Open Canada Data - Analysis of National Defence Contracting and Vendors

In previous analysis of government contract data, the vendor name field was found to be rather unreliable due to a variety of different spellings or misspellings of vendor names. Having to parse through all the names was a bit of a challenge which I did not attempt, however thankfully I found that the Ottawa Civic Tech project had already done much of the hard work on this for me based on an analysis of proactive disclosure data and publicly available for use under an 'unlicence'. (See http://unlicense.org/) Their vendor name information captures many different alternate entries of vendor names and subsidiaries and bundles them under a "parent company". One issue I noted is that parent company level often results in multiple fairly large (from a Canadian perspective), distinct Canadian and foreign-based business units being rolled into one. Depending on the analysis, this kind of grouping of multiple business units, often with very different business lines, may not be ideal.

I have manually updated the vendor data provided by the Ottawa Civic Tech project to include a number of known major and some minor defence suppliers and adjusted parent company name mapping against vendors as a result of recent mergers and acquisitions (for example, Sikorsky is now a business unit of Lockheed Martin). The intent was to improve the quality and tailor it more for an analysis of defence suppliers and the defence industrial base. My updated defence vendor database is publicly available in a csv format on my github repo. In a separate script (wrangling_DND_contracts.R), I imported and wrangled the DND contract data with the cleaned up vendor names joined, into an .rda object. The wrangling script is also available in the repo.

After having integrated vendor name data from the Ottawa Civic Tech project on Government of Canada contract data, I am going to do a short analysis to see if it helps make the analysis of vendor data easier. This analysis was run as of May 2023.

```
library(tidyverse)
```

```
## Warning: package 'ggplot2' was built under R version 4.2.3
```

```
## Warning: package 'tibble' was built under R version 4.2.3
```

```
## Warning: package 'dplyr' was built under R version 4.2.3
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.2     v readr     2.1.4
## v forcats   1.0.0     v stringr   1.5.0
## v ggplot2   3.4.2     v tibble    3.2.1
## v lubridate 1.9.2     v tidyr     1.3.0
## v purrr     1.0.1
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
options(scipen = 999)
load("dnd_contracts.rda")

contract_analysis <- dnd_contracts |>
  select(vendor_name, contract_date, contract_value,
         economic_object_code, description_en, country_of_vendor,
         contract_year, parent_company)

summary(contract_analysis)
```

```
##  vendor_name        contract_date        contract_value
##  Length:278203      Min.   :2000-01-01   Min.   :   -618975
##  Class :character   1st Qu.:2010-11-01   1st Qu.:     15648
##  Mode  :character   Median :2014-08-08   Median :     28000
##                     Mean   :2014-07-10   Mean   :    787040
##                     3rd Qu.:2018-09-03   3rd Qu.:     81703
##                     Max.   :2023-01-09   Max.   :4808234474
##  economic_object_code description_en     country_of_vendor  contract_year
##  Length:278203        Length:278203      Length:278203      Length:278203
##  Class :character     Class :character   Class :character   Class :character
##  Mode  :character     Mode  :character   Mode  :character   Mode  :character
##
##
##
##  parent_company
##  Length:278203
##  Class :character
##  Mode  :character
##
##
##
```

There are about 278,000 entries in the data set. The earliest contracts were from the year 2000 while the latest entries reflect contracts let at the end of January 2023. Entry values range from a negative dollar value entry (likely a data entry error or the result of a contract amendment) to $4 billion per single contract award. 3 out of the top 6 of companies receiving contracts from DND were oil companies - clearly fuel contracts are a major government business opportunity!

There are over 200,000 NA's for parent company. That is a lot of entries that are missed even after I addressed some case sensitivity, punctuation, and company suffix issues in the data wrangling.

```
count(contract_analysis, parent_company) |>
  arrange(desc(n))
```

```
## # A tibble: 273 x 2
##    parent_company                    n
##    <chr>                         <int>
##  1 <NA>                         207531
##  2 IMPERIAL OIL                   6104
##  3 SIMEX DEFENCE                  4124
##  4 WORLD FUEL SERVICES            3567
##  5 SHELL CANADA PRODUCTS          3263
##  6 JHT                            3035
```

```
##  7 CALIAN                              2932
##  8 CANADIAN CORPS OF COMMISSIONAIRES   2169
##  9 UNISOURCE                           2045
## 10 TOP ACES                            1784
## # i 263 more rows
```

