

## **Group Members**

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## **Title**

Testing the hypothesis that the Foreign Tourist Arrival is a good indicator of GDP through various econometric models and statistical hypothesis tests(t-test, F-test).

## **Background & Motivation**

India changed its data sources and methodology for estimating real gross domestic product (GDP) for the period since 2011-12. The year 2011-12 was taken as the new base year and the estimation went from being predominantly volume based to value based.

The former Chief Economic Adviser to the Government of India, Arvind Subramanian analysed the new methodology in his paper titled "India's GDP Mis-estimation: Likelihood, Magnitudes, Mechanisms, and Implications". He claimed that there was an overestimation in the GDP growth.

One of the 17 indicators used by Subramanian in his analysis for the misestimation of the GDP growth was Foreign Tourist Arrivals (FTA). FTA has grown from 6 million in 2000 to 24.7 million in 2016. Due to its numerical nature, FTA in itself is a volume based variable and it is indeed interesting to study the relationship of FTA with GDP growth with the change in methodology from volume based to value based.

## **Problem Statement & Analysis Query**

According to the Prime Minister Economic Advisory Council, "The annual average growth of the indicator Foreign Tourist Arrivals(FTA), in the period 2001-02 to 2011-12 is similar to the period 2012-13 to 2017-18 which is close to 8%. But the correlation with the Gross Domestic Product (GDP) is different in both time periods. The correlation of the indicator FTA with the GDP is much higher in the period 2001-02 & 2011-12 (approximately 0.65) than the correlation in the period 2012-13 and 2017-18 (approximately 0.30)."

One of the problems in the statement is the estimation of the correlation between the two factors, GDP growth and FTA. The correlation value was estimated between a variable recorded as an annual growth value and an annual absolute value. On further testing, the correlation appeared to flip. This does not make intuitive sense as we are now comparing growth vs growth rather than growth vs absolute.

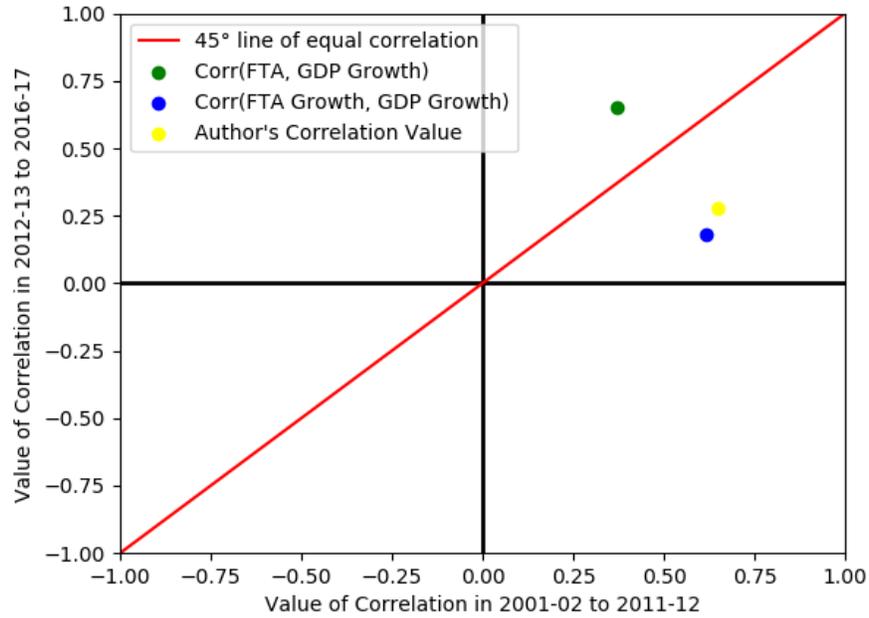


Figure 1. Correlation coefficient for FTA & FTA growth with GDP Growth

We start the analysis by finding whether FTA is even a good indicator to study GDP. Assuming that FTA is indeed a good indicator of GDP, we will run a linear regression on the model [1]. Our null hypothesis  $H_0: \beta_1 \neq 0$  and the alternative hypothesis is  $H_1: \beta_1 = 0$ . Statistically testing our hypothesis, we find out whether FTA is a good indicator of GDP or not.

