

Data visualization: The impact of natural disasters in Pacific island nations

AUTHOR

Shonushka Sawant, Harrison Plate (RSC Statistics)

```
#remove data for non-PI countries

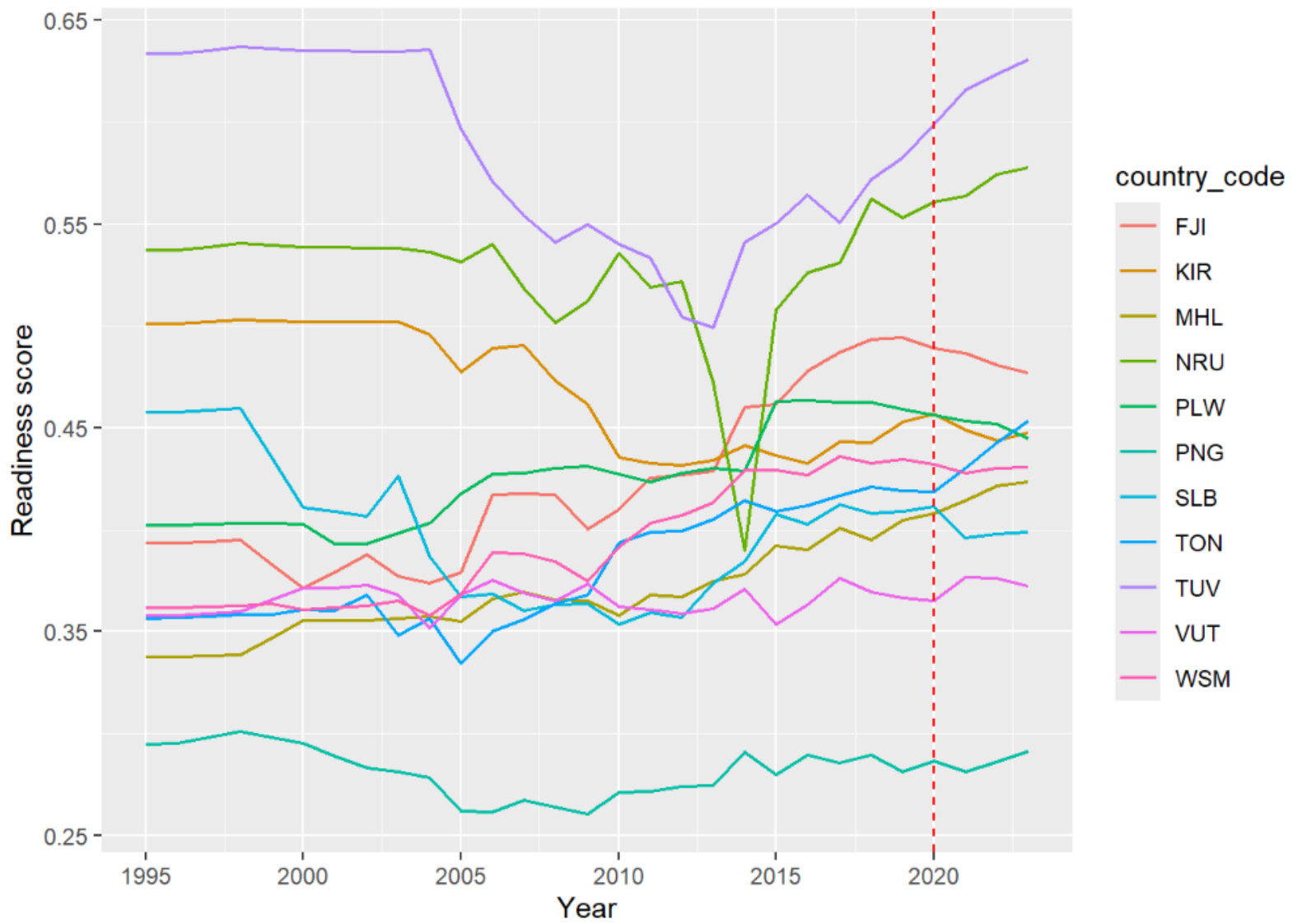
readiness_clean <- readiness_clean %>% filter(country %in% tuberculosis_clean$country)
```