Most large defence suppliers are identified, however it is still possible many are missed. Below is the list of firms with the largest number of contract awards that are not paired with a parent company.

```
contract_analysis |>
  filter(is.na(parent_company)) |>
  count(vendor_name) |>
  arrange(desc(n))
```

```
## # A tibble: 41,751 x 2
##    vendor_name                     n
##    <chr>                       <int>
##  1 AEG FUELS                    1098
##  2 UQSUQ                         735
##  3 TJ NOLAN CONSTRUCTION         653
##  4 ACKLANDS GRAINGER             539
##  5 AEG                           505
##  6 APRON FUEL SERVICES           503
##  7 RIGHTWAY SANITATION SERVICES  419
##  8 IMPERIAL CLEANERS             409
##  9 CHRYSLER CANADA               372
## 10 MACKINNON AND OLDING          368
## # i 41,741 more rows
```

The results are hopeful from this perspective. The firms identified do not appear to be any major contractors. These contracts are undoubtedly for low dollar value and less interesting from defence capability perspective.

Taking another perspective, below are the vendor names doing the largest volume not attributed to a parent company in descending order.

```
contract_analysis |>
  filter(is.na(parent_company)) |>
  group_by(vendor_name) |>
  summarize(contracts_total = sum(contract_value)) |>
  arrange(desc(contracts_total))
```

```
## # A tibble: 41,751 x 2
##    vendor_name                  contracts_total
##    <chr>                                  <dbl>
##  1 CORPORATION DU FORT SAINTJEAN      883413825.
##  2 SANTÉ MONTFORT                     521294600
##  3 CANADIAN BORDER OPERATIONS         382800259.
##  4 INDUSTRIES OCÉAN                   200574923.
##  5 EBC                                166725148
##  6 <NA>                               148117169
##  7 NULL                               138375132
##  8 BRONSWERK MARINE                   137339175.
##  9 ZODIAC HURRICANE TECHNOLOGIES      128662806.
```

```
## 10 IPSS                                  126207356.
## # i 41,741 more rows
```

The vast majority of contracts in the data base are relatively low value. Relatively speaking, we may not want to spend much time adding in vendors where the overall value is not significant. Lets take a look at the total value of contracts with a parent company identified.

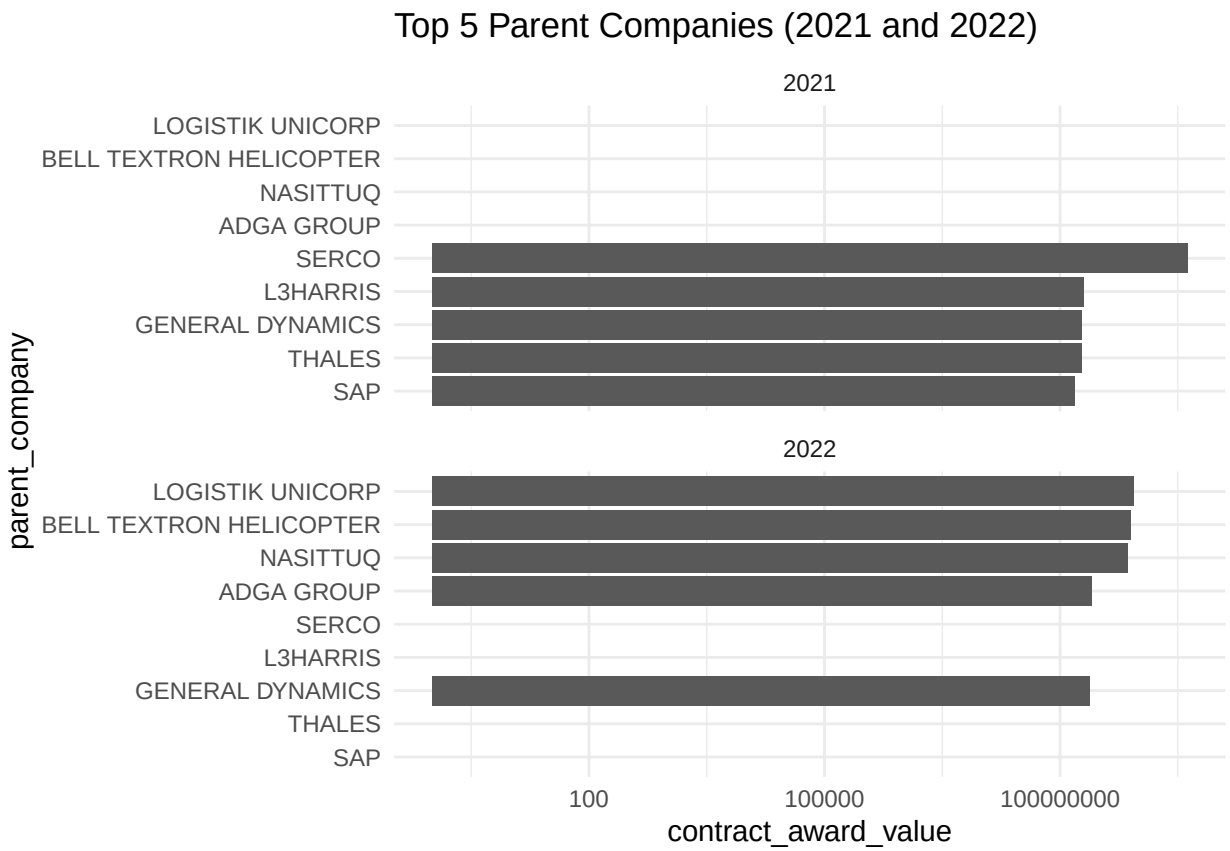
```
parent <- contract_analysis |> filter(!is.na(parent_company))

a <- sum(parent$contract_value, na.rm = TRUE) #contract value sum with parent
b <- sum(contract_analysis$contract_value, na.rm = TRUE)#contract value all entries

c <- sum(parent$contract_value, na.rm = TRUE)/sum(contract_analysis$contract_value, na.rm = TRUE)

d <- nrow(parent)
e <- nrow(contract_analysis)
f <- d/e

contract_value <- c(round(a, 2), round(b, 2), round(c, 2))
n <- c(as.integer(d), as.integer(e), round(f, 2))
y <- c("with_parent", "all", "percentage")
data.frame(contract_value, n, row.names = y)
```

```
##              contract_value         n
## with_parent 183233375821.86  70672.00
## all         218956975750.31 278203.00
## percentage              0.84      0.25
```