The main problem at hand is to analytically find out the reason for the decrease in correlation between  $GDP_{India}$  and  $FTA_{India}$ . Intuitively this is caused by the change in the methodology of calculating GDP. From the change in the methodology arises the question, "Is FTA is still a good indicator of GDP or not?". We will Again run model[2] with a dummy variable T, which takes on the value 0 for the period before 2011 and 1 for the period after 2011.

The GDP calculation for India moved from Volume based to Value-based. The indicator FTA in itself is a Volume based indicator. In line with the volume to value change, we propose a new indicator of Tourism Receipts (TR) to study the GDP. We then run regression on the model[3] replacing FTA with TR.

Now we consider multiple variables intuitively similar to FTA mentioned in the table below. One of the variables is the Foreign Tourism Receipts indicating the foreign tourist expenditure in India. We would test if this has a higher correlation to the GDP(after 2011) compared to FTA.

Foreign Direct Investment(FDI) and Foreign Portfolio Investment in Equity and Debt Segment in India(FPI) inflows have been taken as additional variables which we think would be similar to FTA as we believe that economic prosperity and political stability leads to positive investor's

sentiment as well as increases the soft power of the country which would, in turn, give a boost to the tourism industry.

According to the study by Arvind Subramanian, we consider cross-sectional data of countries (All, Middle income, Lower and middle income) and try to analyze whether India is an outlier among other countries when analyzed using the given variables; FTA, TR, FDI, FPI. We plan to replicate the analysis done by Subramanian by using our own variables which are related to FTA(model[5])

### **Statistical Models**

- 1)  $GDP\ Growth_t = \beta_0 + \beta_1 FTA_t + \varepsilon_t$
- 2)  $GDP\ Growth_t = \beta_0 + \beta_1 T + \beta_2 FTA_t + \beta_3 FTA_t * T + \varepsilon_t$
- 3)  $GDP\ Growth_t = \beta_0 + \beta_1 T + \beta_2 TR_t + \beta_3 TR_t * T + \varepsilon_t$
- 4)  $GDP\ Growth_t = \beta_0 + \beta_1 FTA_t + \beta_2 TR_t + \beta_3 FDI_t + \beta_4 FPI_t + \varepsilon_t$
- 5)  $GDP\ Growth_{it} = \beta_0 + \beta_1 FTA_{it} + \beta_2 TR_{it} + \beta_3 FDI_{it} + \beta_4 FPI_{it} + \beta_7 * T + \beta_8 FTA_{it} * T + \beta_9 TR_{it} * T + \beta_{10} FDI_{it} * T + \beta_{11} FPI_{it} * T + \varepsilon_{it}$
- 6)  $GDP\ Growth_{it} = \beta_0 + \beta_1 FTA_{it} + \beta_2 TR_{it} + \beta_3 FDI_{it} + \beta_4 FPI_{it} + \beta_5 India * T + \beta_6 India + \beta_7 * T + \beta_8 FTA_{it} * T + \beta_9 TR_{it} * T + \beta_{10} FDI_{it} * T + \beta_{11} FPI_{it} * T + \varepsilon_{it}$
- 7)  $GDP\ Growth_{it} = \beta_0 + \beta_1 FTA_{it} + \beta_3 FDI_{it} + \beta_4 FPI_{it} + \beta_5 India * T + \beta_6 India + \beta_7 * T + \beta_8 FTA_{it} * T + \beta_{10} FDI_{it} * T + \beta_{11} FPI_{it} * T + \varepsilon_{it}$
- 8)  $GDP\ Growth_{it} = \beta_0 + \beta_3 FDI_{it} + \beta_4 FPI_{it} + \beta_5 India * T + \beta_6 India + \beta_7 * T + \beta_{10} FDI_{it} * T + \beta_{11} FPI_{it} * T + \varepsilon_{it}$

$T$  is the dummy taking value 1 for time period 2001-11 and 0 for 2012-17.