How has disaster readiness among Pacific island nations changed over time?

```
head(readiness_clean)
```

```
# A tibble: 6 × 4
  country_code country  year readiness_score
  <chr>         <chr>   <int>         <dbl>
1 FJI          Fiji    1995         0.394
2 FJI          Fiji    1996         0.394
3 FJI          Fiji    1997         0.394
4 FJI          Fiji    1998         0.395
5 FJI          Fiji    1999         0.383
6 FJI          Fiji    2000         0.371
```

```
readiness_clean %>%
  ggplot( aes(x = year, y = readiness_score, group = country_code, color = country_code)) +
  geom_line(size = 0.7) +
  geom_vline(xintercept = 2020, linetype = "dashed", color = "red") +
  xlab("Year") +
  ylab("Readiness score")
```



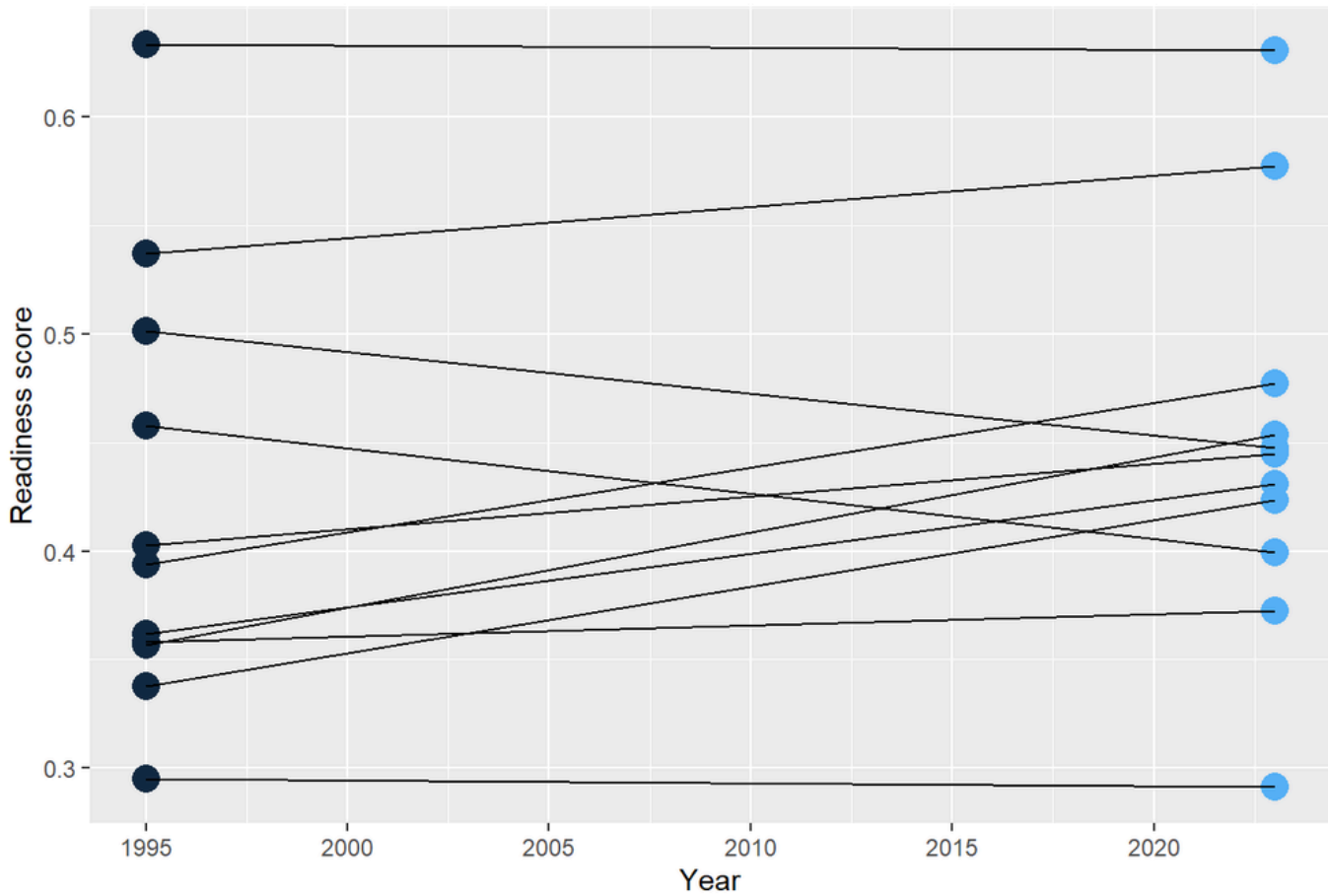
In 2014, we observe a sharp drop in readiness for Nauru, which is not reflected in other nations. We also note that no country reported an uncharacteristic drop in readiness in 2020, meaning that the COVID-19 pandemic may not have significantly affected disaster readiness in any Pacific island nation.