Over 80% of value is captured in the 70,000 some entries. Pretty much all of the largest contracts accounting for several hundred of million or more are attributed to a parent company. I will continue to make updates to the defence vendor name data as time allows, but for now we will live with the 80% solution.

```
library(ggthemes)
contract_analysis |> filter(contract_year %in% c("2021", "2022"), !is.na(parent_company)) |>
  group_by(contract_year, parent_company) |>
  summarize(contract_award_value = sum(contract_value)) |>
  arrange(desc(contract_award_value)) |>
  slice_max(order_by = contract_award_value, n=5) |>
  mutate(parent_company = fct_reorder(parent_company, contract_award_value)) |>
  ggplot(aes(parent_company, contract_award_value)) + geom_col() +
  scale_y_log10() +coord_flip() +
  facet_wrap(vars(contract_year), nrow = 3) +
  ggtitle("Top 5 Parent Companies (2021 and 2022)") + theme_minimal()
```

```
## `summarise()` has grouped output by 'contract_year'. You can override using the
## `.groups` argument.
```



In 2021, we see a variety of contracts with different providers. SERCO is a services provider, so that contract may have to do with relocation or facility services. General Dynamics represents a number of major defence business units in Canada, however a new contract for armoured vehicles was awarded to General Dynamics Land Systems Canada was awarded in 2022.

1250 and 1251 are the economic object codes for aircraft and aircraft parts respectively. Let's see what who are the biggest suppliers here. Hopefully, there will be no surprises.

```
contract_analysis |>
  filter(economic_object_code %in% c("1250", "1251"),
         contract_year %in% c("2017", "2018", "2019", "2020", "2021")) |>
  group_by(contract_year, parent_company, economic_object_code) |>
  summarize(contract_awards = sum(contract_value)) |>
  arrange(desc(contract_awards))
```

```
## `summarise()` has grouped output by 'contract_year', 'parent_company'. You can
## override using the `.groups` argument.
```

```
## # A tibble: 45 x 4
## # Groups:   contract_year, parent_company [41]
##    contract_year parent_company             economic_object_code contract_awards
##    <chr>         <chr>                      <chr>                          <dbl>
##  1 2020          BOMBARDIER                 1251                        116111279.
##  2 2020          UNITED STATES DEPARTMENT ~ 1251                         40377732.
##  3 2018          UNITED STATES DEPARTMENT ~ 1251                         26168475.
##  4 2017          UNITED STATES DEPARTMENT ~ 1251                         25421582.
```

```
##  5 2021          UNITED STATES DEPARTMENT ~ 1251                      17064740
##  6 2019          DEW ENGINEERING            1250                      15189635.
##  7 2019          UNITED STATES DEPARTMENT ~ 1251                      13144100
##  8 2020          <NA>                       1251                       7426406.
##  9 2019          <NA>                       1251                       7357406.
## 10 2020          SIMEX DEFENCE              1251                       7002283.
## # i 35 more rows
```

Most of the names are not surprising though I am not familiar with SIMEX defence, though they figured prominently in the vendor database. However, there are still some very large NA contract award entries under parent company.

