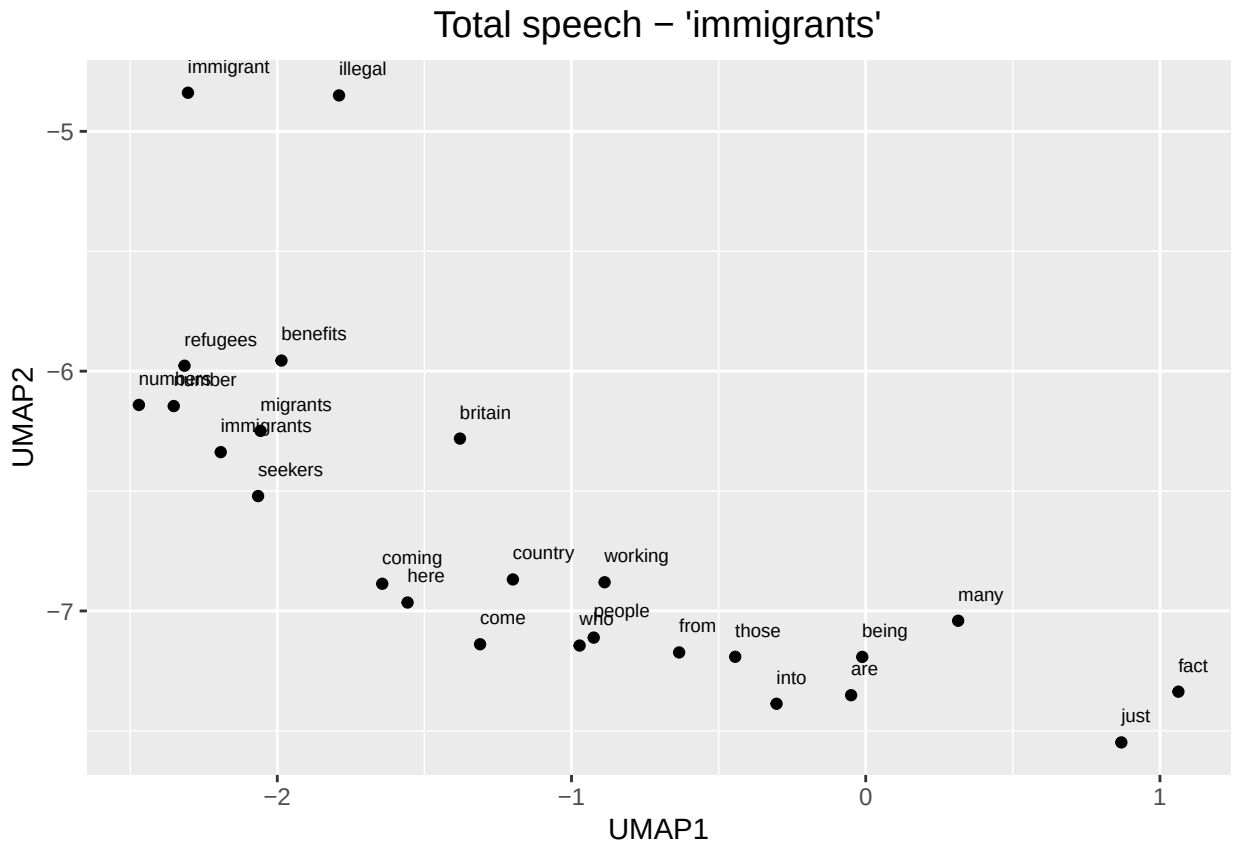


I did it for confirming the modeling process, but we might need to use this map as a comparison plot.

Total parliament speech word embedding of words related to *immigrants*

```
# Plot the word embedding of words that are related for the GloVe model (Case2: immigrants)
word_2 <- glove_embedding["immigrants",, drop = FALSE]
cos_sim = sim2(x = glove_embedding, y = word_2, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_2 <- df_glove_umap %>%
  inner_join(y=select, by= "word")
```

```
#The ggplot visual for GloVe
ggplot(selected_words_2, aes(x = UMAP1, y = UMAP2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(UMAP1, UMAP2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjust=0) +
  labs(title = "Total speech - 'immigrants'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```

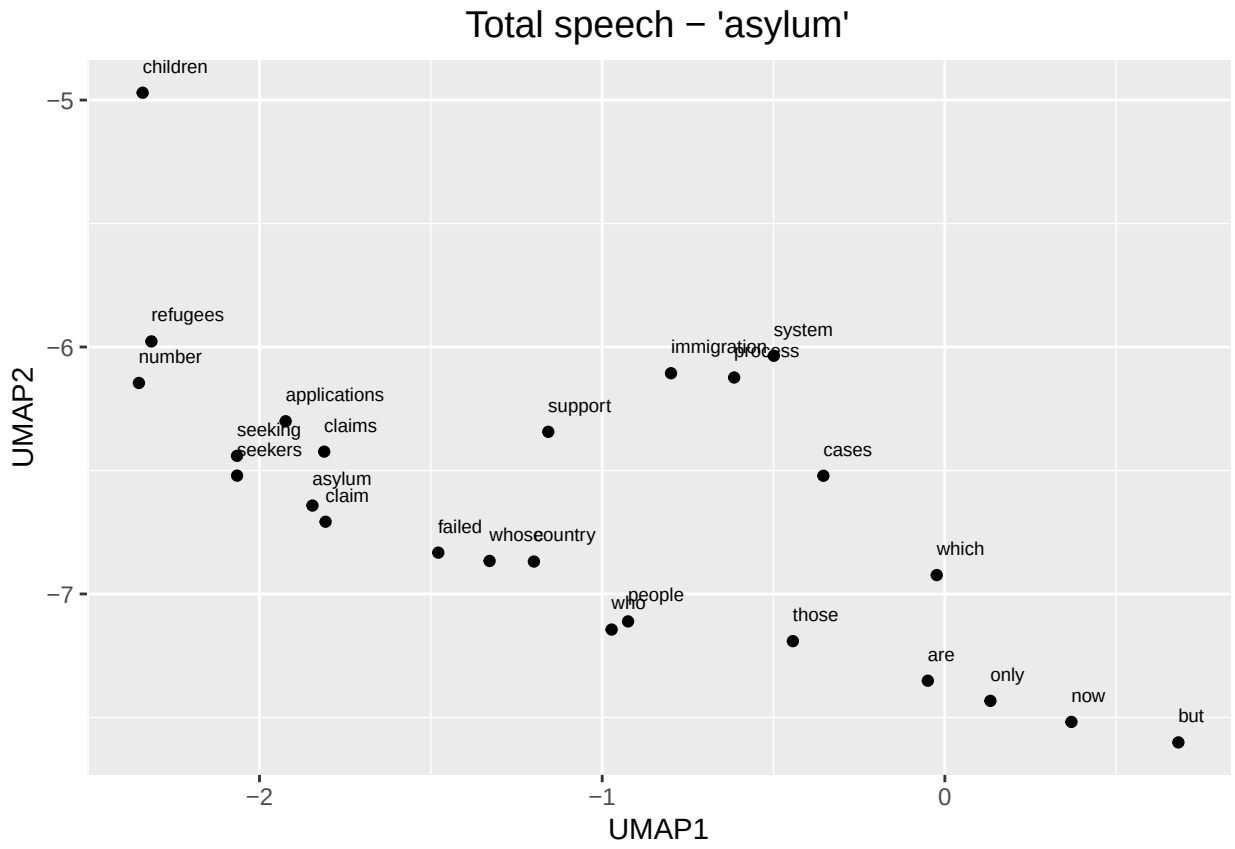


This can be also used for comparison. Also, word embedding maps tell us the general relationships between words, especially those we are interested in.

For the last pilot modelling map, there is a total parliament immigration related speech word embedding of words related to *asylum*

```
# Plot the word embedding of words that are related for the GloVe model (asylum)
word_4 <- glove_embedding["asylum",, drop = FALSE]
cos_sim = sim2(x = glove_embedding, y = word_4, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_4 <- df_glove_umap %>%
  inner_join(y=select, by= "word")
```

```
#The ggplot visual for GloVe
ggplot(selected_words_4, aes(x = UMAP1, y = UMAP2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(UMAP1, UMAP2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjust=0) +
  labs(title = "Total speech - 'asylum'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



(2) The Glove model for total Parliament speech before the 2008 economic crisis

```
# filter data by date. Now have pre/post economic crisis text data related to immigration.

data_pre <- filter(tidy_data_notoken, date < as.Date("2007-09-24"))
data_post <- filter(tidy_data_notoken, date >= as.Date("2007-09-24"))
```

```
# repeat the same modeling process
set.seed(42L)
glove_text_pre <- sample(data_pre$desc)

tokens_pre <- space_tokenizer(glove_text_pre)
it_pre <- itoken(tokens_pre, progressbar = FALSE)
vocab_pre <- create_vocabulary(it_pre)
vocab_pruned_pre <- prune_vocabulary(vocab_pre, term_count_min = COUNT_MIN)

vectorizer_pre <- vocab_vectorizer(vocab_pruned_pre)
tcm_pre <- create_tcm(it_pre, vectorizer_pre, skip_grams_window = WINDOW_SIZE, skip_grams_window_contex

glove_pre <- GlobalVectors$new(rank = DIM, x_max = 100, learning_rate = 0.05)
word_vectors_main_pre <- glove_pre$fit_transform(tcm_pre, n_iter = ITERS, convergence_tol = 0.001, n_thr

word_vectors_context_pre <- glove_pre$components
glove_embedding_pre <- word_vectors_main_pre + t(word_vectors_context_pre)
```

```
saveRDS(glove_embedding_pre, file = "local_glove_pre.rds")
```

Modelling takes time. So I will use the prepared model made by same process for knitting.

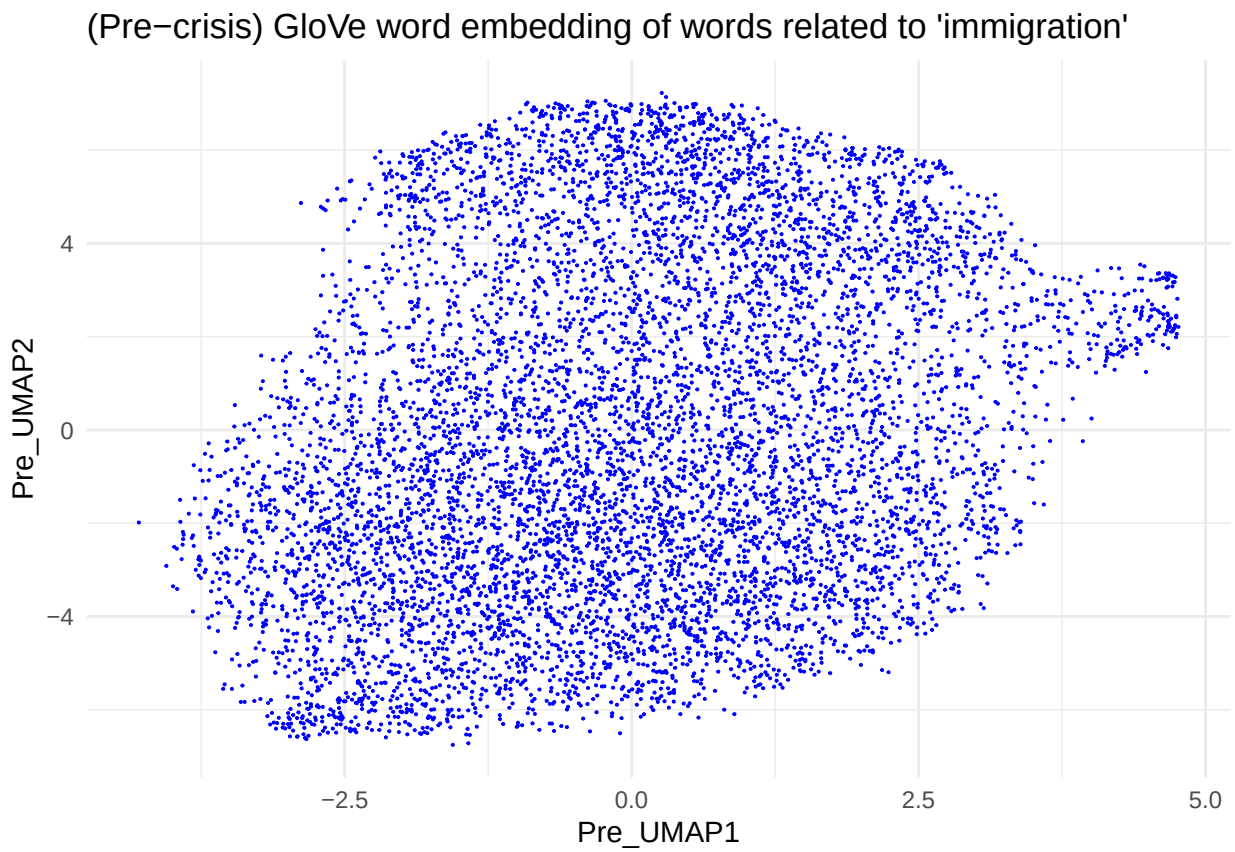
```
url_pre <- "https://github.com/RiverKim-garam/CTA24-Final-assessment/blob/main/local_glove_pre.rds?raw=
glove_embedding_pre <- readRDS(url(url_pre, method = "libcurl"))
```

Pre-crisis GloVe word embedding model of total parliament texts by two dimensional umap

```
# Plotting the whole word embedding of pre-crisis immigration related text
umap_pre <- umap(glove_embedding_pre, n_components = 2, metric = "cosine", n_neighbors = 25, min_dist =

df_umap_pre <- as.data.frame(umap_pre[["layout"]])
df_umap_pre$word <- rownames(df_umap_pre)
colnames(df_umap_pre) <- c("Pre_UMAP1", "Pre_UMAP2", "word")
```