How has readiness changed between now and 1995 (first year of the data)?

```
readiness_delta <- readiness_clean %>% filter(year == 1995 | year == 2023)
```

```
ggplot(readiness_delta, aes(year, readiness_score)) +  
  geom_point(aes(color = year, size=3), show.legend = FALSE) +  
  geom_line(aes(group = country_code), show.legend = FALSE) +  
  ylab("Readiness score") +  
  xlab("Year") +  
  ggtitle("Change in readiness between 1995 and 2023")
```

Change in readiness between 1995 and 2023



Most countries either raised their readiness index or exhibited very minimal change (both positive and negative). However, two countries exhibit a notable drop in readiness between 1995 and 2023.

Which countries are less ready now than they were in 1995?

```
#filtering out all years other than 1995 and 2023
readiness_1995 <- readiness_delta %>% filter(year == 1995)
readiness_2023 <- readiness_delta %>% filter(year == 2023)

readiness_1995 <- rename(readiness_1995, ready95 = readiness_score)
readiness_2023 <- rename(readiness_2023, ready23 = readiness_score)
ready_95_23 <- readiness_1995 %>% inner_join(readiness_2023, by = join_by(country))

library(DT)
ready_95_23$ready_diff <- ready_95_23$ready23 - ready_95_23$ready95
datatable(ready_95_23 %>% select(country, ready_diff),
  caption = htmltools::tags$caption(
    style = 'caption-side: bottom; text-align: left;',
    'Table 6: ', htmltools::em('Change in disaster readiness coverage between 1995 and 2023')
  )
)
```

	country	ready_diff
1	Fiji	0.08350713264931103
2	Kiribati	-0.05381721781735199
3	Marshall Islands	0.085741258861463
4	Nauru	0.04039383239547301
5	Palau	0.04237568961549004
6	Papua New Guinea	-0.003491421761140978
7	Samoa	0.06872719141901401
8	Solomon Islands	-0.058642507784603
9	Tonga	0.096895584932912
10	Tuvalu	-0.003018198509830983

List of countries with lower readiness scores in 2023 than in 1995:

```
decreased_readiness <- ready_95_23 %>% filter(ready_diff < 0)
decreased_readiness$country
```

```
[1] "Kiribati"          "Papua New Guinea" "Solomon Islands"  "Tuvalu"
```