Let's try something similar for the Navy with the codes for ships (1256) and ship repair (1257).

```
contract_analysis |>
  filter(economic_object_code %in% c("1256", "1257"),
         contract_year %in% c("2017", "2018", "2019", "2020", "2021")) |>
  group_by(contract_year, parent_company, economic_object_code) |>
  summarize(contract_awards = sum(contract_value)) |>
  arrange(desc(contract_awards))
```

```
## `summarise()` has grouped output by 'contract_year', 'parent_company'. You can
## override using the `.groups` argument.
```

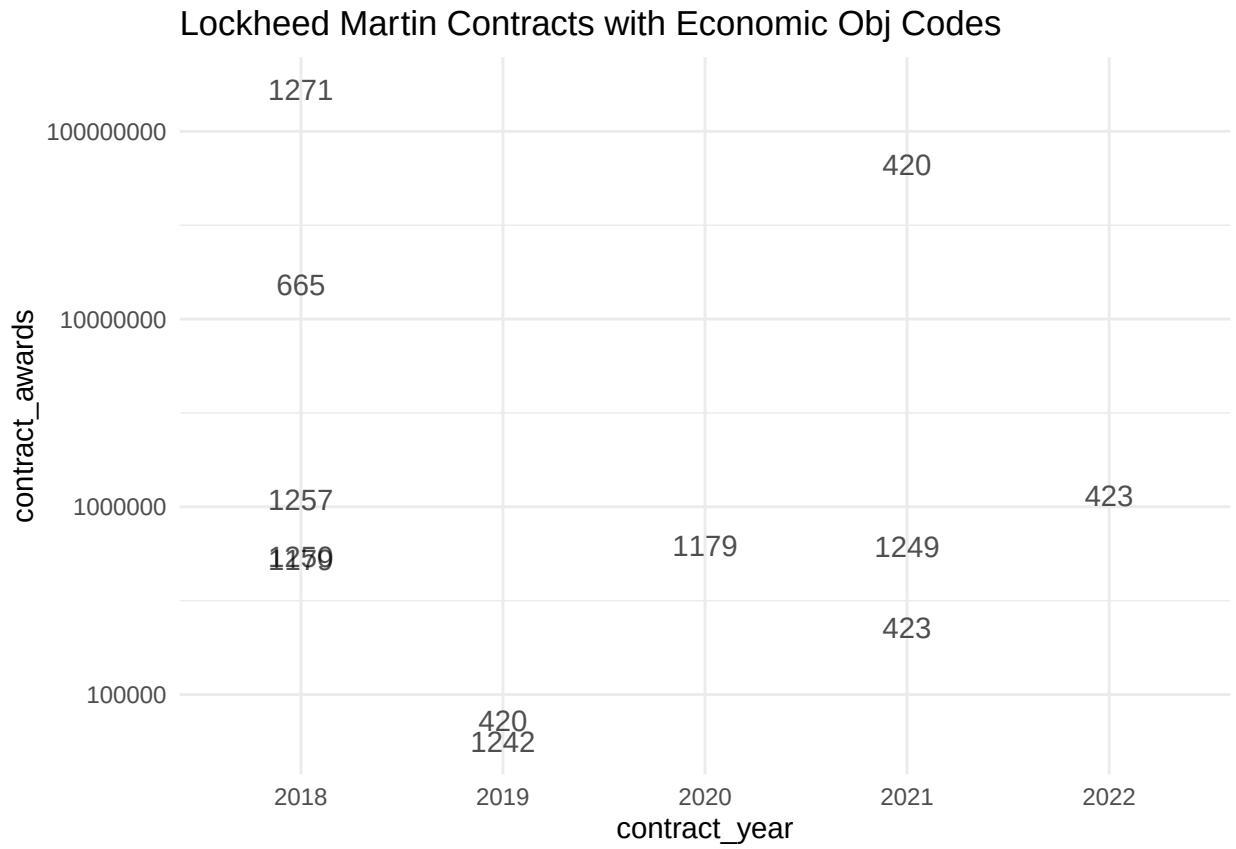
```
## # A tibble: 62 x 4
## # Groups:   contract_year, parent_company [42]
##    contract_year parent_company             economic_object_code contract_awards
##    <chr>         <chr>                      <chr>                          <dbl>
##  1 2020          SEASPAN                    1257                      2447262476
##  2 2018          SEASPAN                    1256                       322839480.
##  3 2019          <NA>                       1256                       303008997.
##  4 2020          <NA>                       1256                        78002741.
##  5 2017          <NA>                       1257                        29337060.
##  6 2018          <NA>                       1257                        17963515.
##  7 2021          <NA>                       1256                        16680292.
##  8 2018          UNITED STATES DEPARTMENT ~ 1257                        13801305
##  9 2017          <NA>                       1256                        12949444.
## 10 2019          <NA>                       1257                        12173730.
## # i 52 more rows
```

Again, some very notable NA entries.