Let's see the whole word embedding map of two dimensions

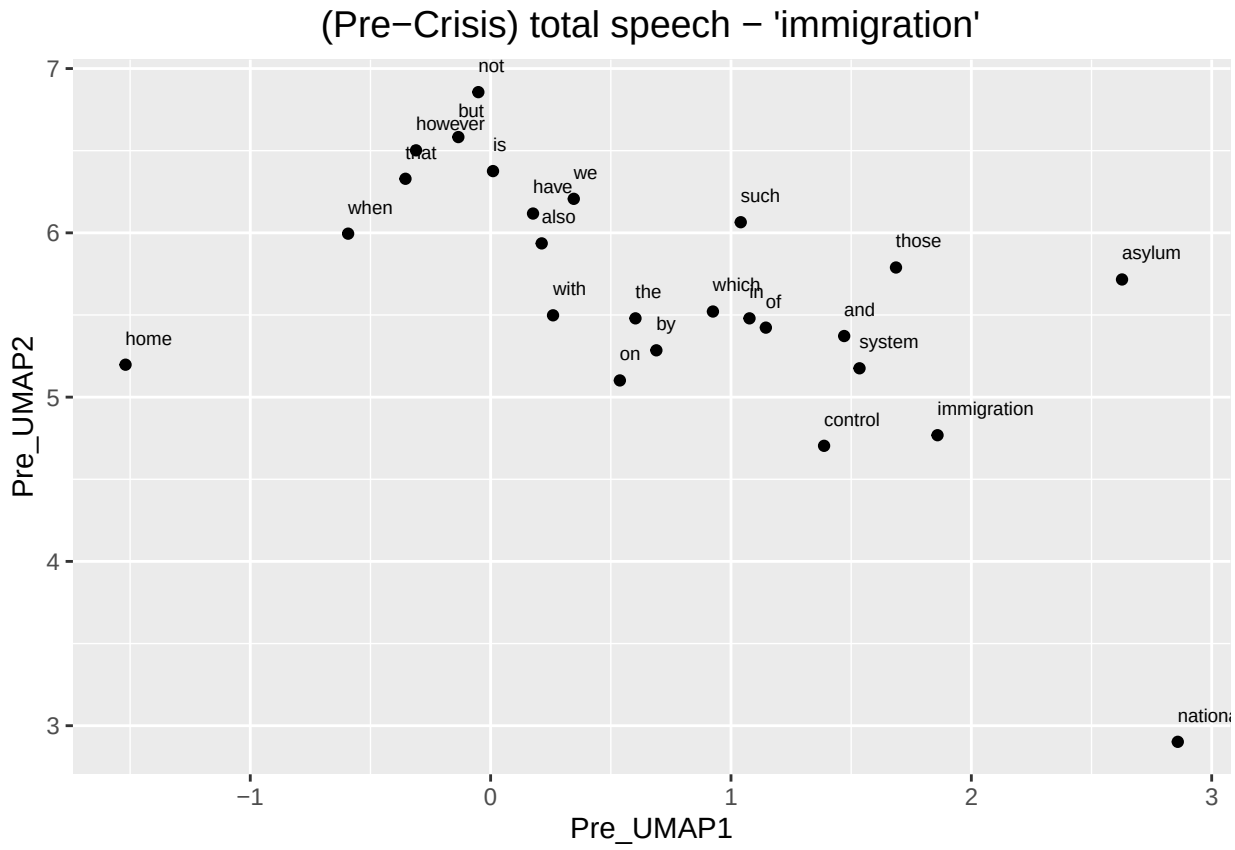
```
ggplot(df_umap_pre) +
  geom_point(aes(x = Pre_UMAP1, y = Pre_UMAP2), color = 'blue', size = 0.05) +
  labs(title = "(Pre-crisis) GloVe word embedding of words related to 'immigration'") +
  theme_minimal()
```



Specify the map. Which words are close to the word 'immigration' in the total parliament texts? Pre-crisis total parliament speech word embedding of words related to *immigration*

```
# Plot the word embedding of words that are related for the GloVe model (Case1: immigration)
word_pre_1 <- glove_embedding_pre["immigration",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_pre, y = word_pre_1, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_pre_1 <- df_umap_pre %>%
  inner_join(y=select, by= "word")
```

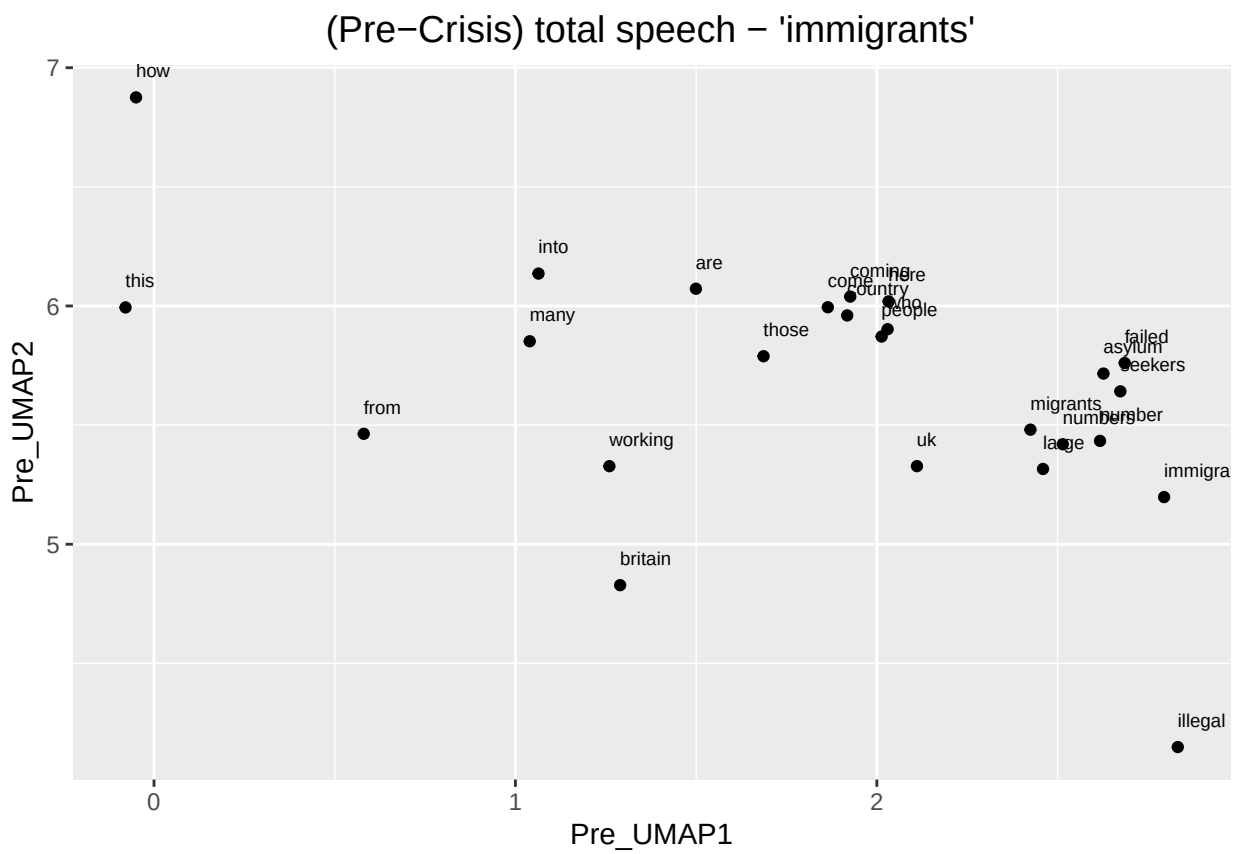
```
#The ggplot visual for GloVe
ggplot(selected_words_pre_1, aes(x = Pre_UMAP1, y = Pre_UMAP2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Pre_UMAP1, Pre_UMAP2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjust=
  labs(title = "(Pre-Crisis) total speech - 'immigration'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



Pre-crisis total parliament speech word embedding of words related to *immigrants*

```
# Plot the word embedding of words that are related for the GloVe model (Case2: immigrants)
word_pre_2 <- glove_embedding_pre["immigrants",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_pre, y = word_pre_2, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_pre_2 <- df_umap_pre %>%
  inner_join(y=select, by= "word")
```

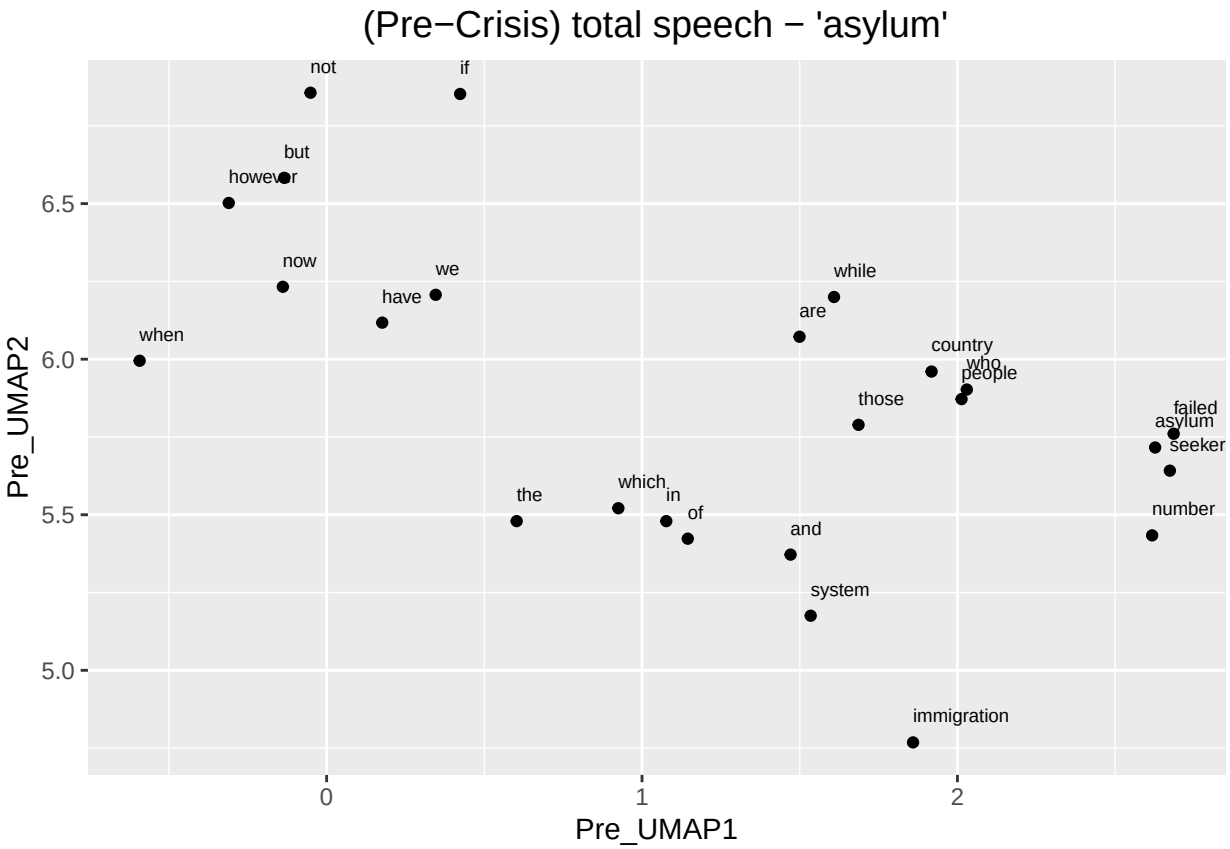
```
#The ggplot visual for GloVe
ggplot(selected_words_pre_2, aes(x = Pre_UMAP1, y = Pre_UMAP2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Pre_UMAP1, Pre_UMAP2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjust=
  labs(title = "(Pre-Crisis) total speech - 'immigrants'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



Pre-crisis total parliament speech word embedding of words related to *asylum*

```
# Plot the word embedding of words that are related for the GloVe model (asylum)
word_pre_3 <- glove_embedding_pre["asylum",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_pre, y = word_pre_3, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_pre_3 <- df_umap_pre %>%
  inner_join(y=select, by= "word")
```

```
#The ggplot visual for GloVe
ggplot(selected_words_pre_3, aes(x = Pre_UMAP1, y = Pre_UMAP2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Pre_UMAP1, Pre_UMAP2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjust=
  labs(title = "(Pre-Crisis) total speech - 'asylum'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



Now we can check the words relationships before the 2008 financail crisis.

(3) The Glove model for total Parliament speech after the 2008 financial crisis

Again, same modeling process

```
set.seed(42L)
glove_text_post <- sample(data_post$desc)

tokens_post <- space_tokenizer(glove_text_post)
it_post <- itoken(tokens_post, progressbar = FALSE)
vocab_post <- create_vocabulary(it_post)
vocab_pruned_post <- prune_vocabulary(vocab_post, term_count_min = COUNT_MIN)

vectorizer_post <- vocab_vectorizer(vocab_pruned_post)
tcm_post <- create_tcm(it_post, vectorizer_post, skip_grams_window = WINDOW_SIZE, skip_grams_window_con

glove_post <- GlobalVectors$new(rank = DIM, x_max = 100, learning_rate = 0.05)
word_vectors_main_post <- glove_post$fit_transform(tcm_post, n_iter = ITERS, convergence_tol = 0.001, n

word_vectors_context_post <- glove_post$components
glove_embedding_post <- word_vectors_main_post + t(word_vectors_context_post)

saveRDS(glove_embedding_post, file = "local_glove_post.rds")
```

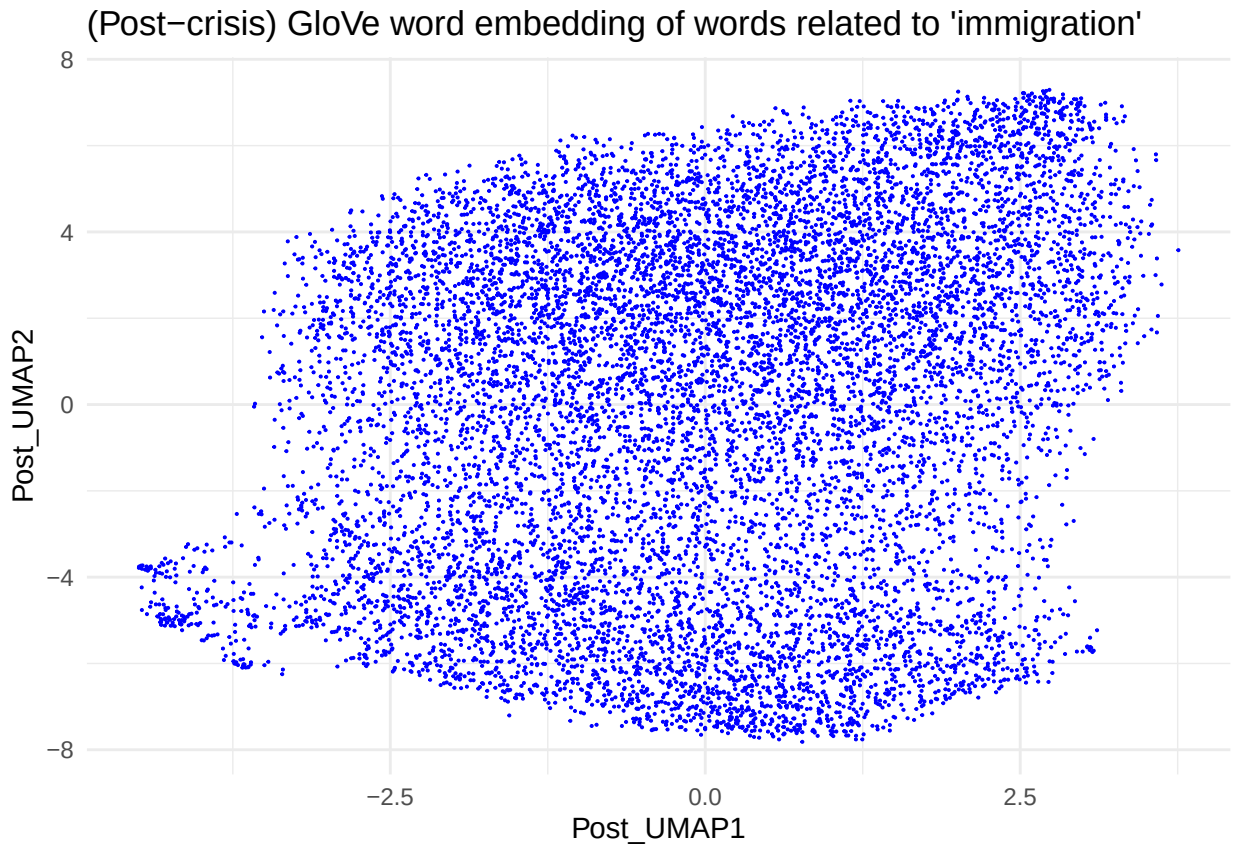
Modelling takes time. So I will use the prepared model made by same process for knitting.