$i$ : country ,  $T$ : years

### **Variables and their Descriptions**

Variable	Description	Dataset Source
GDP <sub>t</sub>	Gross Domestic Product of India for t <sup>th</sup> Year reported by the respective Govt.	<a href="#">GDP_Growth_All_Countries[1]</a> <a href="#">GDP_All_Countries[2]</a>

FTA <sub>t</sub>	Foreign Tourist Arrival for t <sup>th</sup> Year	<a href="#">FTA_All_Countries</a> [3]
TR <sub>t</sub>	Tourism Receipts for t <sup>th</sup> Year	<a href="#">Tourism_Receipts_All_Countries</a> [4]
FDI <sub>t</sub>	Foreign Direct Investment for t <sup>th</sup> Year	<a href="#">FDI_All_Countries</a> [5]
FPI <sub>t</sub>	Foreign Portfolio Investment in Equity and Debt Segment in India	<a href="#">FPI_All_Countries</a> [6]

Table 1. Variables used and their Description

### **Summary Statistics**

Variable	N	Mean	SD	MIN	MAX	Year Range
GDP growth(in %)	11	6.61	1.96	3.08	8.49	2001-2011
FTA(in millions)	11	4.28	1.36	2.38	6.31	2001-2011
FDI(in billions \$)	11	19	15	3.68	43.4	2001-2011
TR(in billions \$)	11	9.19	4.69	3.3	17.7	2001-2011
FPI(in billions \$)	11	10.1	14.55	-15	32.8	2001-2011

Table 2(a). Mean, Std. Deviation, Min, Max values for different variables in 2001-2011

Variable	N	Mean	SD	MIN	MAX	Year Range
GDP growth(in %)	6	7.09	1.02	5.45	8.16	2012-2017
FTA(in millions)	6	11.67	3.9	6.57	15.54	2012-2017
FDI(in billions \$)	6	35.85	8.47	23.99	44.45	2012-2017
TR(in billions \$)	6	21.76	3.44	18.34	27.87	2012-2017
FPI(in billions \$)	6	10.87	8.98	1.93	22.8	2012-2017

Table 2(b). Mean, Std. Deviation, Min, Max values for different variables in 2012-2017

Variable	N	Mean	SD	MIN	MAX	Year Range
GDP growth(in %)	17	6.78	1.67	3.08	8.49	2001-2017
FTA(in millions)	17	6.89	4.38	2.38	15.54	2001-2017
FDI(in billions \$)	17	25.29	15.03	3.68	44.45	2001-2017
TR(in billions \$)	17	13.63	7.47	3.3	27.87	2001-2017
FPI(in billions \$)	17	10.41	12.55	-15	32.8	2001-2017

Table 3. Mean, Std. Deviation, Min, Max values for different variables in 2001-2017

Year 2001-2011 Correlation Matrix	FTA	FDI	TR	FPI
FTA	1	0.89	0.98	0.2
FDI	0.89	1	0.86	-0.03
TR	0.98	0.86	1	0.12
FPI	0.2	-0.03	0.12	1

Table 4. Correlation Matrix for independent variables during 2001-2011  
(High correlation between TR and FTA could lead to multicollinearity)

Year 2012-2017 Correlation Matrix	FTA	FDI	TR	FPI
FTA	1	0.9	0.83	-0.9
FDI	0.9	1	0.66	-0.99
TR	0.83	0.66	1	-0.68
FPI	-0.9	-0.99	-0.68	1

Table 5. Correlation Matrix for independent variables during 2012-2017  
(High correlation(negative) between FDI and FPI could lead to multicollinearity)

