HW1 - Structural Transformation

Nikhilla B, Ezeriki Emetonjor, Alistair Pyle,

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Question 1

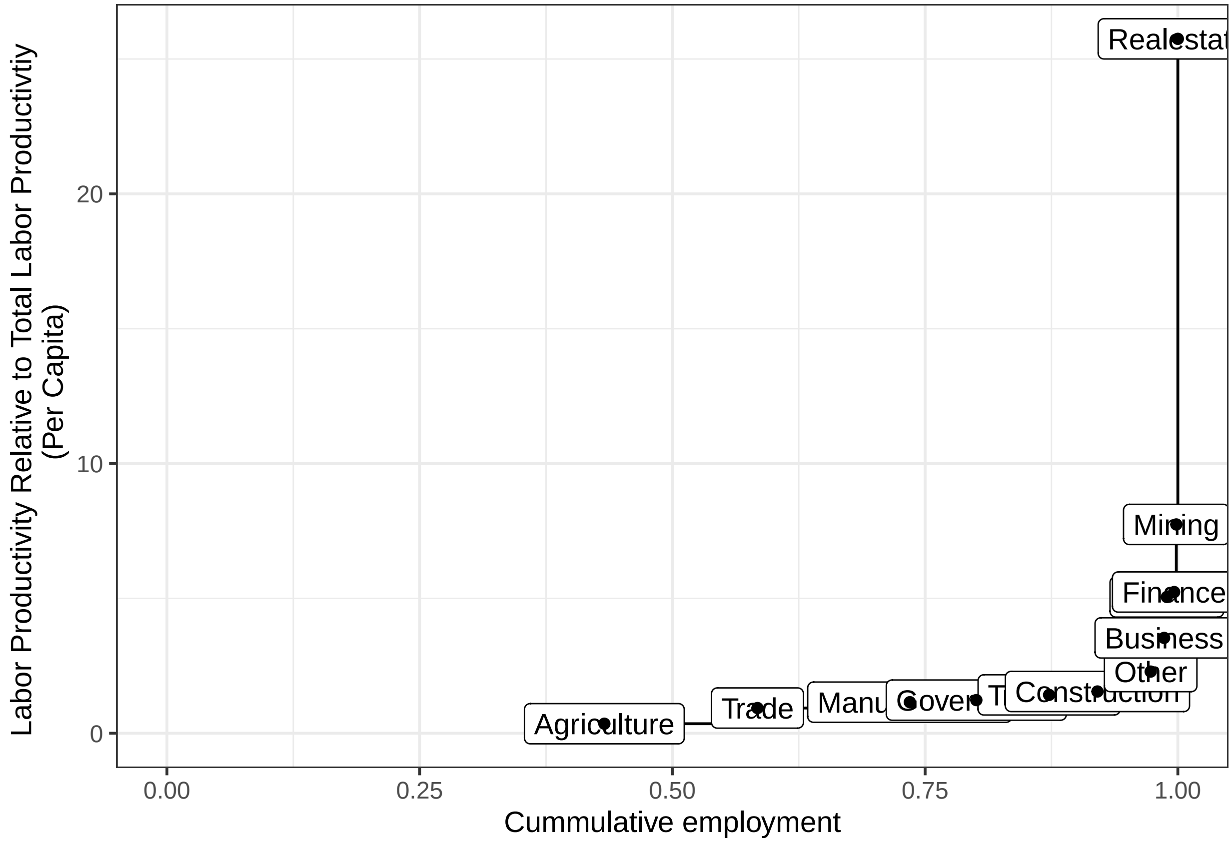
One explanation for this difference could be due to the fact that the data from the Economic Transformation database uses employed labour, while the WDI uses total population for GDP. Another potential explanation for this difference could stem from the World Bank's focus solely on trade-able goods within markets. As a result, numerous agricultural, locally-produced, or community-owned items may not be included in their calculations, potentially leading to an underestimation of the overall value.

```
## # A tibble: 1 x 3
##   Total_VA_Q15 Total_EMP total_per_worker
##          <dbl>     <dbl>            <dbl>
## 1 183156737500  59696514            3068.
```

Question 2

The Normalized productivity of agriculture is 0.353, while the employment share of agriculture is 43.2% (as of 2015)