```
url_post <- "https://github.com/RiverKim-garam/CTA24-Final-assessment/blob/main/local_glove_post.rds?ra
glove_embedding_post <- readRDS(url(url_post, method = "libcurl"))
```

Pre-crisis total GloVe word embedding two dimensional umap

```
# Plotting the whole word embedding of pre-crisis immigration related text
umap_post <- umap(glove_embedding_post, n_components = 2, metric = "cosine", n_neighbors = 25, min_dist

df_umap_post <- as.data.frame(umap_post[["layout"]])
df_umap_post$word <- rownames(df_umap_post)
colnames(df_umap_post) <- c("Post_UMAP1", "Post_UMAP2", "word")
```

```
ggplot(df_umap_post) +
  geom_point(aes(x = Post_UMAP1, y = Post_UMAP2), color = 'blue', size = 0.05) +
  labs(title = "(Post-crisis) GloVe word embedding of words related to 'immigration'") +
  theme_minimal()
```

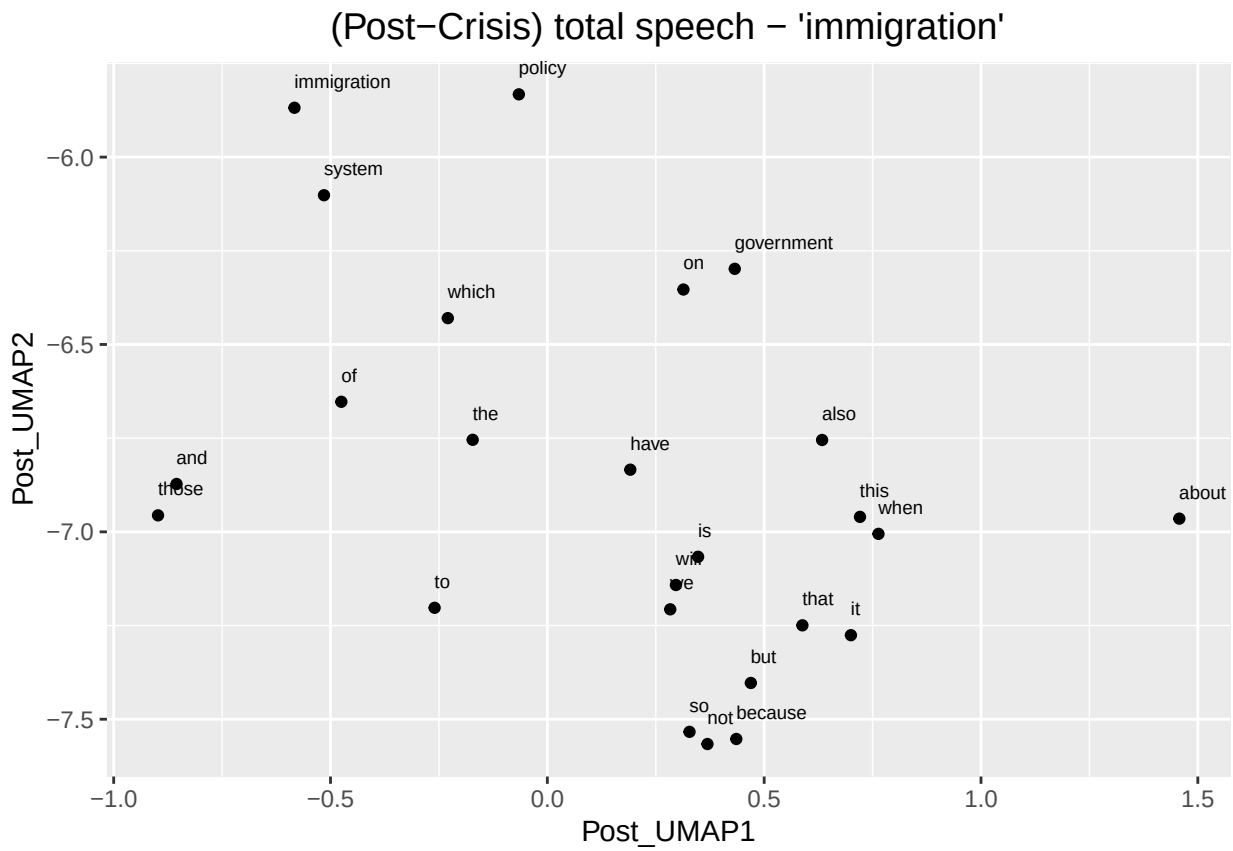


Pre-crisis total parliament speech word embedding of words related to *immigration*

```
# Plot the word embedding of words that are related for the GloVe model (Case1: immigration)
word_post_1 <- glove_embedding_post["immigration",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_post, y = word_post_1, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
```

```
selected_words_post_1 <- df_umap_post %>%
  inner_join(y=select, by= "word")
```

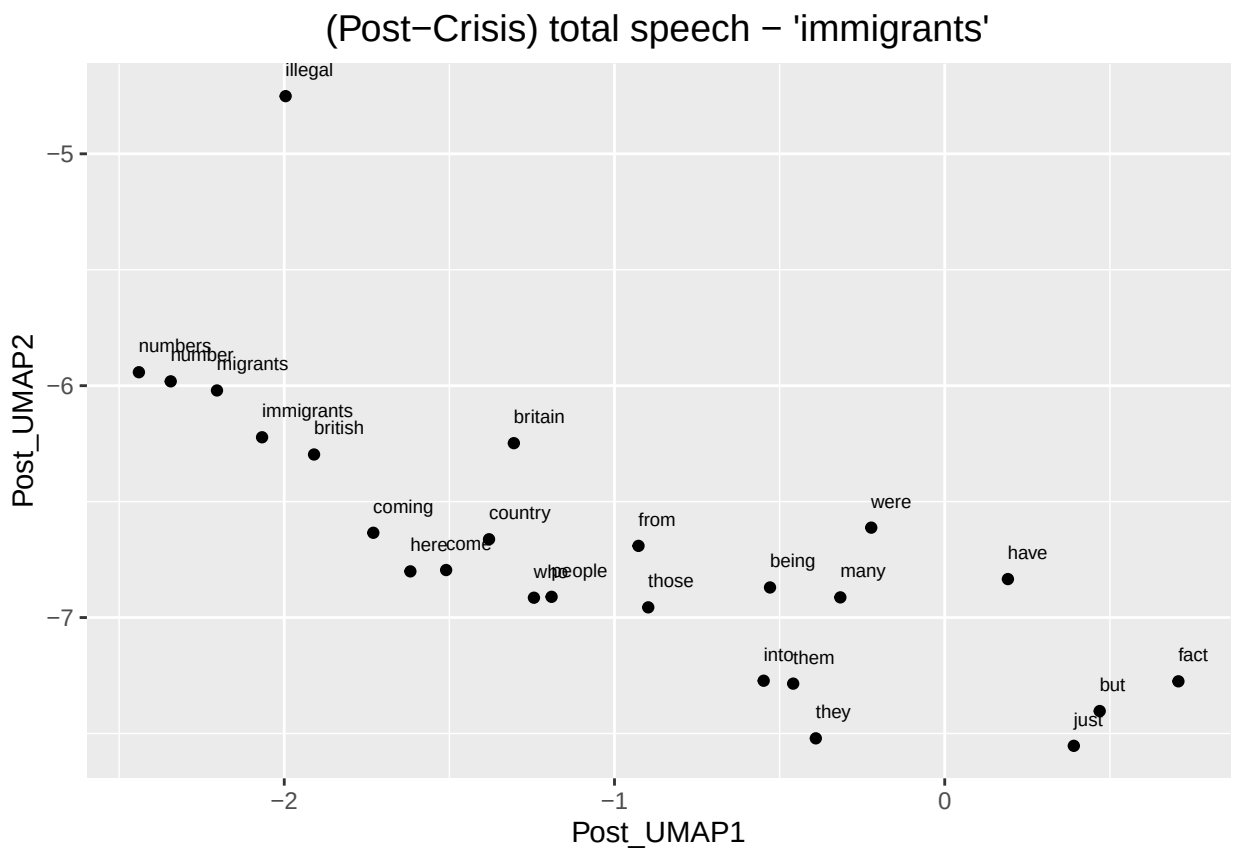
```
#The ggplot visual for GloVe
ggplot(selected_words_post_1, aes(x = Post_UMAP1, y = Post_UMAP2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Post_UMAP1, Post_UMAP2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjus
  labs(title = "(Post-Crisis) total speech - 'immigration'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



Pre-crisis total parliament speech word embedding of words related to *immigrants*

```
# Plot the word embedding of words that are related for the GloVe model (Case2: immigrants)
word_post_2 <- glove_embedding_post["immigrants",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_post, y = word_post_2, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_post_2 <- df_umap_post %>%
  inner_join(y=select, by= "word")
```

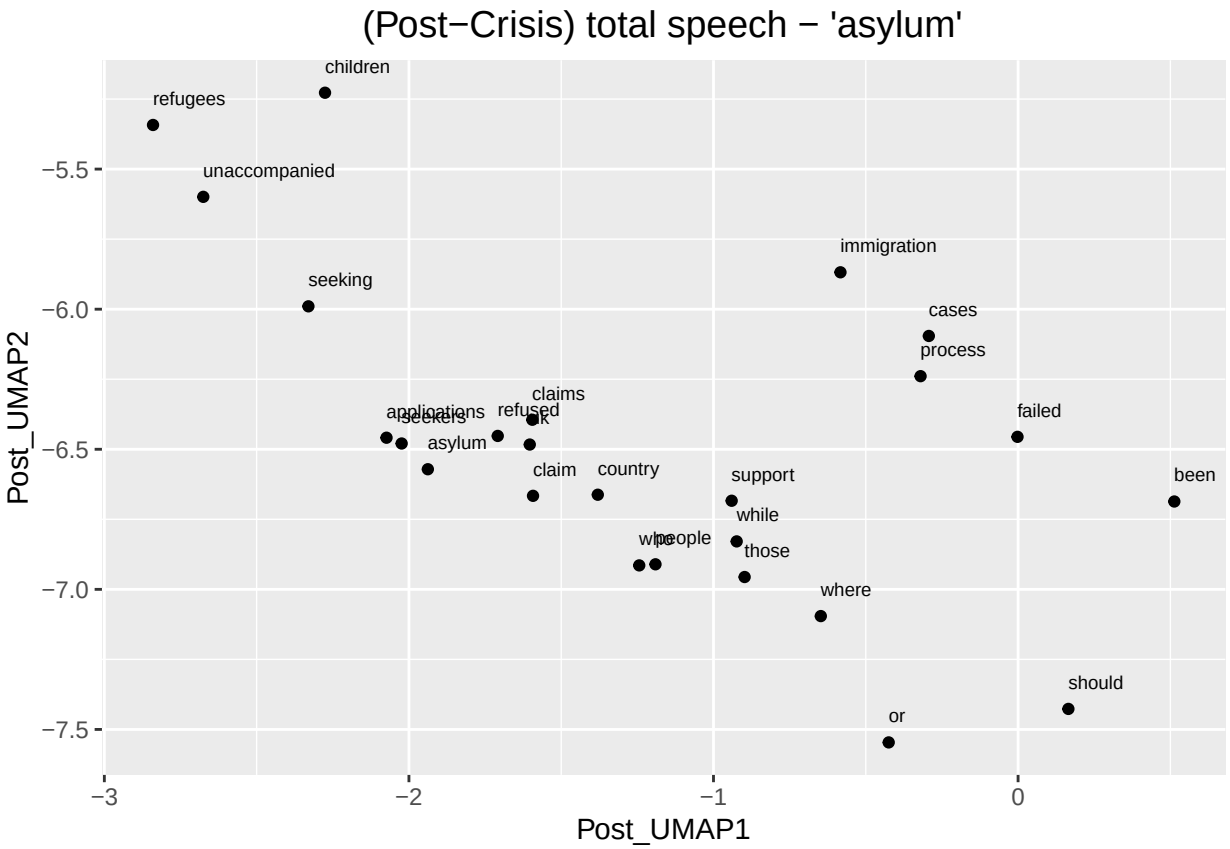
```
#The ggplot visual for GloVe
ggplot(selected_words_post_2, aes(x = Post_UMAP1, y = Post_UMAP2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Post_UMAP1, Post_UMAP2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjus
  labs(title = "(Post-Crisis) total speech - 'immigrants'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



Post-crisis total parliament speech word embedding of words related to *asylum*

```
# Plot the word embedding of words that are related for the GloVe model (asylum)
word_post_4 <- glove_embedding_post["asylum",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_post, y = word_post_4, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_post_4 <- df_umap_post %>%
  inner_join(y=select, by= "word")
```

```
#The ggplot visual for GloVe
ggplot(selected_words_post_4, aes(x = Post_UMAP1, y = Post_UMAP2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Post_UMAP1, Post_UMAP2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjus
  labs(title = "(Post-Crisis) total speech - 'asylum'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



We can now compare the two periods with three different embedding maps.