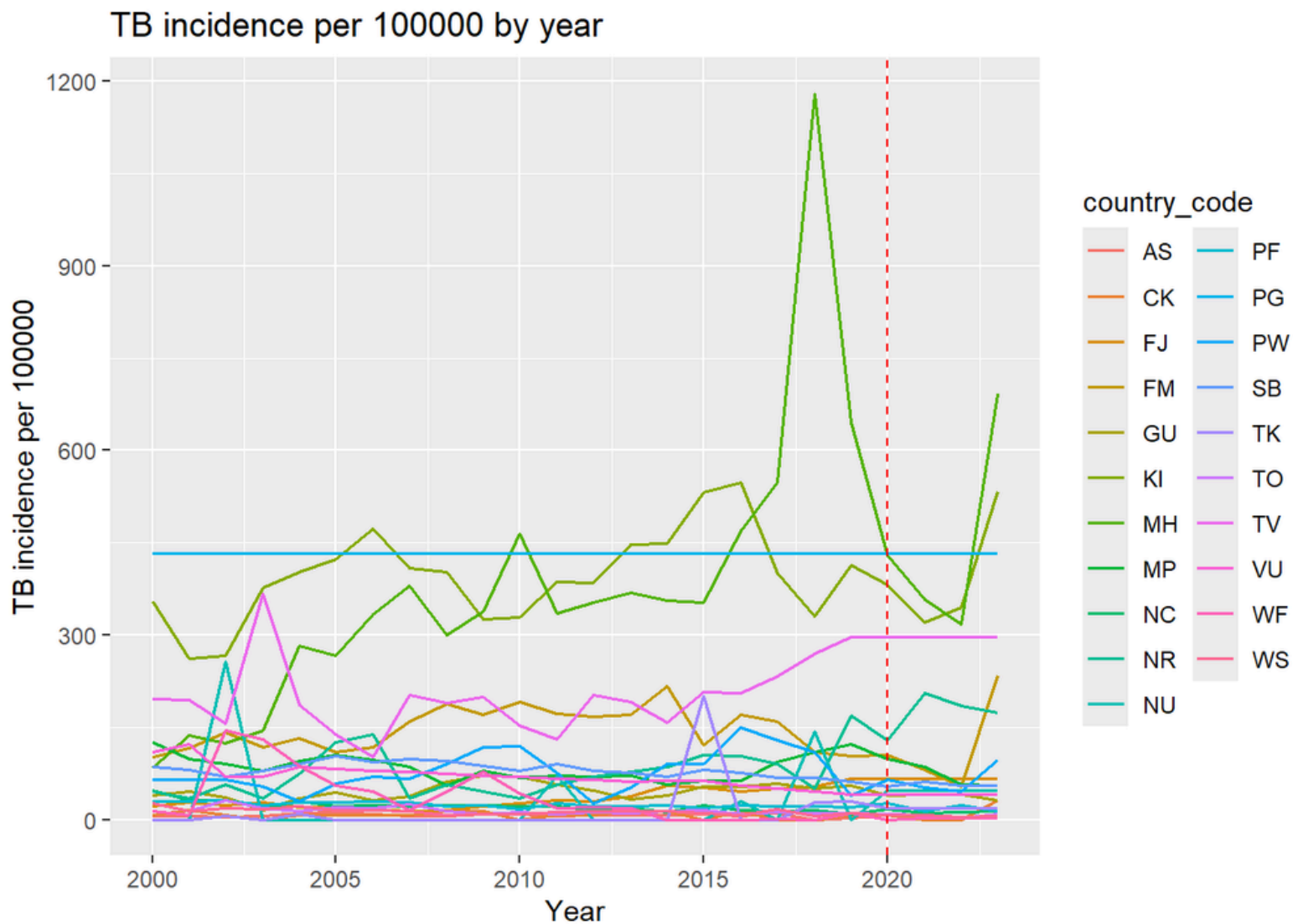
Kiribati and the Solomon Islands reported markedly lower readiness in 2023 than they did in 1995 (only 0.3 percentage difference for Papua New Guinea and Tuvalu; ~5% for Kiribati and the Solomon Islands.)