Question 3

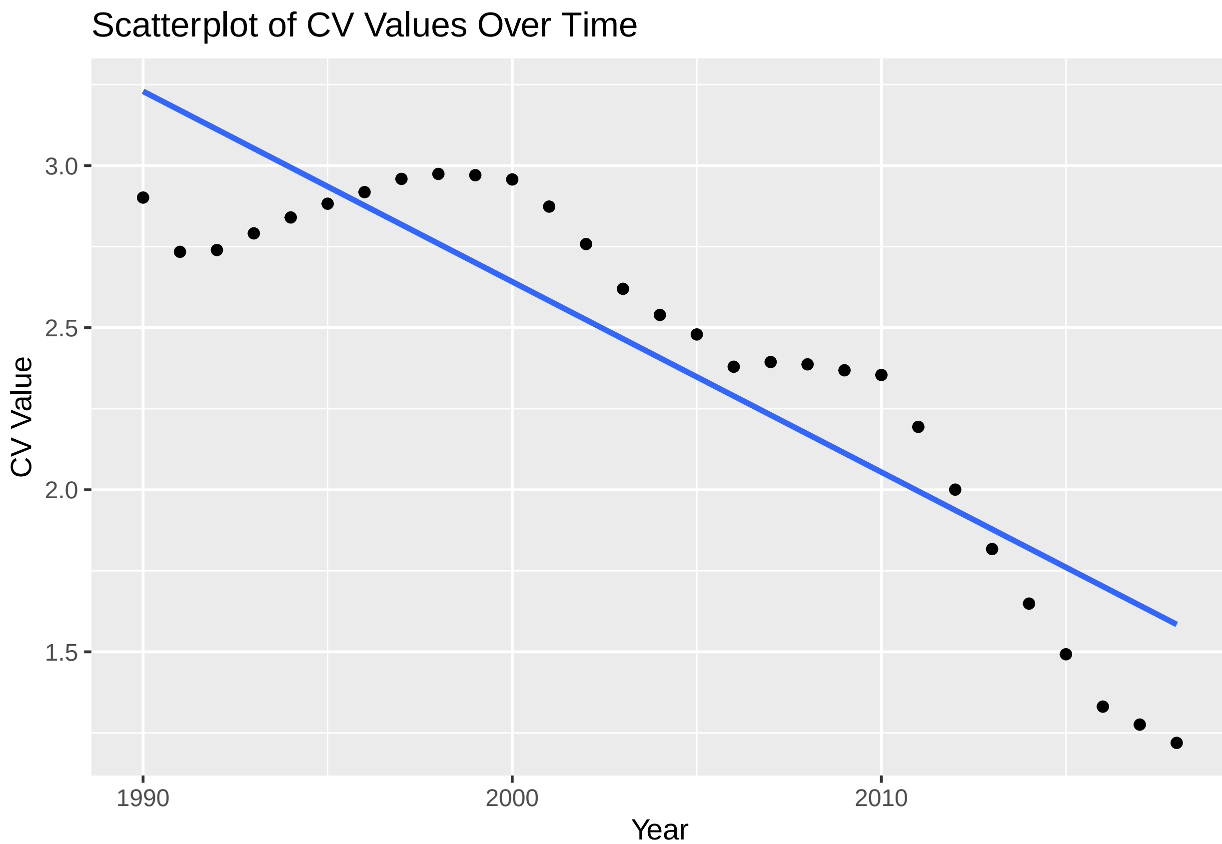


This data illustrates an intriguing trend: despite being the least productive sector, Agriculture boasted the largest share of the labor force in Bangladesh in 2015. Conversely, highly productive sectors like Real Estate, Mining, Finance, and Business commanded only a miniscule fraction of the labor force. This disparity among sectors has the potential to hinder overall labor productivity.

Question 4

The percentage increase after flipping productivity of agriculture and manufacturing is 22.5% (from 3068.131 to 3759.322)

Question 5



As labor productivity across sectors converges towards the mean over time, it suggests that less productive sectors are narrowing the gap with others. This trend results from reduced variation in productivity within each sector, leading to more consistent output. Such stability fosters an environment conducive to progress. Consequently, Bangladesh may resemble advanced countries discussed in previous lectures more closely than other low-income countries, owing to this decreased variation in sector productivity.