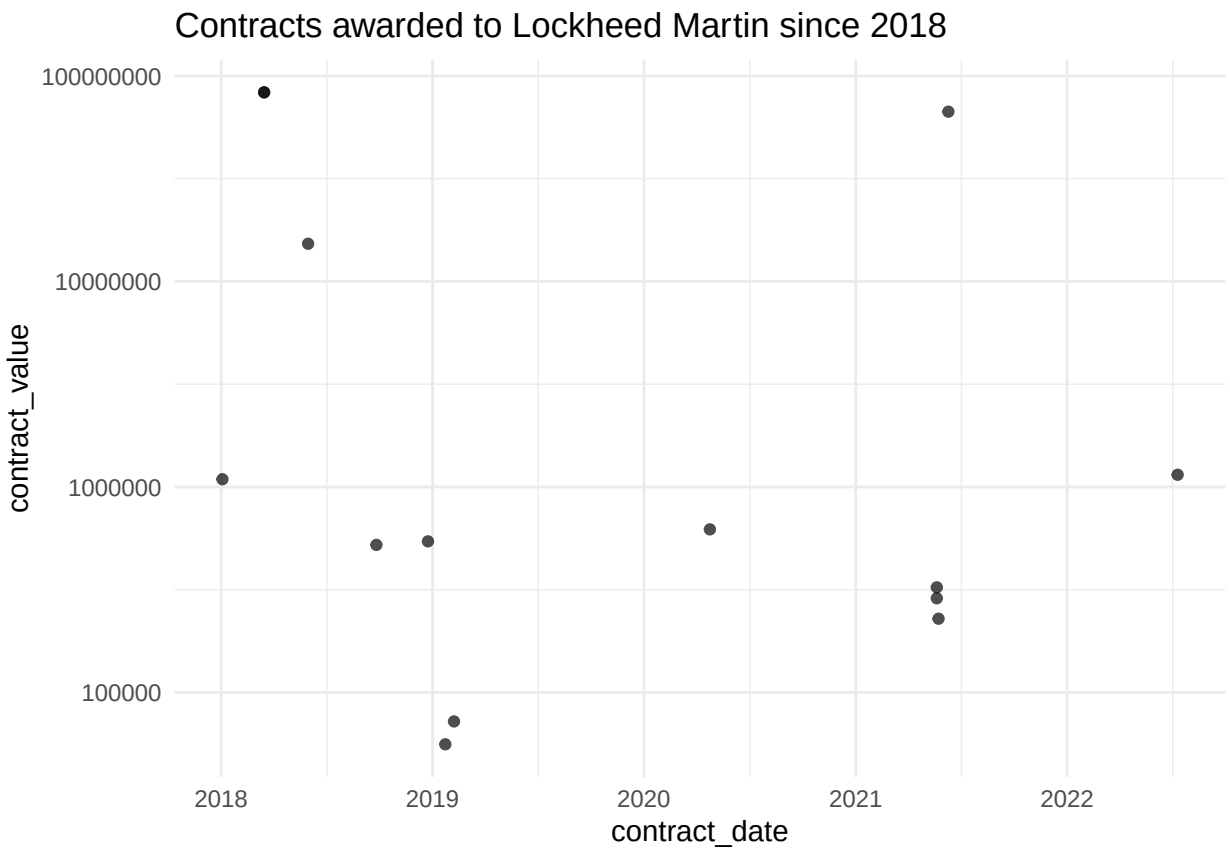
Let's do some specific firm analysis before we wrap this up.

```
contract_analysis |>
  filter(contract_year %in% c("2018", "2019", "2020", "2021", "2022"),
         parent_company == "LOCKHEED MARTIN") |>
  group_by(contract_year, parent_company, economic_object_code) |>
  summarize(contract_awards = sum(contract_value)) |>
  arrange(desc(contract_awards)) |>
  ggplot(aes(contract_year, contract_awards, label=economic_object_code)) +
  geom_text(alpha = .7) +scale_y_log10() +
  ggtitle("Lockheed Martin Contracts with Economic Obj Codes") +
  theme_minimal()
```

```
## `summarise()` has grouped output by 'contract_year', 'parent_company'. You can
## override using the `.groups` argument.
```




```
contract_analysis |>
  filter(parent_company == "LOCKHEED MARTIN", contract_date>"2018-01-01") |>
  ggplot(aes(contract_date, contract_value)) +
  geom_point(alpha = .7) +
  scale_y_log10() +
  ggtitle("Contracts awarded to Lockheed Martin since 2018") +
  theme_minimal()
```