How have tuberculosis rates changed since 2000?

```
tuberculosis_clean %>%
  ggplot( aes(x = year, y = tb_incidence_per_100000, group = country_code, color = country_code)
  geom_line(size = 0.7) +
  geom_vline(xintercept = 2020, linetype = "dashed", color = "red") +
  ylab("TB incidence per 100000") +
  xlab("Year") +
  ggtitle("TB incidence per 100000 by year")
```

<

>



This plot fails to demonstrate tuberculosis infection trends in countries with lower incidence; so we will create a faceted plot for each individual country.

```
#faceting plot showing tb rates
library(hrbrthemes)
library(viridis)
```

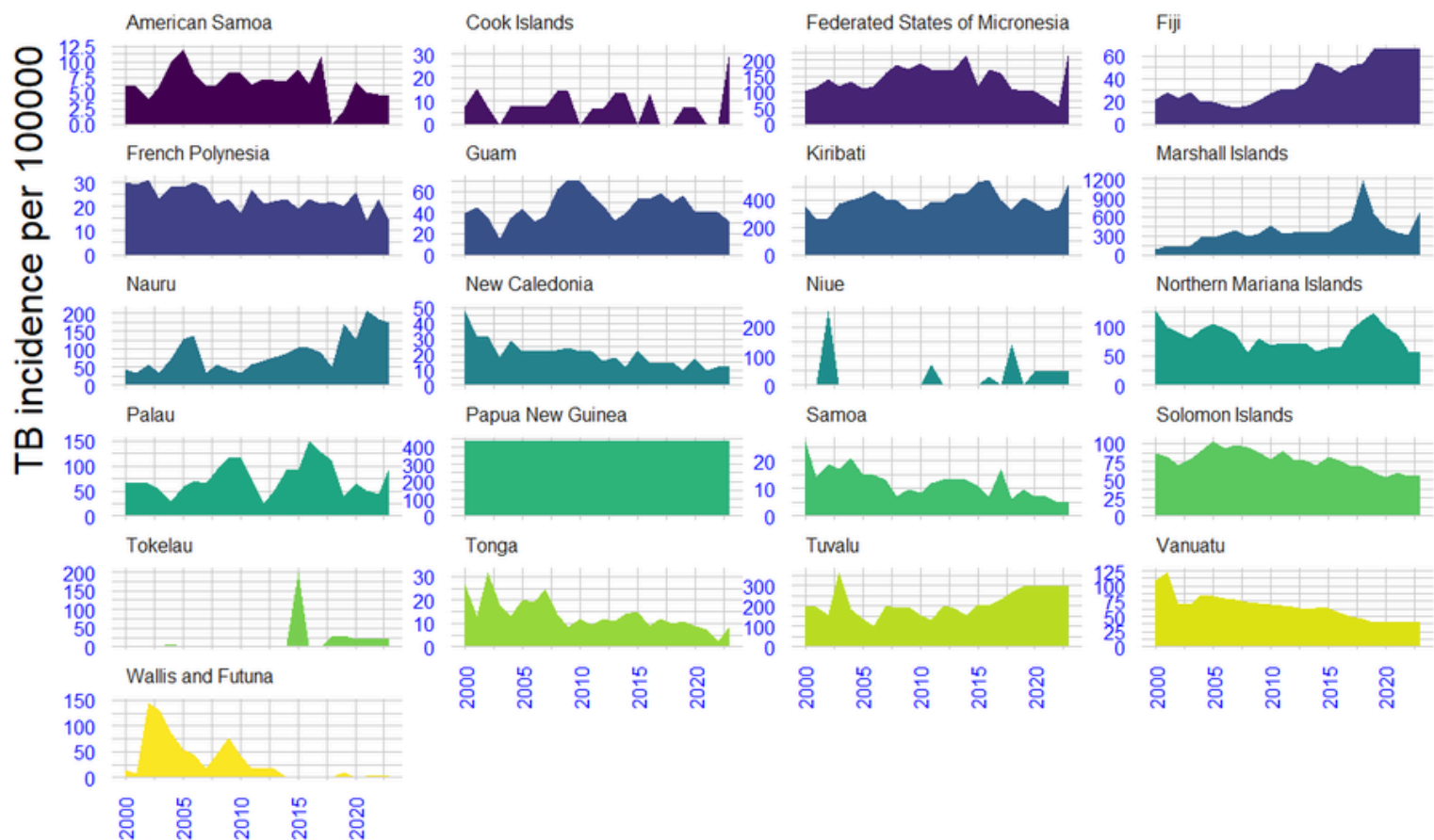
```

tb_plot <- tuberculosis_clean %>%
  ggplot( aes(x = year, y = tb_incidence_per_100000, group = country, fill = country)) +
  geom_area() +
  scale_fill_viridis(discrete = TRUE) +
  theme(legend.position="none") +
  ggtitle("Tuberculosis incidence in Pacific island nations (1995-2023)") +
  theme_ipsum() +
  theme(
    legend.position="none",
    panel.spacing = unit(0, "lines"),
    strip.text.x = element_text(size = 6),
    plot.title = element_text(size=13),
    axis.title.x = element_text(size = 12),
    axis.title.y = element_text(size = 12),
    axis.text.x = element_text(size = 6, color = "blue",
                                angle = 90, vjust = 0.5, hjust=1),
    axis.text.y = element_text(size = 6, color = "blue")

  ) +
  facet_wrap(~country, scale = "free_y", ncol = 4) +
  xlab("Year") +
  ylab("TB incidence per 100000")