Question 6

```
## # A tibble: 3 x 7
##    year Agriculture_VA_Q15 Agriculture_EMP       mfg_va mfg_emp   services_va
##   <dbl>              <dbl>           <dbl>        <dbl>   <dbl>         <dbl>
## 1  1990       12232852827.        26836213  5682913328. 5289198  31048064719.
## 2  2005       18822526115.        22984794 16003341476. 5051255  65661485604.
## 3  2018       30887840910.        25808861 51965884144. 9735080 142898353083.
## # i 1 more variable: services_emp <dbl>
```

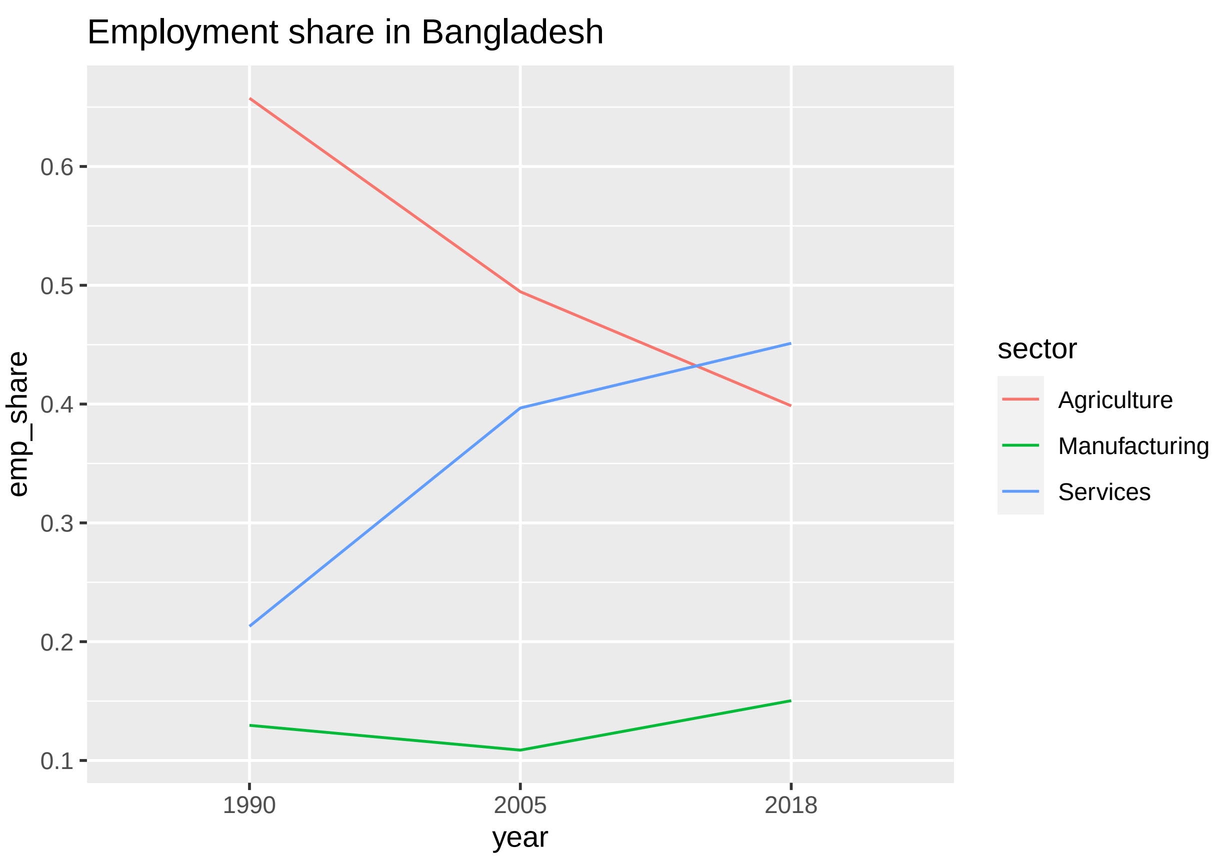
Question 7

Between 1990 and 2005, approximately 47% of productivity decomposition stemmed from inter-sector labor reallocation, illustrating Bangladesh's shift away from agriculture dependency towards manufacturing. Conversely, 52% of the productivity decomposition during this period originated from intra-sector reallocation, likely influenced by advancements in the ready-made garment industry.