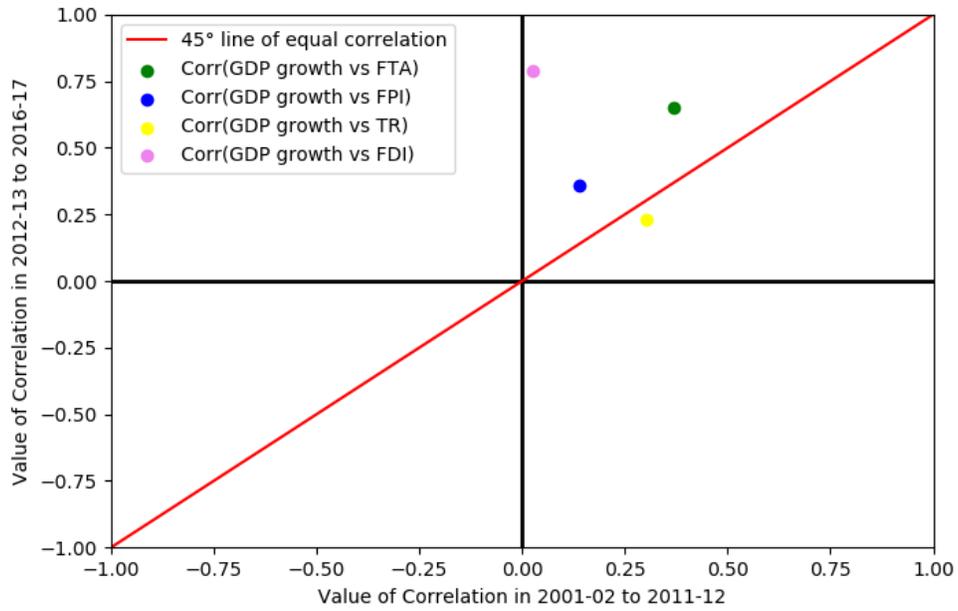


Figure 2. Correlation Coefficient between GDP Growth & Absolute value of other variables