2) Training by party and pre/post economic crisis

To make four different GloVe embedding models, dividing data by party and date

```
library(RcppParallel)

# filter data by party and date. Now have pre/post economic crisis text data of Conservative and Labour
data_conser_pre <- filter(tidy_data_notoken, party == "Conservative" & date < as.Date("2007-09-24"))
data_labour_pre <- filter(tidy_data_notoken, party == "Labour" & date < as.Date("2007-09-24"))

data_conser_post <- filter(tidy_data_notoken, party == "Conservative" & date >= as.Date("2007-09-24"))
data_labour_post <- filter(tidy_data_notoken, party == "Labour" & date >= as.Date("2007-09-24"))
```

(1) The GloVe model for Conservative party before the 2008 economic crisis

Training process

```
set.seed(42L)
glove_text_conser_pre <- sample(data_conser_pre$desc)

tokens_conser_pre <- space_tokenizer(glove_text_conser_pre)
it_conser_pre <- itoken(tokens_conser_pre, progressbar = FALSE)
```

```
vocab_conser_pre <- create_vocabulary(it_conser_pre)
vocab_pruned_conser_pre <- prune_vocabulary(vocab_conser_pre, term_count_min = COUNT_MIN)

vectorizer_conser_pre <- vocab_vectorizer(vocab_pruned_conser_pre)
tcm_conser_pre <- create_tcm(it_conser_pre, vectorizer_conser_pre, skip_grams_window = WINDOW_SIZE, ski

glove_conser_pre <- GlobalVectors$new(rank = DIM, x_max = 100, learning_rate = 0.05)
word_vectors_main_conser_pre <- glove_conser_pre$fit_transform(tcm_conser_pre, n_iter = ITERS, converge

word_vectors_context_conser_pre <- glove_conser_pre$components
glove_embedding_conser_pre <- word_vectors_main_conser_pre + t(word_vectors_context_conser_pre)

saveRDS(glove_embedding_conser_pre, file = "local_glove_conser_pre.rds")
```

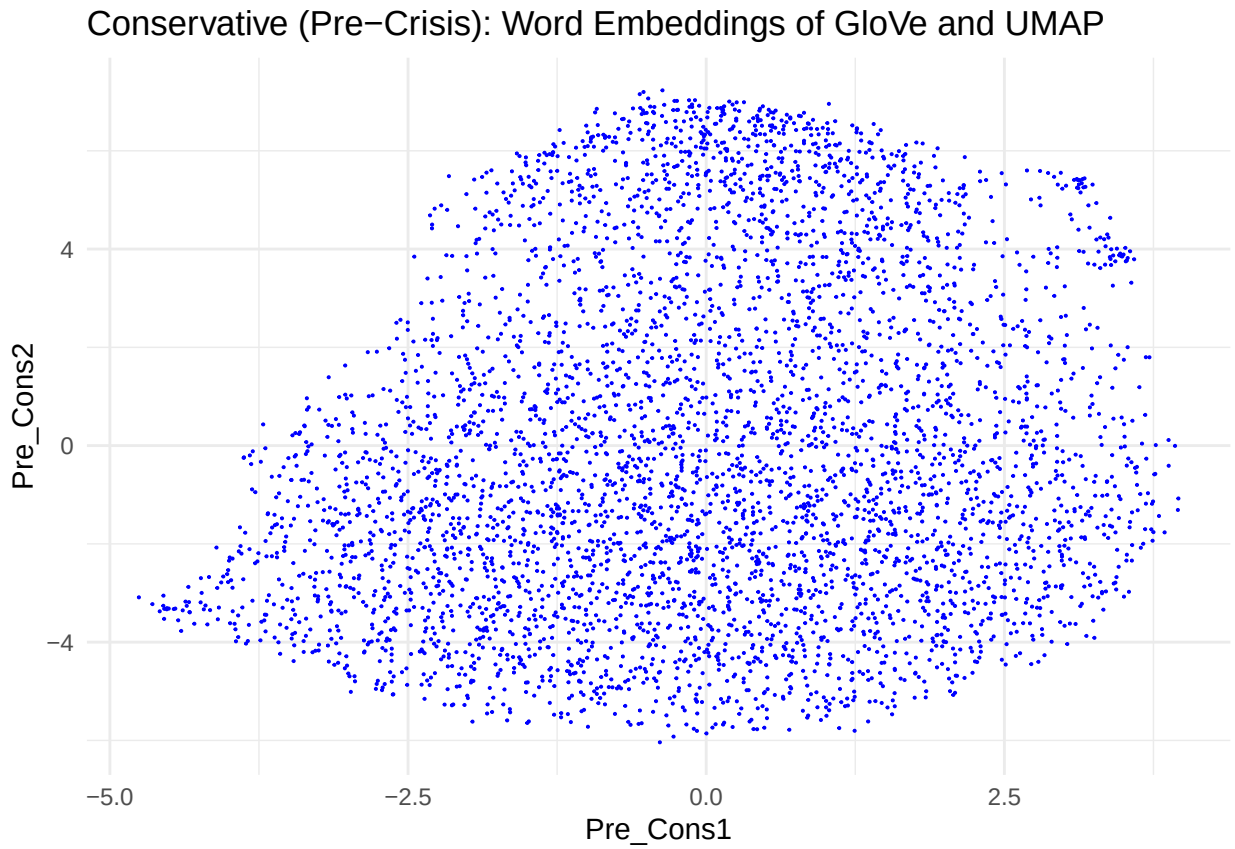
Modelling takes time. So I will use the prepared model made by same process for knitting.

```
url_conser_pre <- "https://github.com/RiverKim-garam/CTA24-Final-assessment/blob/main/local_glove_conse
glove_embedding_conser_pre <- readRDS(url(url_conser_pre, method = "libcurl"))
```

Total GloVe word embedding two dimensional umap

```
# Plotting the whole word embeddings of pre-crisis Conservative party immigration related text
umap_conser_pre <- umap(glove_embedding_conser_pre, n_components = 2, metric = "cosine", n_neighbors = 

df_umap_conser_pre <- as.data.frame(umap_conser_pre[["layout"]])
df_umap_conser_pre$word <- rownames(df_umap_conser_pre)
colnames(df_umap_conser_pre) <- c("Pre_Cons1", "Pre_Cons2", "word")
```

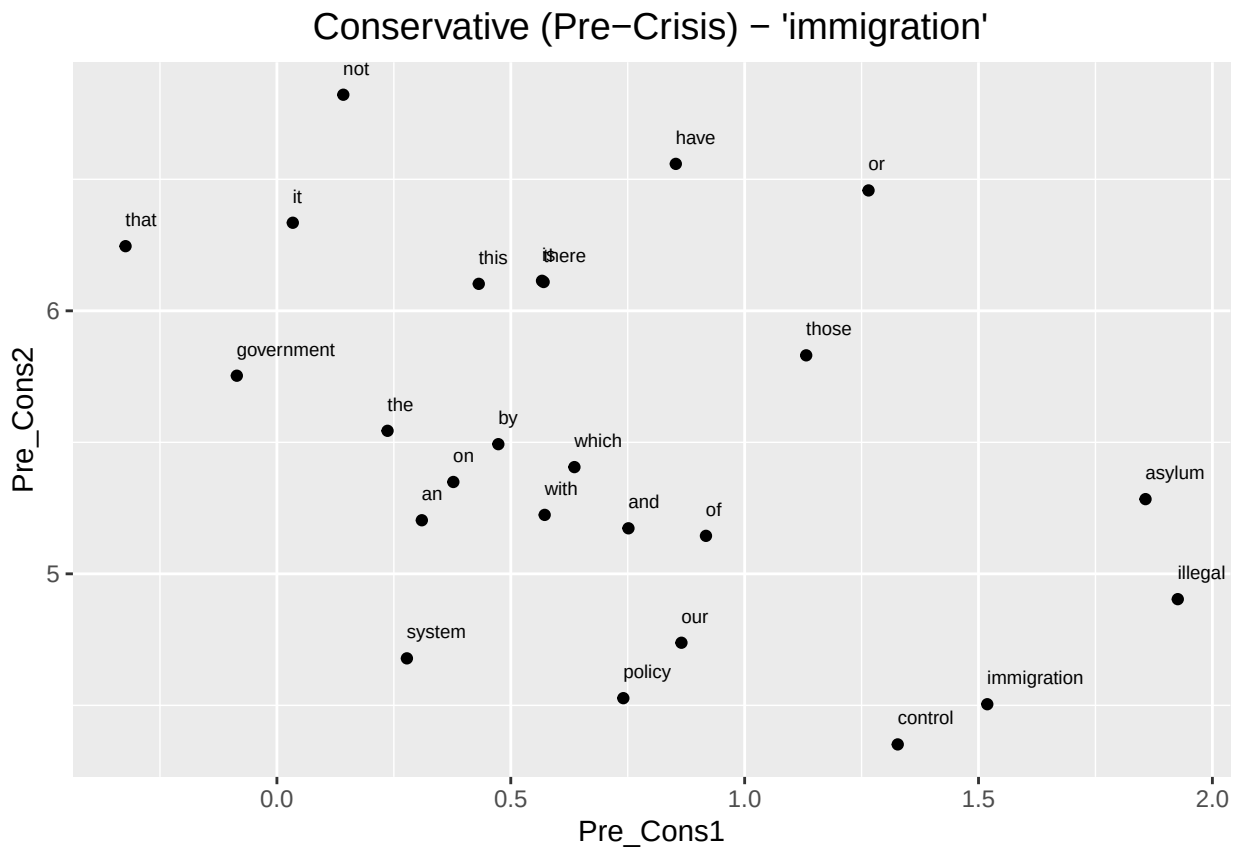
```
ggplot(df_umap_conser_pre) +
  geom_point(aes(x = Pre_Cons1, y = Pre_Cons2), color = 'blue', size = 0.05) +
  labs(title = "Conservative (Pre-Crisis): Word Embeddings of GloVe and UMAP") +
  theme_minimal()
```



Pre-crisis Conservative party word embedding of words related to *immigration*

```
# Plot the word embedding of words that are related for the GloVe model (Case1: immigration)
word_conser_pre_1 <- glove_embedding_conser_pre["immigration",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_conser_pre, y = word_conser_pre_1, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_conser_pre_1 <- df_umap_conser_pre %>%
  inner_join(y=select, by= "word")
```

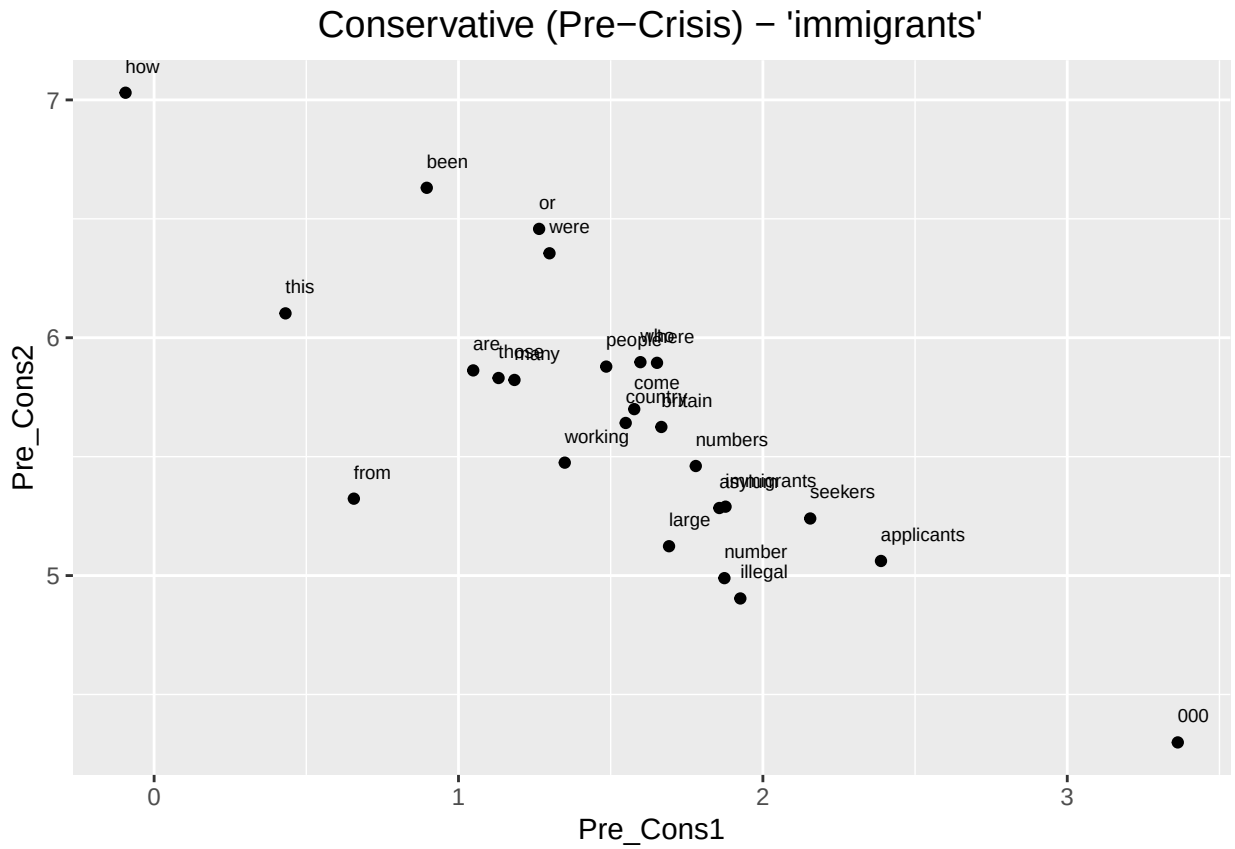
```
#The ggplot visual for GloVe
ggplot(selected_words_conser_pre_1, aes(x = Pre_Cons1, y = Pre_Cons2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Pre_Cons1, Pre_Cons2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjust=
  labs(title = "Conservative (Pre-Crisis) - 'immigration'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



Pre-crisis Conservative party word embedding of words related to *immigrants*