In the timeframe from 2005 to 2018, 71% of the productivity decomposition was attributed to within-sector productivity growth, possibly reflecting enhancements in the services sector. This shift, accompanied by a structural change towards the service sector (28%), may encapsulate Bangladesh's narrative of structural transformation.

```
## # A tibble: 6 x 15
##   sector year     emp      va    lp      L emp_share      VA    LP del_lp del_LP
##   <chr>  <chr>  <dbl>   <dbl> <dbl>  <dbl>     <dbl>   <dbl> <dbl>  <dbl>  <dbl>
## 1 Agric~ 2005  2.30e7 1.88e10  819. 4.65e7     0.495 1.00e11 2162.      0      0
## 2 Agric~ 2018  2.58e7 3.09e10 1197. 6.48e7     0.398 2.26e11 3486.   378.  1323.
## 3 Manuf~ 2005  5.05e6 1.60e10 3168. 4.65e7     0.109 1.00e11 2162.      0      0
## 4 Manuf~ 2018  9.74e6 5.20e10 5338. 6.48e7     0.150 2.26e11 3486.  2170.  1323.
## 5 Servi~ 2005  1.84e7 6.57e10 3561. 4.65e7     0.397 1.00e11 2162.      0      0
## 6 Servi~ 2018  2.92e7 1.43e11 4890. 6.48e7     0.451 2.26e11 3486.  1329.  1323.
## # i 4 more variables: del_emp_share <dbl>, product <dbl>, numerator <dbl>,
## #   within <dbl>
```

Question 8



The decomposition within sectors further confirms that the bulk of productivity growth from the 1990s to 2005 occurred within the manufacturing sector, with the service sector contributing the least with 28% and 0.2% decline respectively. Whereas agriculture saw an increase of about 28% in productivity within sector. In contrast, between 2005 and 2018, the service sector experienced the most significant productivity growth, with agriculture contributing only 14.12%. In contrast, the manufacturing sector contributed 17.82% and the service sector contributed 39.83%. This shows how the service sector contributed signficantly to productivity growth. Additionally, the graph reveals a sharp decline in the employment share within the agriculture sector from 2005 onwards, accompanied by a proportional increase in the service sector. Notably, while manufacturing does not dominate employment share, it still experiences growth between 2005 and 2018.

Question 9

We withhold final judgement on Bangladesh's developmental prospects based on these findings regarding their structural trajectory. Similar to the approach outlined in Fan et al., our optimism for Bangladesh would be warranted if the expansion of the services sector is driven by productivity growth rather than mere demand. This scenario would suggest the potential for sustained growth. While we lack this specific model applied to Bangladesh, we maintain cautious optimism regarding their structural transition from agriculture to services.

Code

```
# Loading data ---------------------------
structural_change <- readRDS("ETD_230918.RDS")

#structural_change |> colnames()

# functions ----------------------------
perform_division <- function(prefix, your_data) {
  # Column names with "_VA_Q15" suffix
  col_va <- paste0(prefix, "_VA_Q15")
  # Column names with "_EMP" suffix
  col_emp <- paste0(prefix, "_EMP")
  # Perform division
  if (col_va %in% colnames(your_data) & col_emp %in% colnames(your_data)) {
    labor_product <- your_data[[col_va]] / your_data[[col_emp]]
    return(labor_product)
  }
}


# converting variables -----------------------
structural_change_transform <- structural_change |>
  filter((var == "VA_Q15" | var == "EMP") & country == "Bangladesh") |>
  pivot_wider(names_from = var, values_from = c(Agriculture, Mining,
                                               Manufacturing, Utilities, Construction,
                                               Trade, Transport, Business, Finance,
                                               Realestate, Government, Other, Total,
                                               Warflag)) |>
  mutate(across(ends_with("VA_Q15"), ~ (.x * 1000000 /80))) |>
  mutate(across(ends_with("EMP"), ~ .x * 1000))


# Question 1 ---------------------------
# total value added per worker in 2015
structural_change_transform |>
  filter(year == 2015) |>
  select(c(Total_VA_Q15, Total_EMP)) |>
  mutate(total_per_worker = Total_VA_Q15/Total_EMP)
```