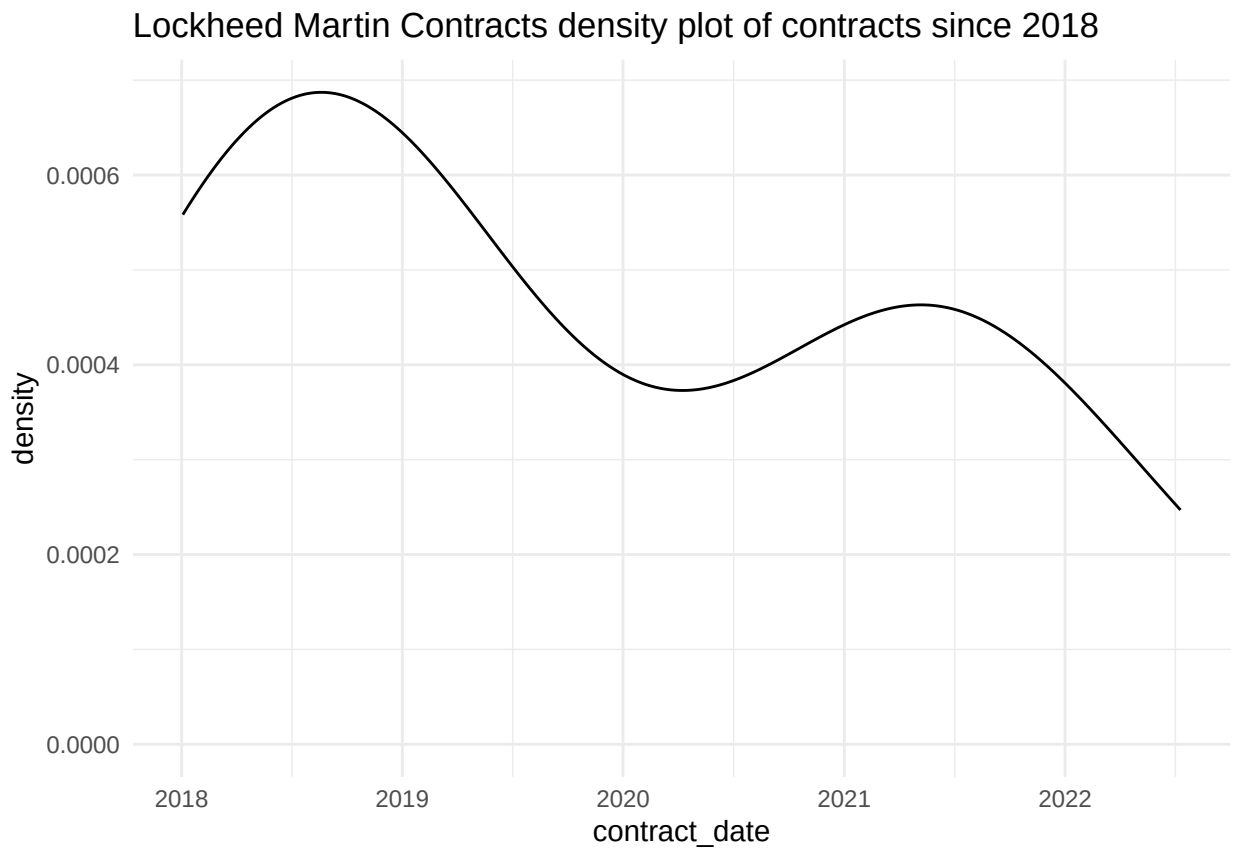
There is a far greater number of points when you do not use the economic object code. I suspect there are a lot of NAs causing for many entries. Another interesting aspect is that this does not capture a significant recent expenditures to Lockheed Martin Canada in the context of shipbuilding. Those contracts flowed through another company so are not reflected here. Clearly the contract data does not capture all the complexities of some of these business relationships.

```
sum(is.na(contract_analysis$economic_object_code))/nrow(contract_analysis)
```

```
## [1] 0.6320816
```

Almost 2/3 of entries are missing their economic object code. Combined with some suspicious entries, I don't think any meaningful analysis using economic object codes in the contract data is possible.

```
contract_analysis |>
  filter(parent_company == "LOCKHEED MARTIN", contract_date>"2018-01-01") |>
  ggplot(aes(contract_date)) +
  geom_density() +
  ggtitle("Lockheed Martin Contracts density plot of contracts since 2018") +
  theme_minimal()
```