```
# Plot the word embedding of words that are related for the GloVe model (Case2: immigrants)
word_conser_pre_2 <- glove_embedding_conser_pre["immigrants",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_conser_pre, y = word_conser_pre_2, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_conser_pre_2 <- df_umap_conser_pre %>%
  inner_join(y=select, by= "word")
```

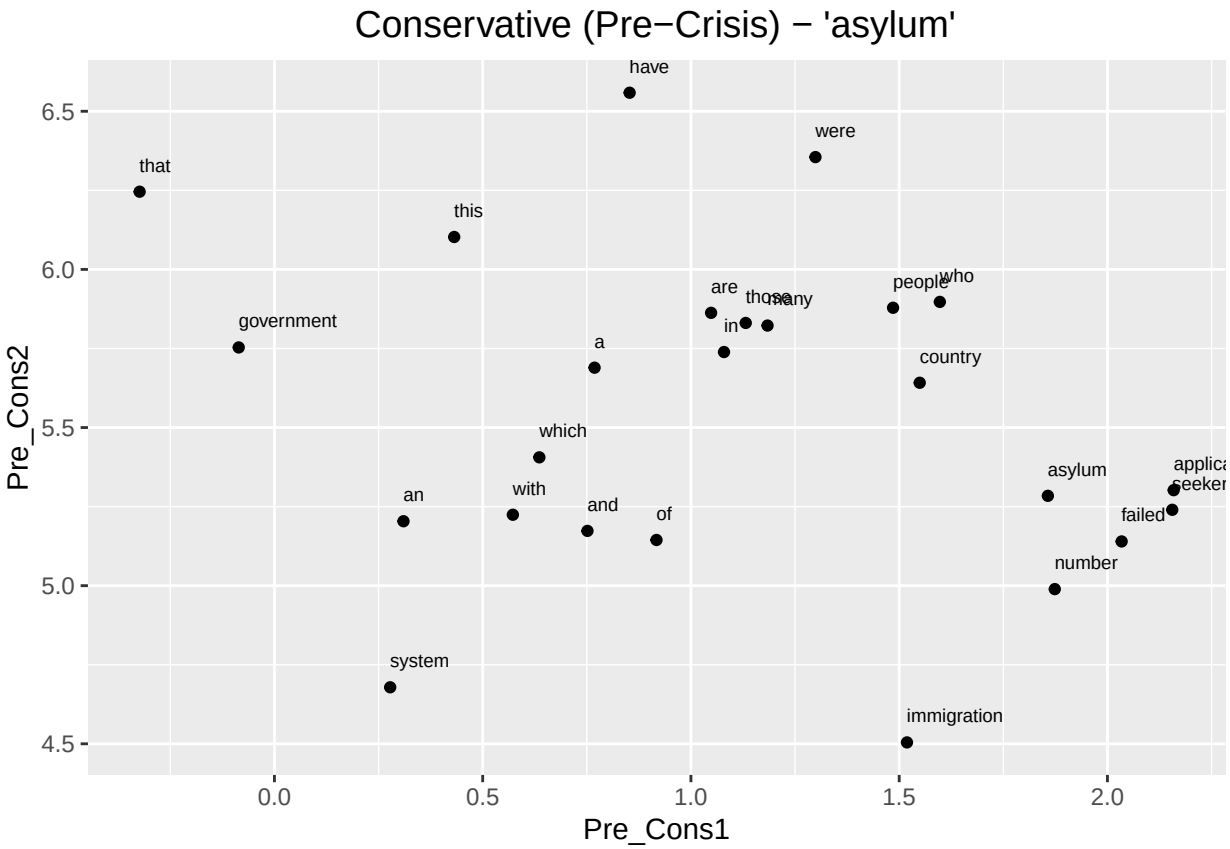
```
#The ggplot visual for GloVe
ggplot(selected_words_conser_pre_2, aes(x = Pre_Cons1, y = Pre_Cons2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Pre_Cons1, Pre_Cons2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjust=
  labs(title = "Conservative (Pre-Crisis) - 'immigrants'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



Pre-crisis Conservative party word embedding of words related to *asylum*

```
# Plot the word embedding of words that are related for the GloVe model (case3: asylum)
word_conser_pre_3 <- glove_embedding_conser_pre["asylum",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_conser_pre, y = word_conser_pre_3, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_conser_pre_3 <- df_umap_conser_pre %>%
  inner_join(y=select, by= "word")
```

```
#The ggplot visual for GloVe
ggplot(selected_words_conser_pre_3, aes(x = Pre_Cons1, y = Pre_Cons2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Pre_Cons1, Pre_Cons2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjust=
  labs(title = "Conservative (Pre-Crisis) - 'asylum'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



(2) The GloVe model for Conservative party after the 2008 economic crisis

Training process

```
set.seed(42L)
glove_text_conser_post <- sample(data_conser_post$desc)

tokens_conser_post <- space_tokenizer(glove_text_conser_post)
it_conser_post <- itoken(tokens_conser_post, progressbar = FALSE)
vocab_conser_post <- create_vocabulary(it_conser_post)
vocab_pruned_conser_post <- prune_vocabulary(vocab_conser_post, term_count_min = COUNT_MIN)

vectorizer_conser_post <- vocab_vectorizer(vocab_pruned_conser_post)
tcm_conser_post <- create_tcm(it_conser_post, vectorizer_conser_post, skip_grams_window = WINDOW_SIZE, s

glove_conser_post <- GlobalVectors$new(rank = DIM, x_max = 100, learning_rate = 0.05)
word_vectors_main_conser_post <- glove_conser_post$fit_transform(tcm_conser_post, n_iter = ITERS, conve

word_vectors_context_conser_post <- glove_conser_post$components
glove_embedding_conser_post <- word_vectors_main_conser_post + t(word_vectors_context_conser_post)

saveRDS(glove_embedding_conser_post, file = "local_glove_conser_post.rds")
```

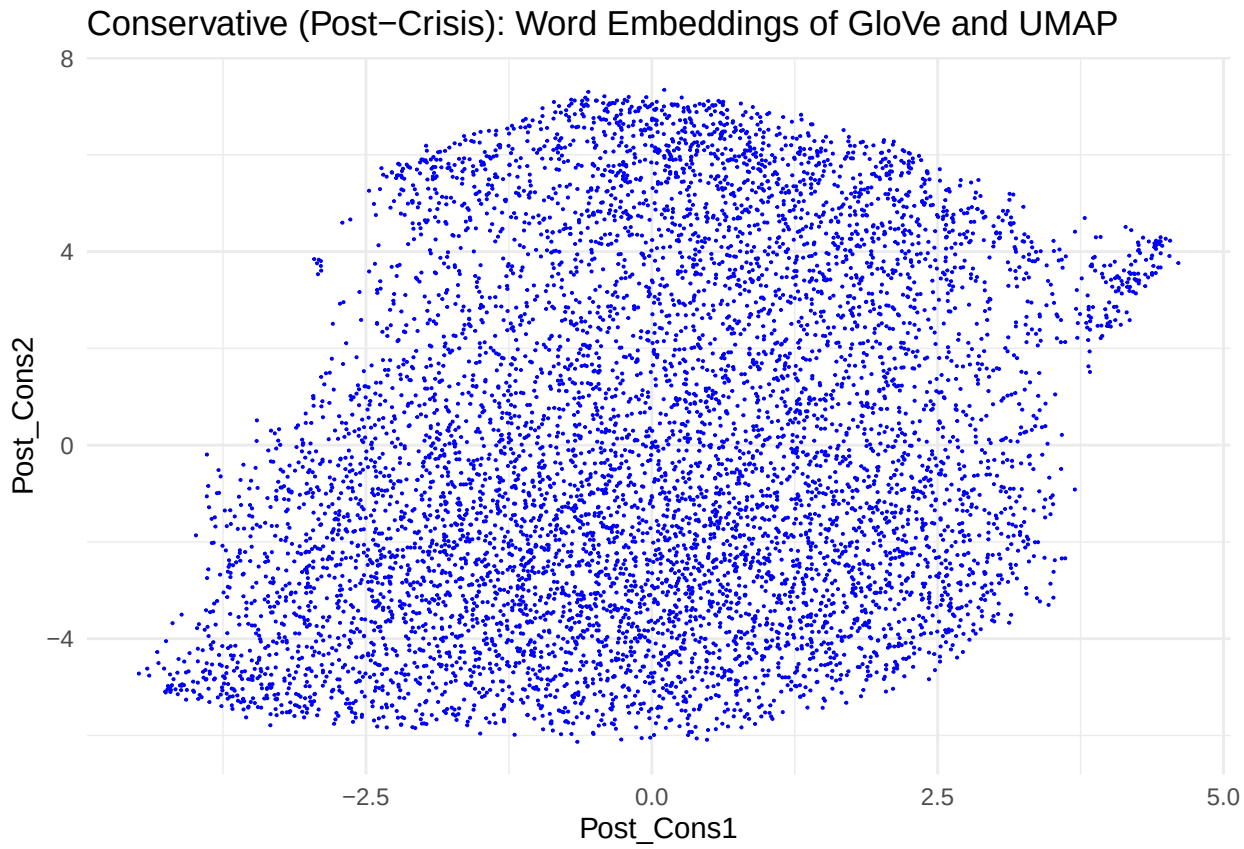
Modelling takes time. So I will use the prepared model made by same process for knitting.

```
url_conser_post <- "https://github.com/RiverKim-garam/CTA24-Final-assessment/blob/main/local_glove_conse
glove_embedding_conser_post <- readRDS(url(url_conser_post, method = "libcurl"))
```

Total GloVe word embedding two dimensional umap

```
# Plotting the whole word embeddings of post-crisis Conservative party immigration related text
umap_conser_post <- umap(glove_embedding_conser_post, n_components = 2, metric = "cosine", n_neighbors =

df_umap_conser_post <- as.data.frame(umap_conser_post[["layout"]])
df_umap_conser_post$word <- rownames(df_umap_conser_post)
colnames(df_umap_conser_post) <- c("Post_Cons1", "Post_Cons2", "word")
```

```
ggplot(df_umap_conser_post) +
  geom_point(aes(x = Post_Cons1, y = Post_Cons2), color = 'blue', size = 0.05) +
  labs(title = "Conservative (Post-Crisis): Word Embeddings of GloVe and UMAP") +
  theme_minimal()
```

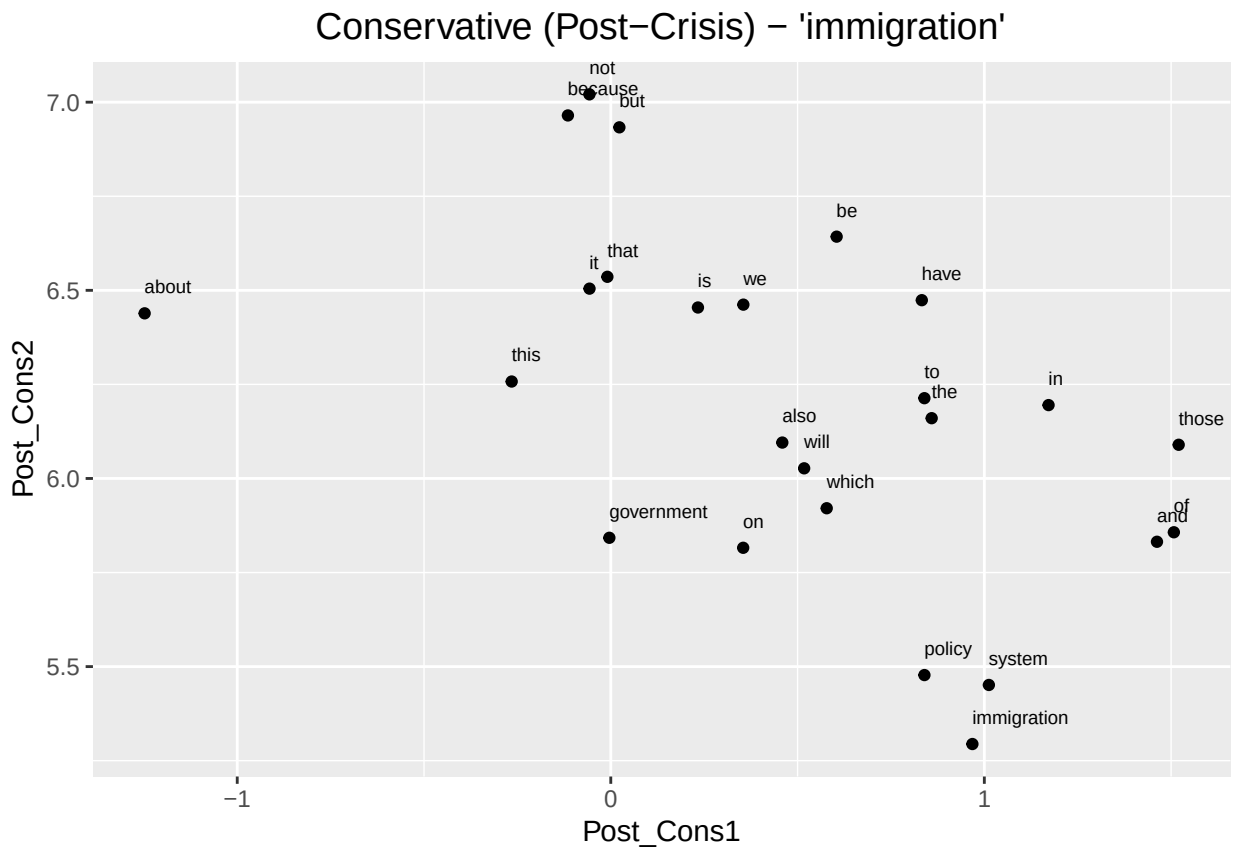


Post-crisis Conservative party word embedding of words related to *immigration*

```
# Plot the word embedding of words that are related for the GloVe model (Case1: immigration)
word_conser_post_1 <- glove_embedding_conser_post["immigration",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_conser_post, y = word_conser_post_1, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
```