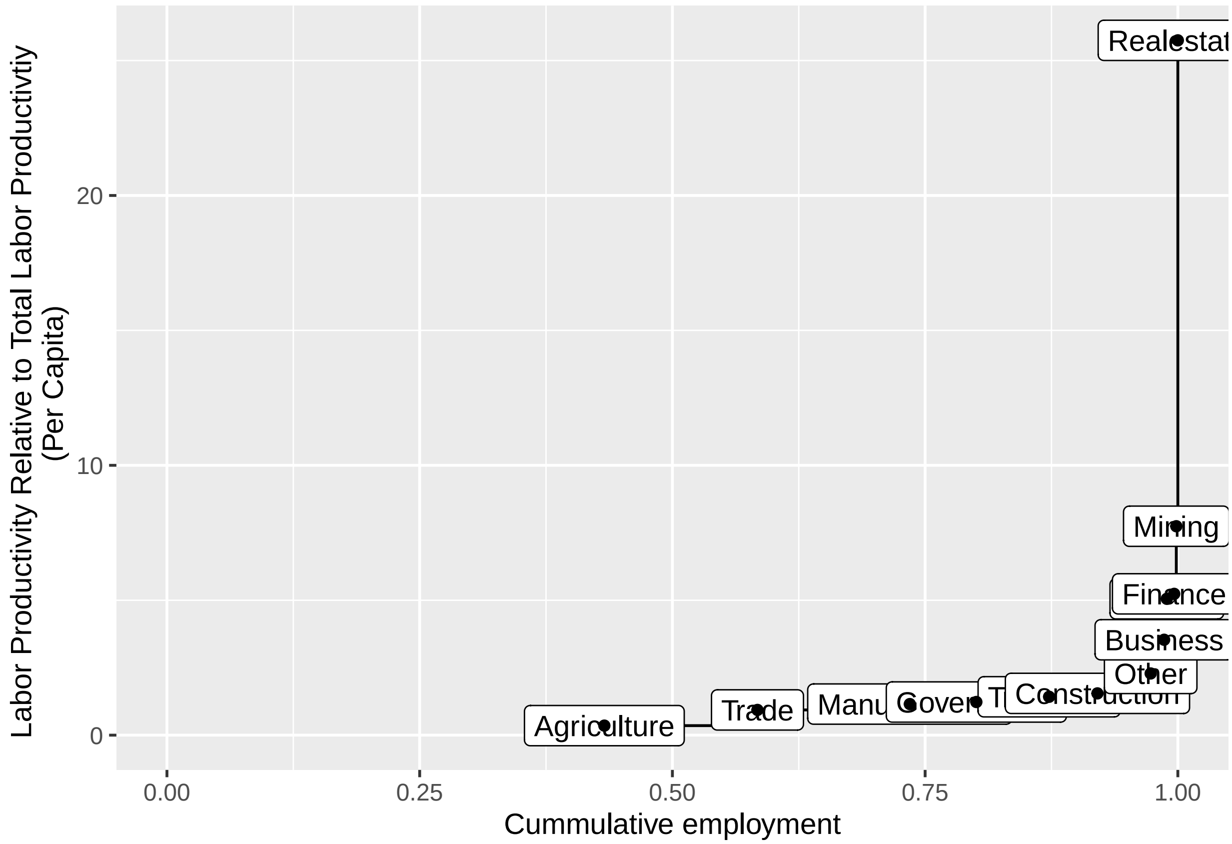
```
## # A tibble: 1 x 3
##   Total_VA_Q15 Total_EMP total_per_worker
##          <dbl>     <dbl>            <dbl>
## 1 183156737500  59696514            3068.
```

```r
# the reason for this discrepancy might be because the World Bank only takes into account
# trade-able goods in markets
# However, a lot of agricultural, home produced or locally owned production might
# not be counted in that, which in turn might underestimate the total value
# added per workers in the country

# Question 2 ---------------------
structure_2015 <- structural_change_transform |>
  filter(year == 2015)

sectors <- list("Agriculture", "Mining", "Manufacturing", "Utilities",
                "Construction", "Trade", "Transport", "Business",
                "Finance", "Realestate", "Government", "Other")


# Loop through sectors and perform division
sector_labor_product = list()
for (sector in sectors) {
  labor_prod = perform_division(sector, structure_2015)
  sector_labor_product = append(sector_labor_product, labor_prod)
}

# Convert sector_labor_product to numeric if it's not already numeric
if (!is.numeric(sector_labor_product)) {
  sector_labor_product <- as.numeric(sector_labor_product)
}

# Perform subtraction
sector_standardized <- sector_labor_product / 3068.131

# naming the standardized values
names(sector_standardized) <- sectors

# Normalized productivity of agriculture is -1983.73
# Employment share of agriculture is 43.2% (code for this in question 4)


# Question 3 ---------------------
# Loop through sectors to get employment

#total employment in 2015
total_emp = structure_2015$Total_EMP

# creating employment list
employment = list()

structure_2015_emp <- structure_2015 |>
```

```r
  select(ends_with("_EMP")) |>
  subset(select = -c(Total_EMP, Warflag_EMP))
for (col in names(structure_2015)) {
  # Append values of each column to the list
  employment[[col]] <- structure_2015_emp[[col]]
}

names(employment) <- sectors

# combining my lists of employment
keys <- unique(c(names(sector_standardized), names(employment)))
combined_prod <- setNames(mapply(c, sector_standardized[keys], employment[keys]), keys)

# changing to dataframe
structure_2015_long <- as.data.frame(combined_prod) |>
  pivot_longer(cols = Agriculture:Other,
               names_to = "Sector",
               values_to = "labor_prod")

# getting employment section
employment <- structure_2015_long[13:24,]

# dropping employment section from combined
structure_2015_long <- structure_2015_long[-c(13:24), ]