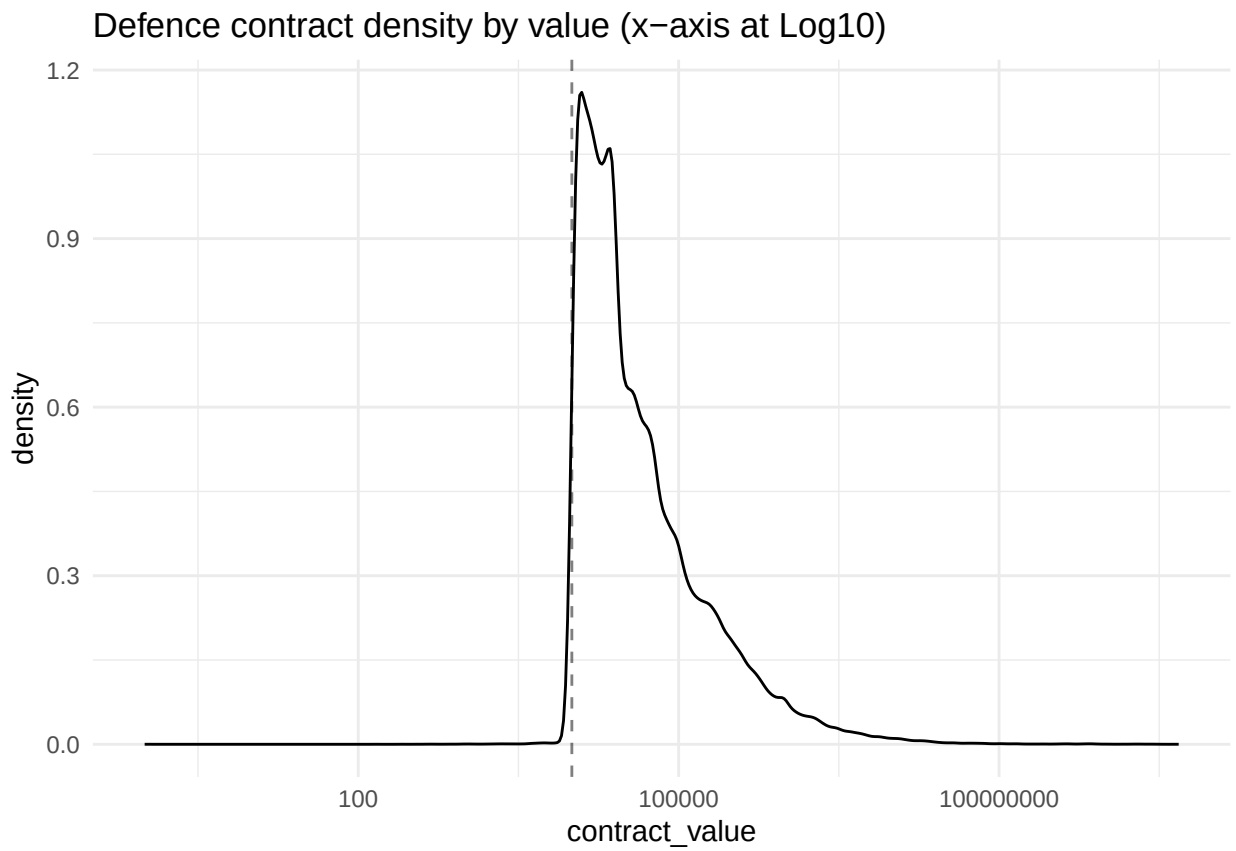



```
contract_analysis |>
  ggplot(aes(contract_value)) +geom_density() +
  scale_x_log10() +
  ggtitle("Defence contract density by value (x-axis at Log10)") +
  geom_vline(xintercept = 10000, alpha=.5, linetype=2)+
  theme_minimal()
```

```
## Warning in self$trans$transform(x): NaNs produced
```