```
selected_words_conser_post_1 <- df_umap_conser_post %>%
  inner_join(y=select, by= "word")
```

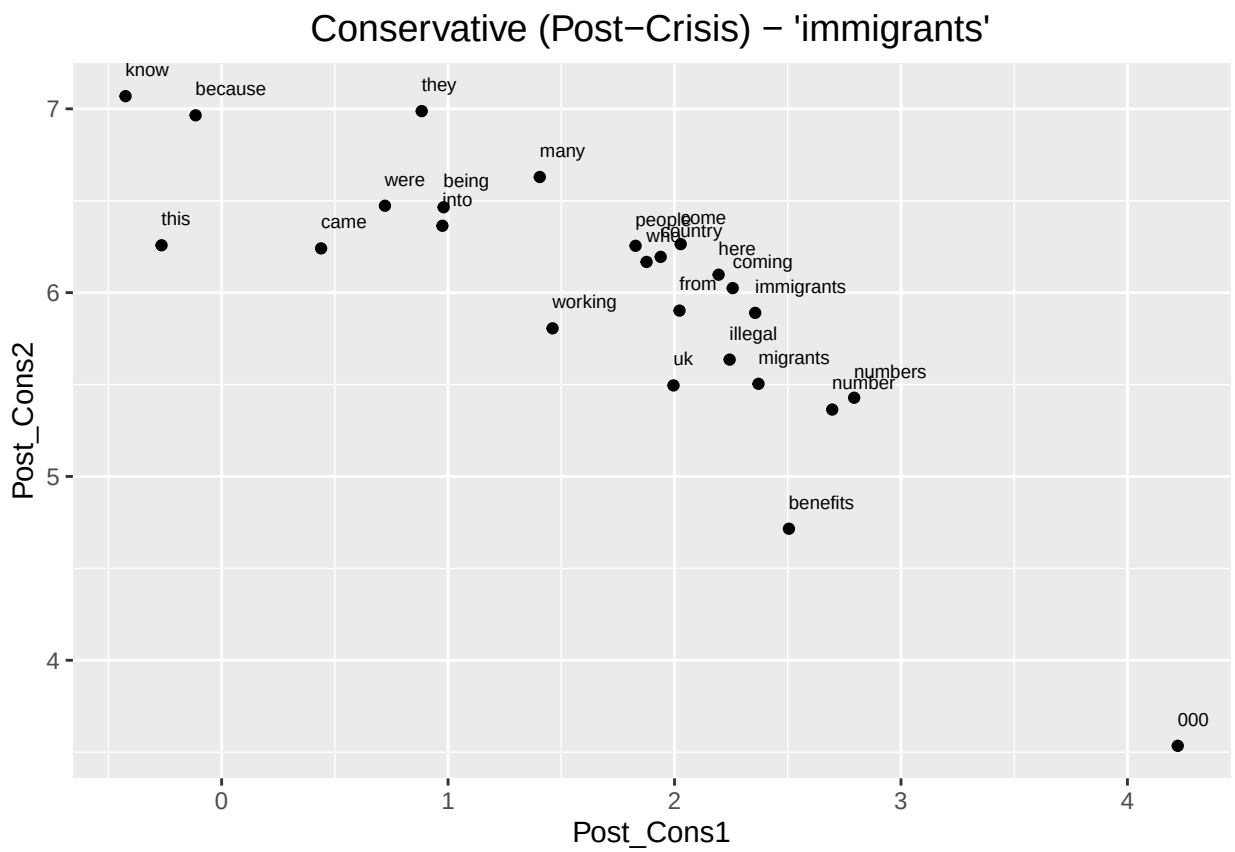
```
#The ggplot visual for GloVe
ggplot(selected_words_conser_post_1, aes(x = Post_Cons1, y = Post_Cons2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Post_Cons1, Post_Cons2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjus
  labs(title = "Conservative (Post-Crisis) - 'immigration'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



Post-crisis Conservative party word embedding of words related to *immigrants*

```
# Plot the word embedding of words that are related for the GloVe model (case2: immigrants)
word_conser_post_2 <- glove_embedding_conser_post["immigrants",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_conser_post, y = word_conser_post_2, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_conser_post_2 <- df_umap_conser_post %>%
  inner_join(y=select, by= "word")
```

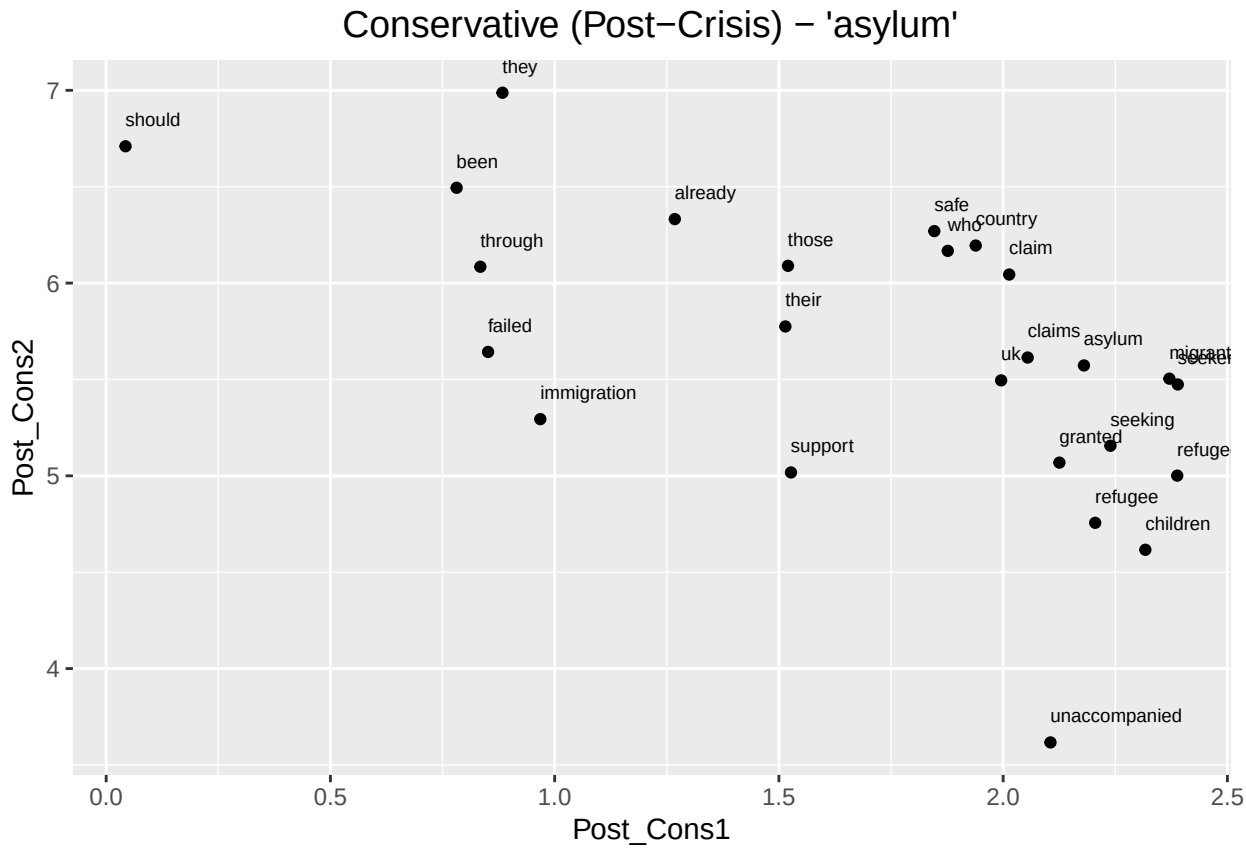
```
#The ggplot visual for GloVe
ggplot(selected_words_conser_post_2, aes(x = Post_Cons1, y = Post_Cons2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Post_Cons1, Post_Cons2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjus
  labs(title = "Conservative (Post-Crisis) - 'immigrants'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



Post-crisis Conservative party word embedding of words related to *asylum*

```
# Plot the word embedding of words that are related for the GloVe model (Case3: asylum)
word_conser_post_4 <- glove_embedding_conser_post["asylum",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_conser_post, y = word_conser_post_4, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_conser_post_4 <- df_umap_conser_post %>%
  inner_join(y=select, by= "word")
```

```
#The ggplot visual for GloVe
ggplot(selected_words_conser_post_4, aes(x = Post_Cons1, y = Post_Cons2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Post_Cons1, Post_Cons2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjus
  labs(title = "Conservative (Post-Crisis) - 'asylum'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



(3) The GloVe model for Labour party before the 2008 economic crisis

Training process

```
set.seed(42L)
glove_text_labour_pre <- sample(data_labour_pre$desc)

tokens_labour_pre <- space_tokenizer(glove_text_labour_pre)
it_labour_pre <- itoken(tokens_labour_pre, progressbar = FALSE)
vocab_labour_pre <- create_vocabulary(it_labour_pre)
vocab_pruned_labour_pre <- prune_vocabulary(vocab_labour_pre, term_count_min = COUNT_MIN)

vectorizer_labour_pre <- vocab_vectorizer(vocab_pruned_labour_pre)
tcm_labour_pre <- create_tcm(it_labour_pre, vectorizer_labour_pre, skip_grams_window = WINDOW_SIZE, ski

glove_labour_pre <- GlobalVectors$new(rank = DIM, x_max = 100, learning_rate = 0.05)
word_vectors_main_labour_pre <- glove_labour_pre$fit_transform(tcm_labour_pre, n_iter = ITERS, converge

word_vectors_context_labour_pre <- glove_labour_pre$components
glove_embedding_labour_pre <- word_vectors_main_labour_pre + t(word_vectors_context_labour_pre)

saveRDS(glove_embedding_labour_pre, file = "local_glove_labour_pre.rds")
```

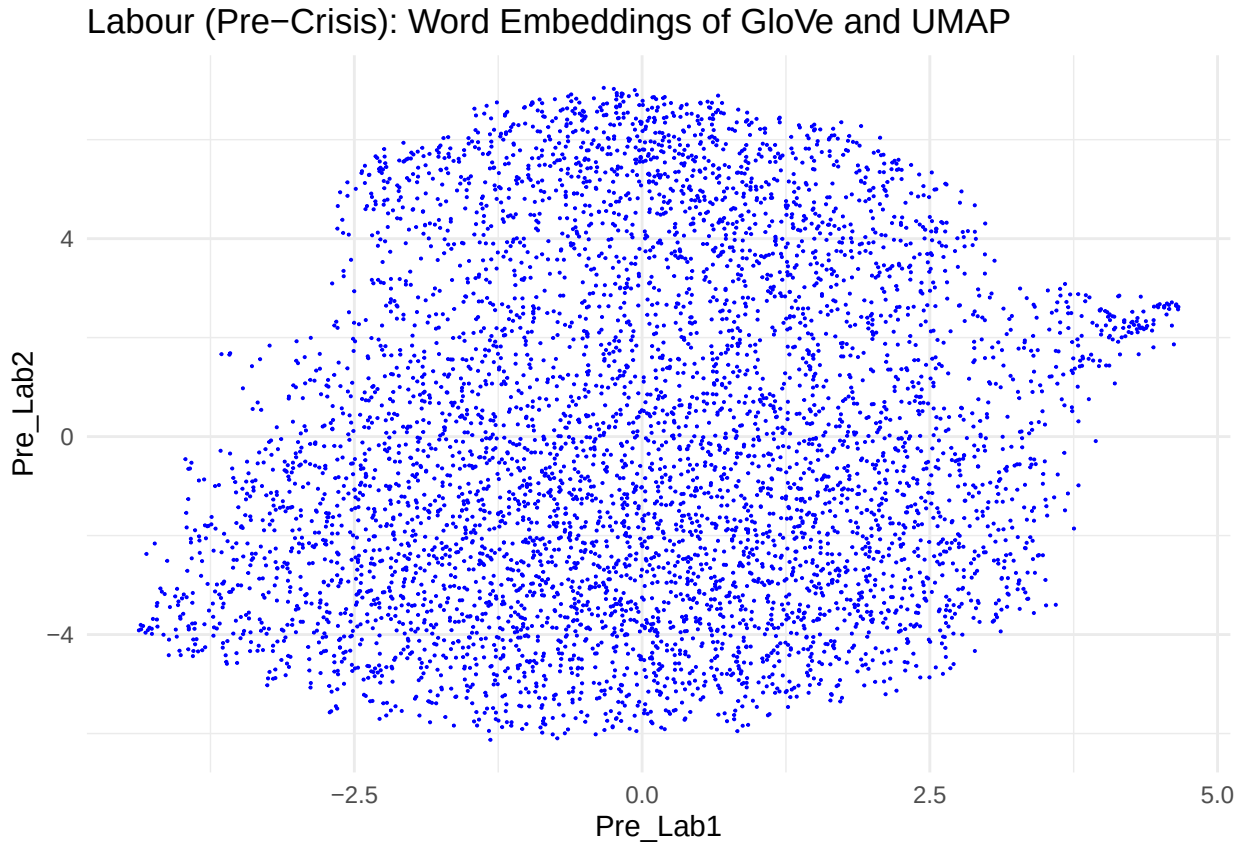
Modelling takes time. So I will use the prepared model made by same process for knitting.

```
url_labour_pre <- "https://github.com/RiverKim-garam/CTA24-Final-assessment/blob/main/local_glove_labou
glove_embedding_labour_pre <- readRDS(url(url_labour_pre, method = "libcurl"))
```

Total GloVe word embedding two dimensional umap

```
# Plotting the whole word embeddings of pre-crisis Labour party immigration related text
umap_labour_pre <- umap(glove_embedding_labour_pre, n_components = 2, metric = "cosine", n_neighbors = 

df_umap_labour_pre <- as.data.frame(umap_labour_pre[["layout"]])
df_umap_labour_pre$word <- rownames(df_umap_labour_pre)
colnames(df_umap_labour_pre) <- c("Pre_Lab1", "Pre_Lab2", "word")
```

```
ggplot(df_umap_labour_pre) +
  geom_point(aes(x = Pre_Lab1, y = Pre_Lab2), color = 'blue', size = 0.05) +
  labs(title = "Labour (Pre-Crisis): Word Embeddings of GloVe and UMAP") +
  theme_minimal()
```