```

Tuberculosis incidence in Pacific island nations (1995-2023)



Year

```

#Readiness gdp and tb in 2023

#use: gdp_per_capita_latest

#unique(tuberculosis_clean$year)
#check country counts for 2000 and 2023
tub_2000 <- tuberculosis_clean %>% filter(year == 2000)
tub_2023 <- tuberculosis_clean %>% filter(year == 2023)
#unique(tub_2000$country)
#unique(tub_2023$country)

#join latest gdp to tb

gdp_tb <- gdp_per_capita_latest %>% inner_join(tub_2023, by = join_by(country))

gdp_tb_read <- gdp_tb %>% inner_join(readiness_2023, by = join_by(country))

```

Do we observe a correlation between readiness and tuberculosis incidence in 2023?

```

ggplot(gdp_tb_read, aes(x = ready23, y = tb_incidence_per_100000)) +
  xlab("Readiness score") +
  ylab("Tuberculosis incidence per 100000") +
  ggtitle("Tuberculosis incidence vs. Readiness score (2023)") +
  geom_point()

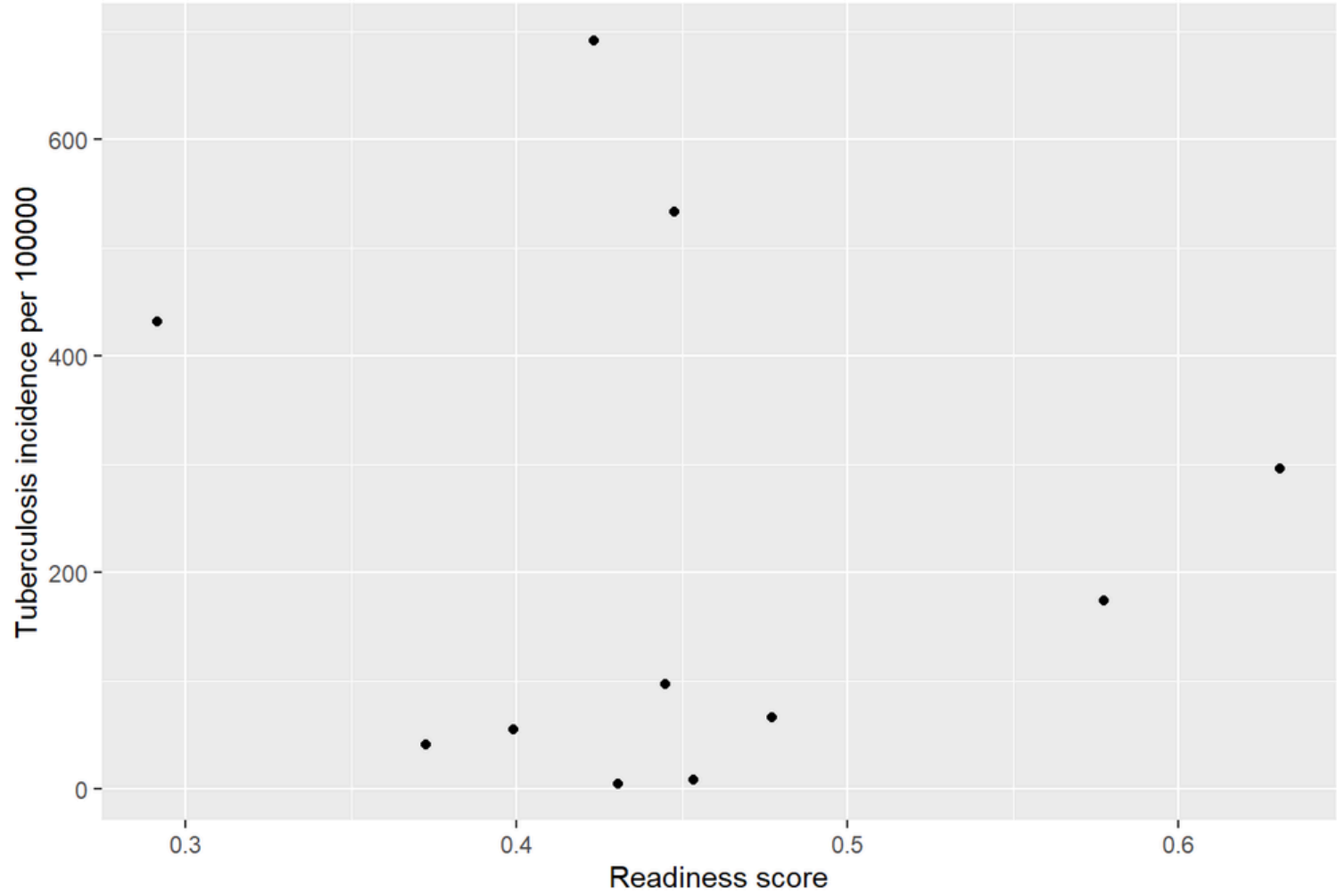
```

```

ggplot(gdp_tb_read, aes(x = ready23, y = tb_incidence_per_100000)) +
  xlab("Readiness score") +
  ylab("Tuberculosis incidence per 100000") +
  ggtitle("Tuberculosis incidence vs. Readiness score (2023)") +
  geom_point()