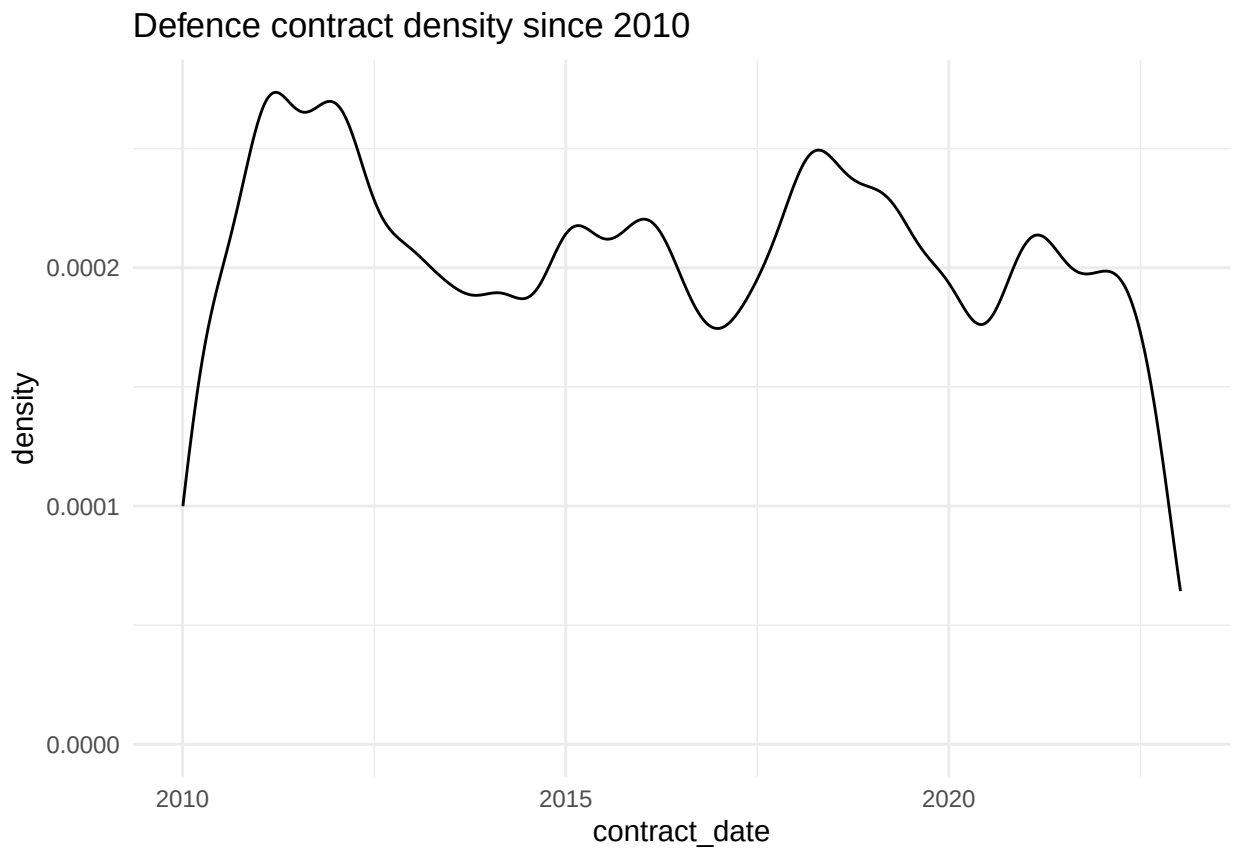
```
## Warning: Transformation introduced infinite values in continuous x-axis
```

```
## Warning: Removed 6722 rows containing non-finite values (‘stat_density()‘).
```



As we can see from the graph, at the 10K mark (noted by the dashed vertical line), the contract entries shoot up. This is logical as this database is only for contracts valued over $10K. We can also see that even with a logarithmic y axis that there is a steep drop in the number of contracts as contract value increases. Using an empirical cumulative distribution function we can see that almost 80% of contracting activity is below $100,000 in value. In fact, almost 99% of defence department contracting activity is below $5 million dollars. This contracting activity would include call ups on standing offers and other contractual arrangements that would be routine and transactional, however it is impressive nonetheless. It also highlights that the most talked about defence contracts in Parliament or in the media only make up a small percentage of the total volume of activity.

```
contract_analysis |>
  filter(contract_date>"2010-01-01") |>
  ggplot(aes(contract_date)) +
  geom_density() +
  ggtitle("Defence contract density since 2010") +
  theme_minimal()
```



As we can see since 2010 there has been a slight drop in the overall volume of contract activity but with with some variation throughout each year. We can likely attribute the peak after 2010 for contracting activity during and towards the end of Canada's mission in Afghanistan. We can see a dip around the 2015 election and the lead up to the release of the 2017 defence policy, however there seems to be growth since that time. There is also a dip in the number of contracts around 2020 and the onset of the COVID pandemic. The latest drop off closer to the current date is a trend I have noticed in the past as many contracts are not necessarily entered promptly in the contracting database and therefore it takes some time for the data accuracy to catch up.

We will look to update this analysis from time to time.