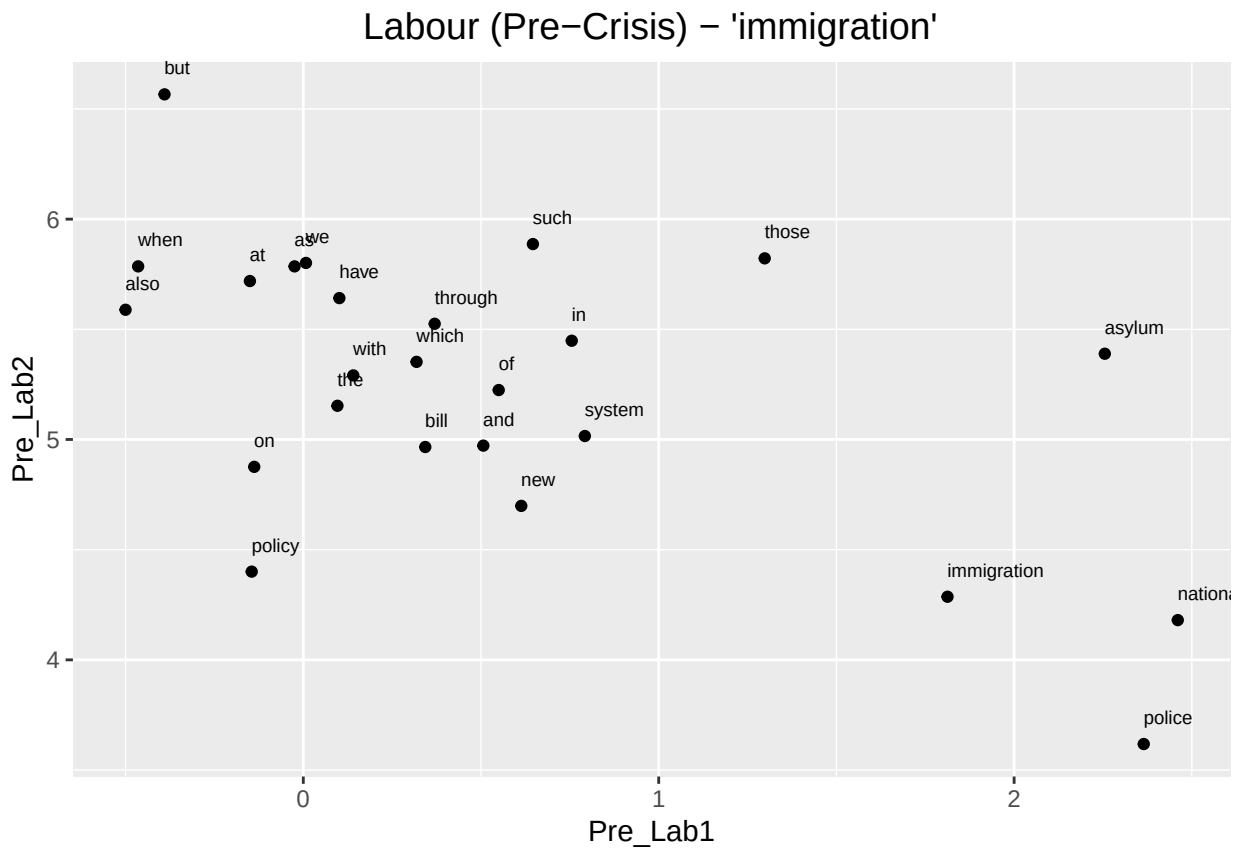


Pre-crisis Labour party word embedding of words related to *immigration*

```
# Plot the word embedding of words that are related for the GloVe model (case1: immigration)
word_labour_pre_1 <- glove_embedding_labour_pre["immigration",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_labour_pre, y = word_labour_pre_1, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
```

```
selected_words_labour_pre_1 <- df_umap_labour_pre %>%
  inner_join(y=select, by= "word")
```

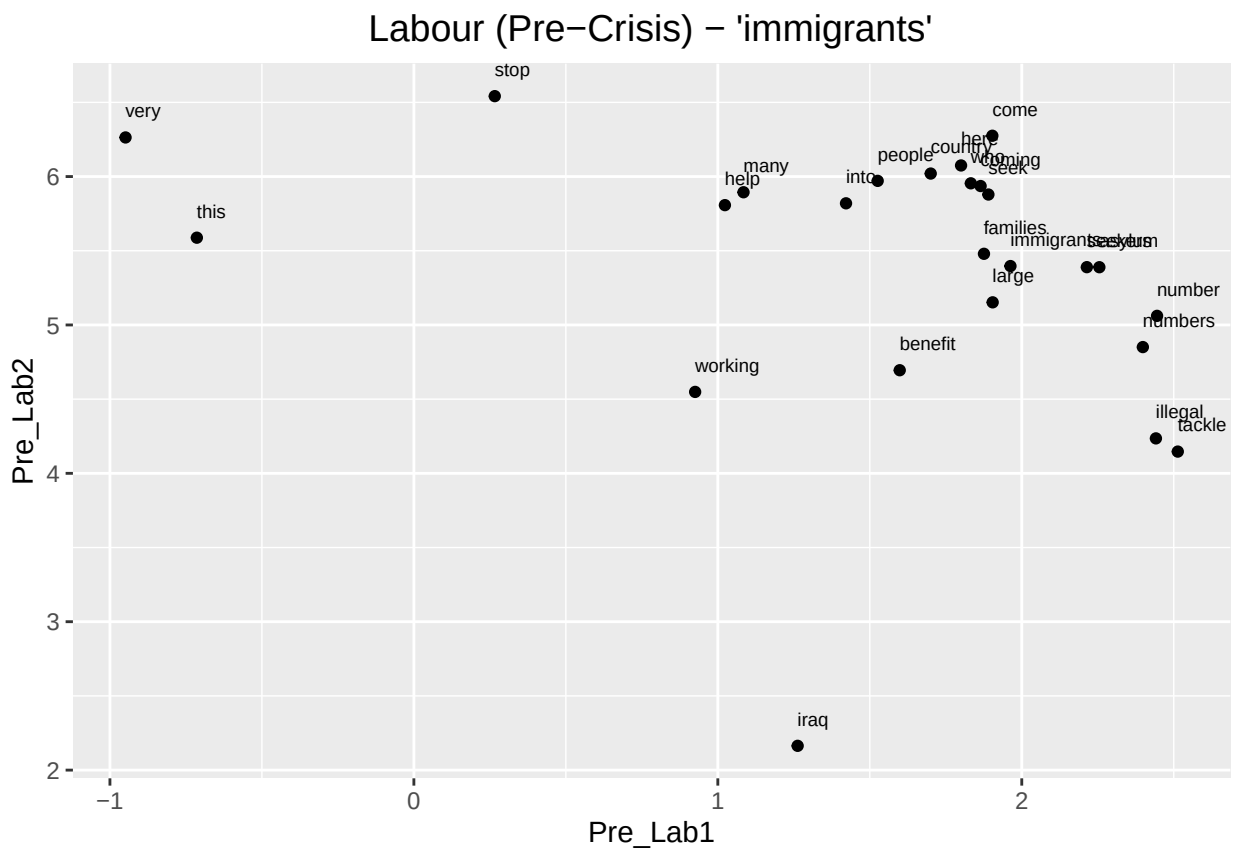
```
#The ggplot visual for GloVe
ggplot(selected_words_labour_pre_1, aes(x = Pre_Lab1, y = Pre_Lab2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Pre_Lab1, Pre_Lab2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjust=0)
  labs(title = "Labour (Pre-Crisis) - 'immigration'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



Pre-crisis Labour party word embedding of words related to *immigrants*

```
# Plot the word embedding of words that are related for the GloVe model (Case2: immigrants)
word_labour_pre_2 <- glove_embedding_labour_pre["immigrants",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_labour_pre, y = word_labour_pre_2, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_labour_pre_2 <- df_umap_labour_pre %>%
  inner_join(y=select, by= "word")
```

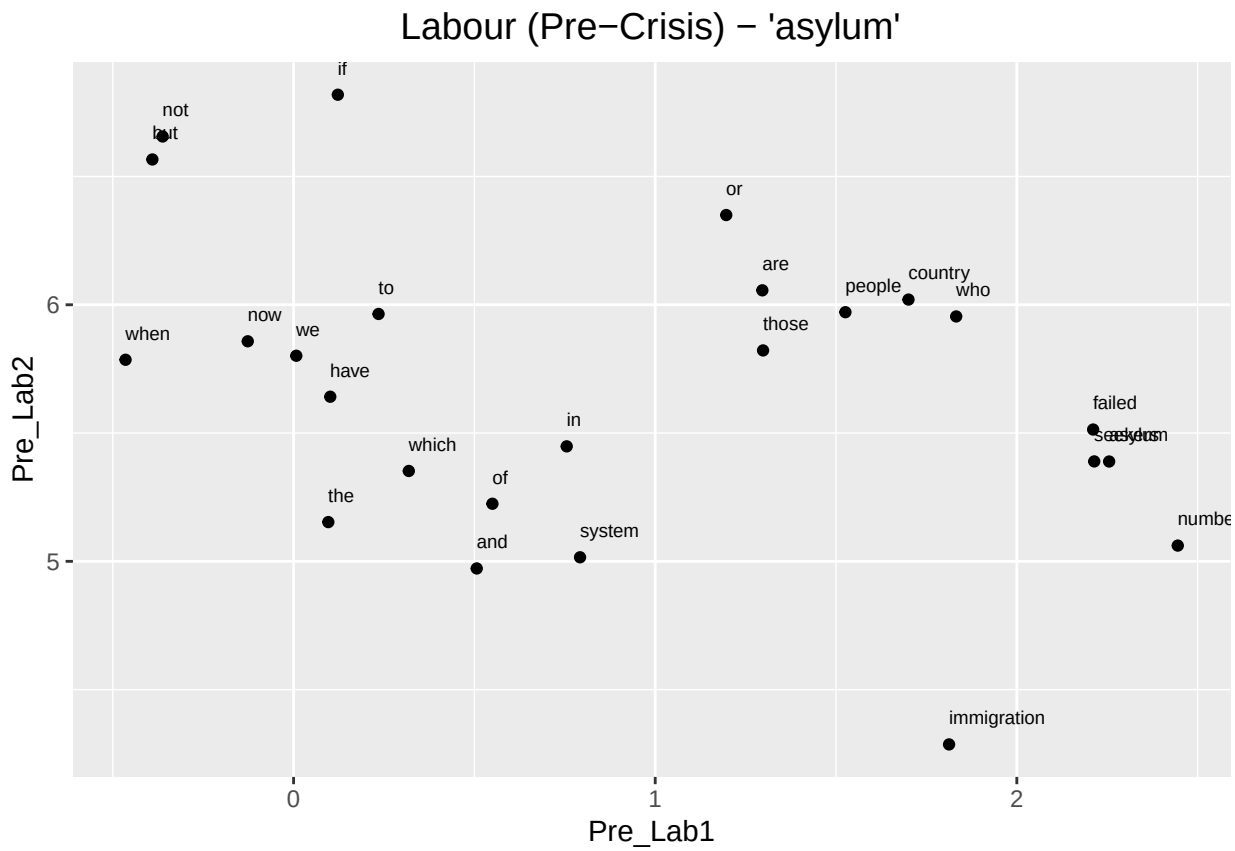
```
#The ggplot visual for GloVe
ggplot(selected_words_labour_pre_2, aes(x = Pre_Lab1, y = Pre_Lab2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Pre_Lab1, Pre_Lab2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjust=0)
  labs(title = "Labour (Pre-Crisis) - 'immigrants'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



Pre-crisis Labour party word embedding of words related to *asylum*

```
# Plot the word embedding of words that are related for the GloVe model (case3: asylum)
word_labour_pre_3 <- glove_embedding_labour_pre["asylum",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_labour_pre, y = word_labour_pre_3, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_labour_pre_3 <- df_umap_labour_pre %>%
  inner_join(y=select, by= "word")
```

```
#The ggplot visual for GloVe
ggplot(selected_words_labour_pre_3, aes(x = Pre_Lab1, y = Pre_Lab2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Pre_Lab1, Pre_Lab2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjust=0
  labs(title = "Labour (Pre-Crisis) - 'asylum'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



(4) The GloVe model for Labour party after the 2008 economic crisis

Training process

```
set.seed(42L)
glove_text_labour_post <- sample(data_labour_post$desc)

tokens_labour_post <- space_tokenizer(glove_text_labour_post)
it_labour_post <- itoken(tokens_labour_post, progressbar = FALSE)
vocab_labour_post <- create_vocabulary(it_labour_post)
vocab_pruned_labour_post <- prune_vocabulary(vocab_labour_post, term_count_min = COUNT_MIN)

vectorizer_labour_post <- vocab_vectorizer(vocab_pruned_labour_post)
tcm_labour_post <- create_tcm(it_labour_post, vectorizer_labour_post, skip_grams_window = WINDOW_SIZE, s

glove_labour_post <- GlobalVectors$new(rank = DIM, x_max = 100, learning_rate = 0.05)
word_vectors_main_labour_post <- glove_labour_post$fit_transform(tcm_labour_post, n_iter = ITERS, conve

word_vectors_context_labour_post <- glove_labour_post$components
glove_embedding_labour_post <- word_vectors_main_labour_post + t(word_vectors_context_labour_post)

saveRDS(glove_embedding_labour_post, file = "local_glove_labour_post.rds")
```

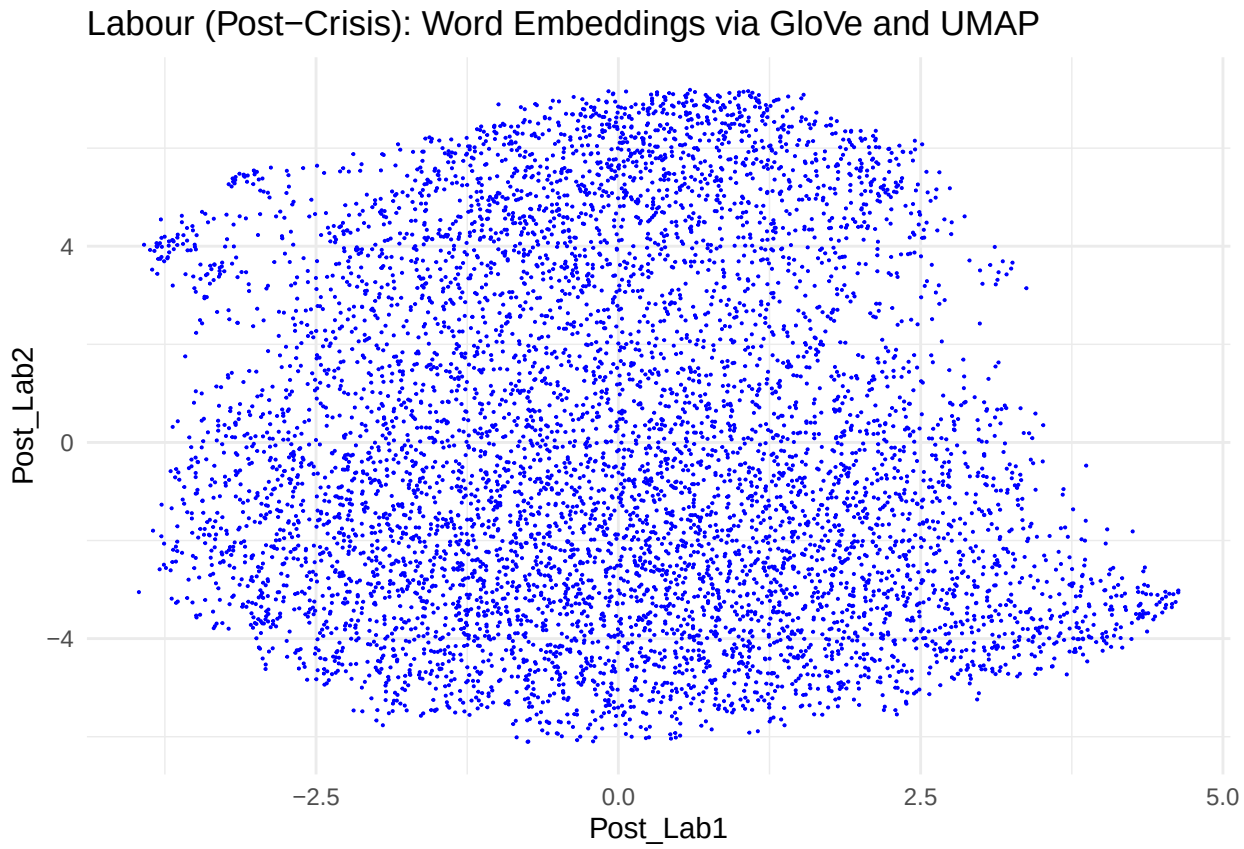
Modelling takes time. So I will use the prepared model made by same process for knitting.