# column binding
structure_2015_long <- bind_cols(structure_2015_long, employment) |>
  rename(
    Sector = Sector...1,
    Sector_prod_stand = labor_prod...2,
    Employment = labor_prod...4) |>
  subset(select = -c(Sector...3)) |>
  arrange(Sector_prod_stand) |>
  mutate(cummulative_employment = cumsum(Employment)/sum(Employment)) |>
  arrange(Sector_prod_stand)
```

```
## New names:
## * `Sector` -> `Sector...1`
## * `labor_prod` -> `labor_prod...2`
## * `Sector` -> `Sector...3`
## * `labor_prod` -> `labor_prod...4`
```

```r
# plotting figure
structure_2015_long |>
  ggplot( aes(x = cummulative_employment, y = Sector_prod_stand, label = Sector)) +
  geom_step() +
  geom_label() +
  geom_point() +
  expand_limits(x = 0, y = 0) +
  labs(y = "Labor Productivity Relative to Total Labor Productivtiy \n (Per Capita)",
       x = "Cummulative employment")
```




```
# This figure shows us that the least productive sector, Agriculture, actually had the largest
# labor force share in Bangladesh in 2015.
# On the other hand, extremely productive sectors, such as Real Estate, Mining,
# Finance, and Business have minuscule shares of the labor force
# The combination of these phenomenons can drag down the overall labor productivity


# Question 4 ---------------------
# naming the non standardized values
# naming the standardized values
names(sector_labor_product) <- sectors

# order the sectors by order of production
sector_labor_product <- sort(sector_labor_product)

# Combining the non standardized values with employment
structure_2015_long <- structure_2015_long |>
  mutate(Sector_prod_non_stand = sector_labor_product,
         Employment_share = Employment/sum(Employment),
         weighted_sector_prod = Sector_prod_non_stand*Employment_share)

# weighted sum of productivity of sectors
weighted_prod <- sum(structure_2015_long$weighted_sector_prod)

# flipping employment shares of manufacturing and agriculture
# first getting the values
```

```r
agriculture_share <- structure_2015_long$Employment_share[1]
manufacturing_share <- structure_2015_long$Employment_share[3]

# now flipping
structure_2015_long$Employment_share[1] <- manufacturing_share
structure_2015_long$Employment_share[3] <- agriculture_share

# calculating the new weighted labor productivity
flipped_prod <- sum(structure_2015_long$Sector_prod_non_stand*structure_2015_long$Employment_share)

# percentage increase
percent_increase <- ((flipped_prod - weighted_prod)/weighted_prod) * 100
```