```

Tuberculosis incidence vs. Readiness score (2023)



We note the presence of three outliers and identify them:

```
head(gdp_tb_read %>% arrange(desc(tb_incidence_per_100000)))
```

A tibble: 6 × 10

	country	gdp_per_capita_year	gdp_per_capita_usd	country_code.x	year.x
	<chr>	<int>	<dbl>	<chr>	<int>
1	Marshall Islands	2024	7726.	MH	2023
2	Kiribati	2024	2289.	KI	2023
3	Papua New Guinea	2024	3007.	PG	2023
4	Tuvalu	2023	6345.	TV	2023
5	Nauru	2024	13609.	NR	2023
6	Palau	2023	15611.	PW	2023

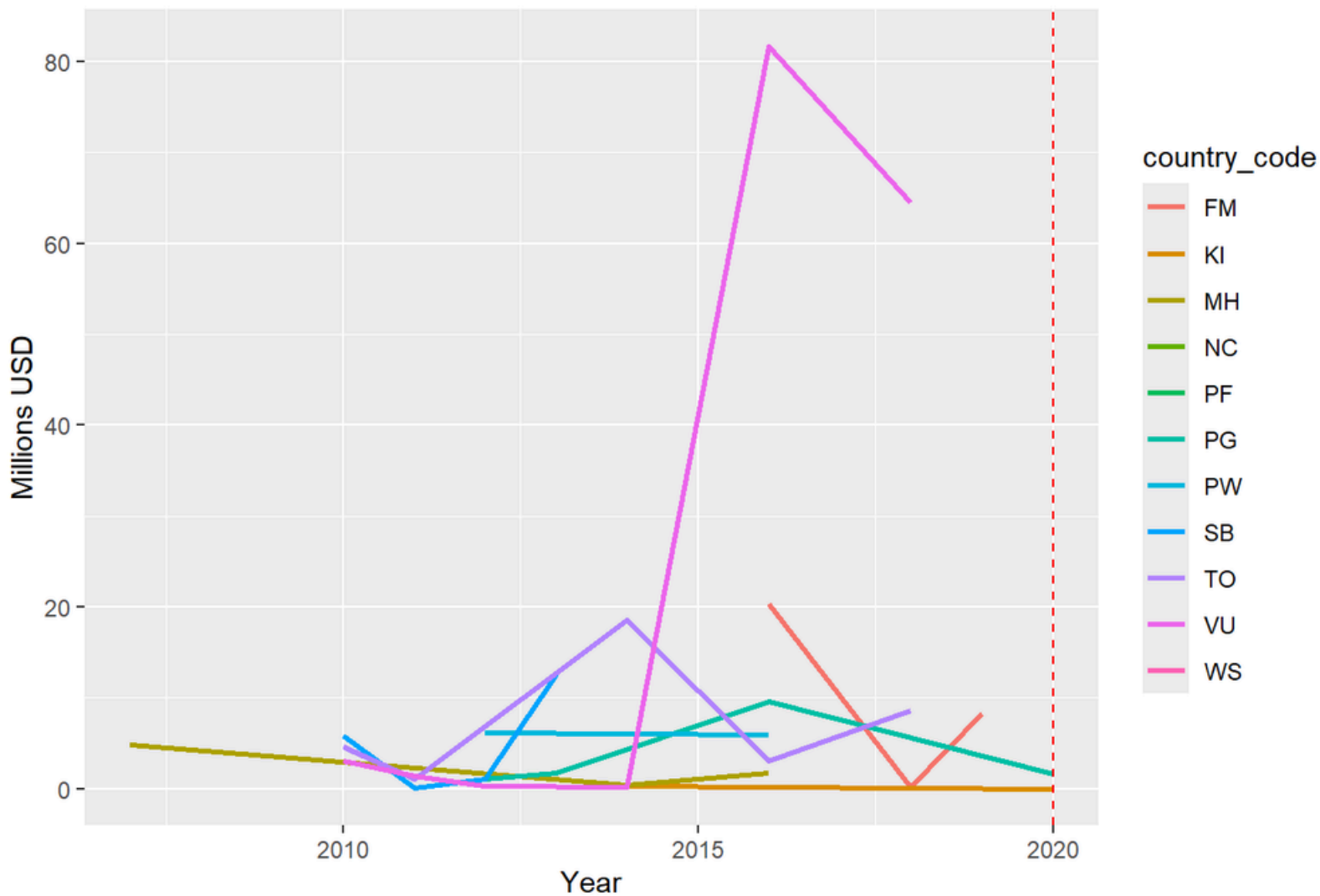
i 5 more variables: tb_incidence_per_100000 <dbl>, unit <chr>,
country_code.y <chr>, year.y <int>, ready23 <dbl>

The outliers are the Marshall Islands, Kiribati, and Papua New Guinea. Discounting these, there appears to be a slight positive correlation between readiness and tuberculosis incidence; this may be because sparsely-populated countries lack the infrastructure for higher disaster readiness while simultaneously limiting the spread of disease due to low population density.

Examining disaster-related economic loss between 2007 and 2020:

```
economic_loss_filt <- economic_loss_clean %>% filter(country != "Fiji")
economic_loss_filt %>%
  ggplot(aes(x = year, y = economic_loss_usd/1000000, group = country_code, color = country_code)) +
  geom_line(size = 1) +
  geom_vline(xintercept = 2020, linetype = "dashed", color = "red") +
  ylab("Millions USD") +
  xlab("Year") +
  ggtitle("Disaster-related economic loss in millions USD from 2007-2020")
```

Disaster-related economic loss in millions USD from 2007-2020



This plot does not tell us much about trends in economic loss, as several years are missing from the dataset. However, we see that visible trends in different countries do not mirror one another, meaning that natural disasters affecting multiple countries may have impacted some countries much more severely than others.