```
url_labour_post <- "https://github.com/RiverKim-garam/CTA24-Final-assessment/blob/main/local_glove_labou
glove_embedding_labour_post <- readRDS(url(url_labour_post, method = "libcurl"))
```

Total GloVe word embedding two dimensional umap

```
# Plotting the whole word embeddings of post-crisis Labour party immigration related text
umap_labour_post <- umap(glove_embedding_labour_post, n_components = 2, metric = "cosine", n_neighbors =

df_umap_labour_post <- as.data.frame(umap_labour_post[["layout"]])
df_umap_labour_post$word <- rownames(df_umap_labour_post)
colnames(df_umap_labour_post) <- c("Post_Lab1", "Post_Lab2", "word")
```

```
ggplot(df_umap_labour_post) +
  geom_point(aes(x = Post_Lab1, y = Post_Lab2), color = 'blue', size = 0.05) +
  labs(title = "Labour (Post-Crisis): Word Embeddings via GloVe and UMAP") +
  theme_minimal()
```

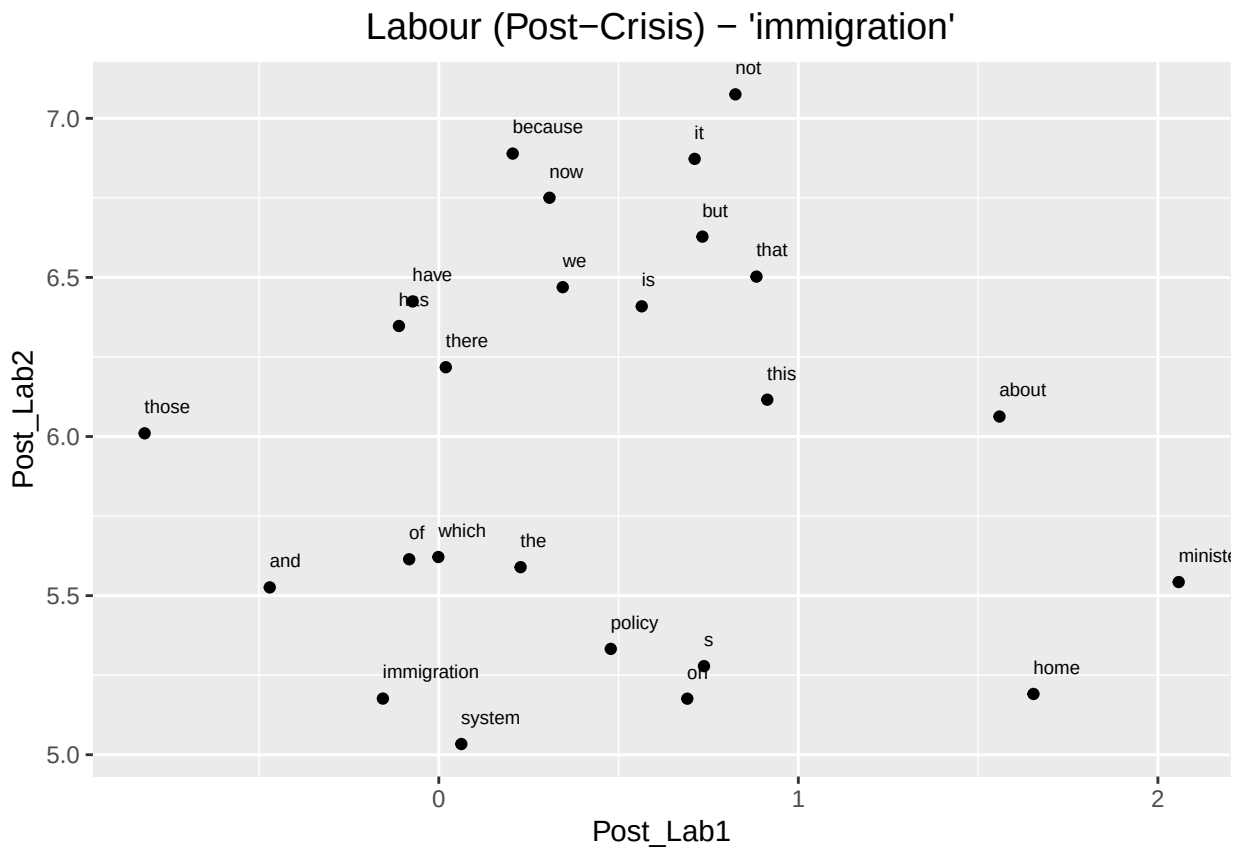


Post-crisis Labour party word embedding of words related to *immigration*

```
# Plot the word embedding of words that are related for the GloVe model (case1: immigration)
word_labour_post_1 <- glove_embedding_labour_post["immigration",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_labour_post, y = word_labour_post_1, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
```

```
selected_words_labour_post_1 <- df_umap_labour_post %>%
  inner_join(y=select, by= "word")
```

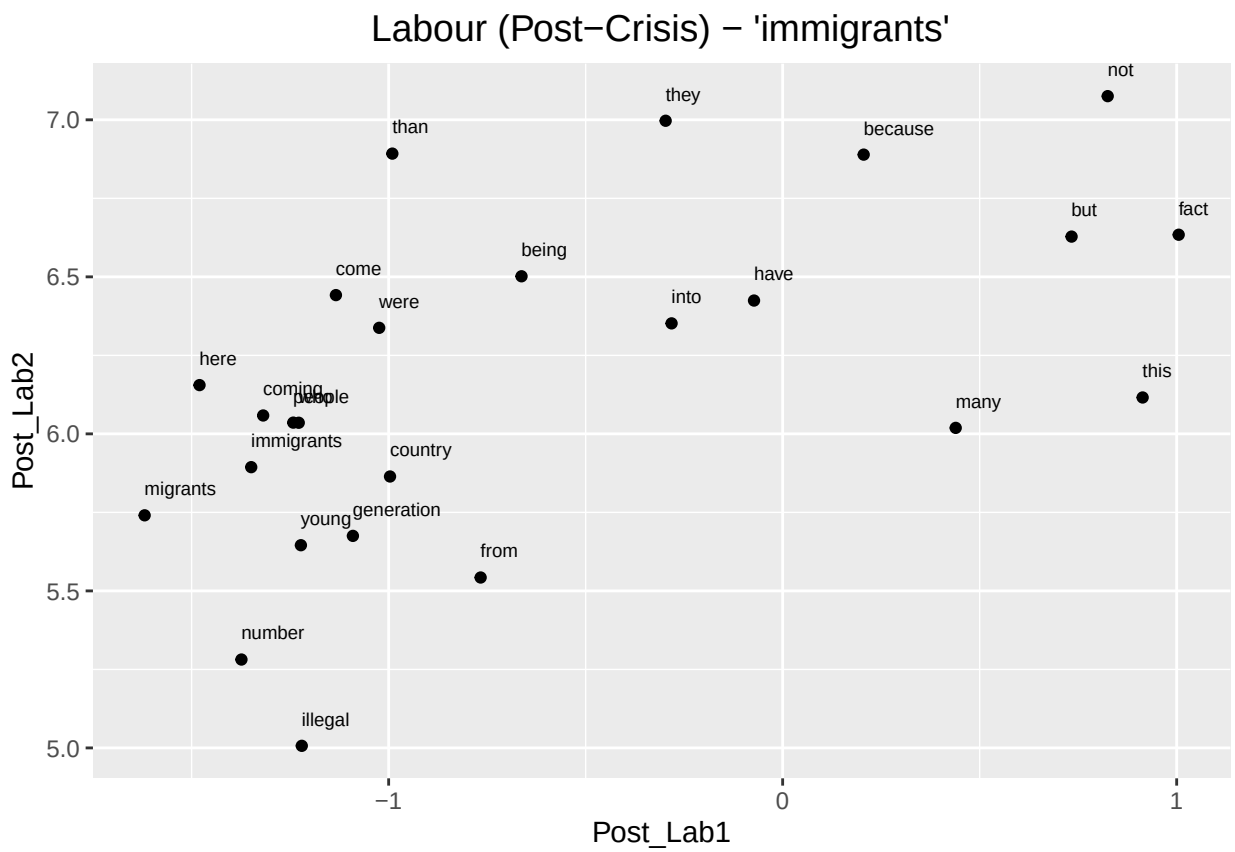
```
#The ggplot visual for GloVe
ggplot(selected_words_labour_post_1, aes(x = Post_Lab1, y = Post_Lab2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Post_Lab1, Post_Lab2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjust=
  labs(title = "Labour (Post-Crisis) - 'immigration'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



Pre-crisis Labour party word embedding of words related to *immigrants*

```
# Plot the word embedding of words that are related for the GloVe model (case2: immigrants)
word_labour_post_2 <- glove_embedding_labour_post["immigrants",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_labour_post, y = word_labour_post_2, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_labour_post_2 <- df_umap_labour_post %>%
  inner_join(y=select, by= "word")
```

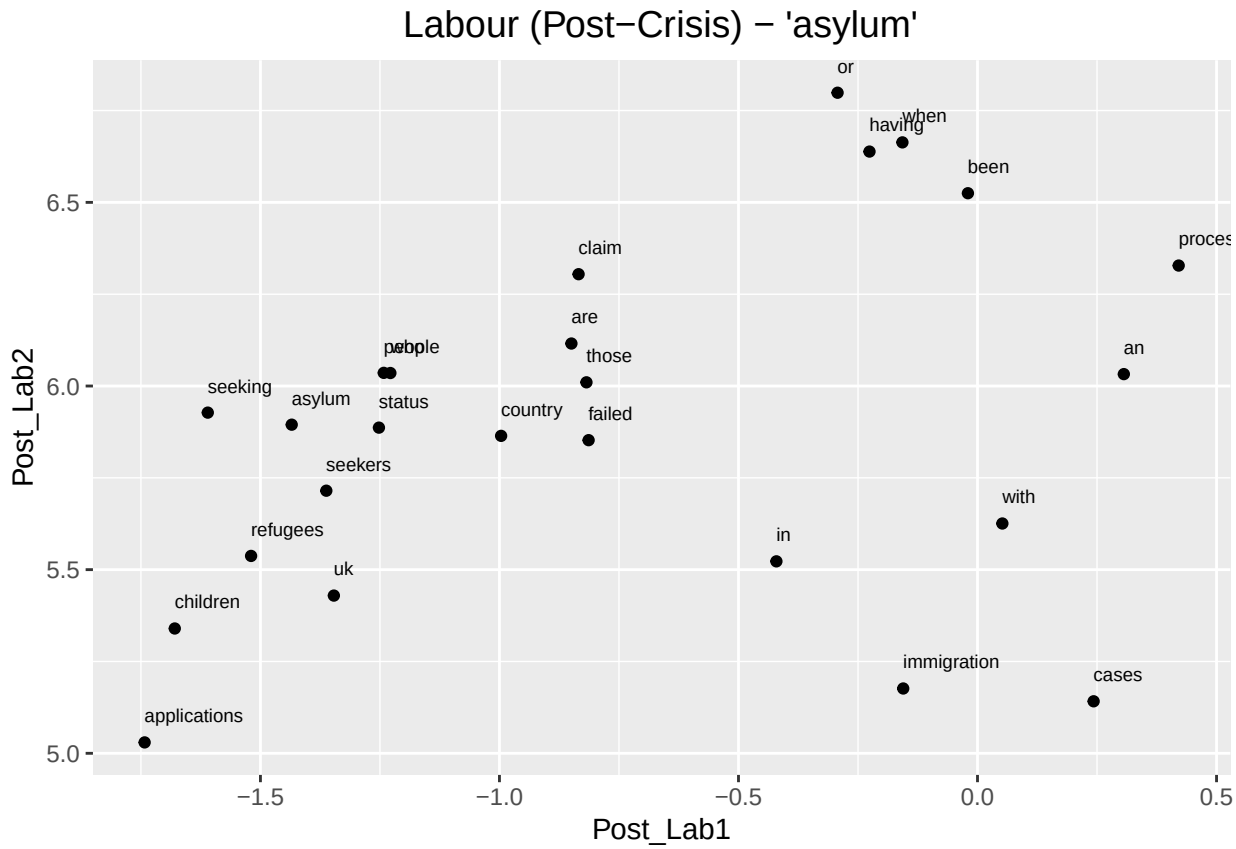
```
#The ggplot visual for GloVe
ggplot(selected_words_labour_post_2, aes(x = Post_Lab1, y = Post_Lab2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Post_Lab1, Post_Lab2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjust=
  labs(title = "Labour (Post-Crisis) - 'immigrants'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



Pre-crisis Labour party word embedding of words related to *asylum*

```
# Plot the word embedding of words that are related for the GloVe model (case3: asylum)
word_labour_post_3 <- glove_embedding_labour_post["asylum",, drop = FALSE]
cos_sim = sim2(x = glove_embedding_labour_post, y = word_labour_post_3, method = "cosine", norm = "l2")
select <- data.frame(rownames(as.data.frame(head(sort(cos_sim[,1], decreasing = TRUE), 25))))
colnames(select) <- "word"
selected_words_labour_post_3 <- df_umap_labour_post %>%
  inner_join(y=select, by= "word")
```

```
#The ggplot visual for GloVe
ggplot(selected_words_labour_post_3, aes(x = Post_Lab1, y = Post_Lab2)) +
  geom_point(show.legend = FALSE) +
  geom_text(aes(Post_Lab1, Post_Lab2, label = word), show.legend = FALSE, size = 2.5, vjust=-1.5, hjust=
  labs(title = "Labour (Post-Crisis) - 'asylum'") +
  theme(plot.title = element_text(hjust = .5, size = 14))
```



Now we made three different specific words (immigration, immigrants, asylum) GloVE embedding umap by party and the period. By comparing the connections of words, we can estimate the contexts how the words were used.

```
# Instead of LaTex, use TinyTeX to knit the mark down result into pdf
library(tinytex)
```