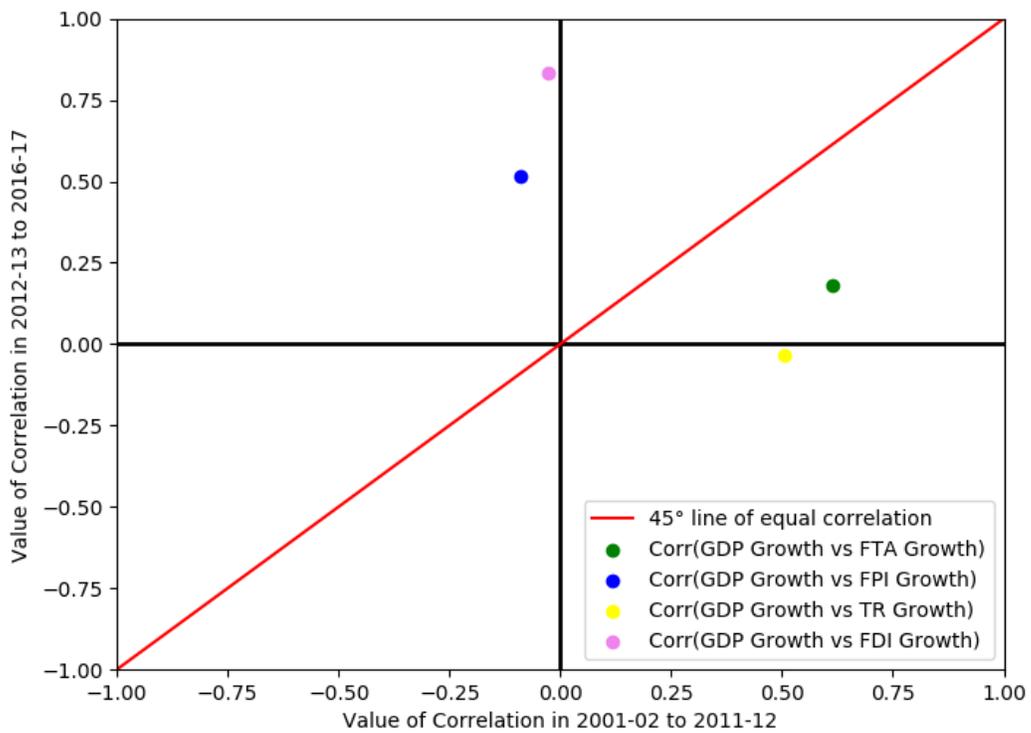


Figure 3. Correlation Coefficient between GDP Growth & Growth of other variables

Test for multicollinearity using VIF values for Model 4.

Many papers claim VIF <10 is acceptable.

For 2001-11

FDI,FPI,TR,FTA

VIF value for model 4 : 8.641817      2.319168      66.290743      98.233197

On excluding FTA : 4.436817      1.100346      4.500563

On excluding TR : 6.401416      1.351511      6.669177

For 2011-17

FDI,FPI,TR,FTA

**240.149535      257.634332      3.823881      10.984395**

On excluding FDI : 6.397863      3.571212      10.981798

On excluding FPI : 5.963661      3.659977      10.745306

## Results

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

MODEL 1 Regressor	GDP Growth(2001-2017)
Intercept	Estimate : 6*** Standard error : 7.6e-1
FTA	Estimate : 1.12e-7 Standard error : 9.4e-8

MODEL 1 Regressor(2001-2011)	GDP Growth(2001-2011)
Intercept	Estimate : 5.77* Standard error : 2.12
FTA	Estimate : 1.96e-7 Standard error : 4.75e-7

MODEL 1 Regressor(2011-2017)	GDP Growth(2011-2017)
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Intercept	Estimate : 4.5** Standard error : 8.48e-1
FTA	Estimate : 2.2e-7* Standard error : 6.94e-8

<b>MODEL 2 Regressor</b>	<b>GDP Growth(2001-2017)</b>
Intercept	Estimate : 5.77** Standard error : 1.8
FTA	Estimate : 1.95e-7 Standard error : 4e-7
T	Estimate : -1.28 Standard error : 3
FTA*T	Estimate : 2.8e-8 Standard error : 4.5e-7

<b>MODEL 3 Regressor</b>	<b>GDP Growth(2001-2017)</b>
Intercept	Estimate : 6.347*** Standard error : 1.24
TR	Estimate : 2.9e-1 Standard error : 1.2e-10
T	Estimate : -2.49 Standard error : 5.3
TR*T	Estimate : 1.2e-10 Standard error : 2.6e-10

<b>MODEL 4 Regressor</b>	<b>GDP Growth(2001-2017)</b>
Intercept	Estimate : 5.47** Standard error : 7.3e-1
FTA	Estimate : 4.7e-7* Standard error : 1.9e-7
TR	Estimate : -2e-10 Standard error : 1.3e-10

FDI	Estimate : -5e-12 Standard error : 4e-11
FPI	Estimate : 9e-11** Standard error : 2.79e-11

<b>Model 5 Regressor</b>	<b>GDP Growth(2001-2017)</b>
Intercept	Estimate : 4.16*** Standard error : 1.03e-01
FTA	Estimate : 1.827e-8*** Standard error : 2.9e-9
TR	Estimate : -2.47e-11*** Standard error : 3.45e-12
FDI	Estimate : 3.62e-12*** Standard error : 8.67e-13
FPI	Estimate : -1.83e-12 Standard error : 8.61e-13
T	Estimate : -0.88*** Standard error : -0.16
FTA x T	Estimate : -1.330e-08 ** Standard error : 4.171e-09
TR x T	Estimate : 1.576e-11** Standard error : 5.131e-12
FDI x T	Estimate : -9.869e-13 Standard error : 1.842e-12
FPI x T	Estimate : 2.097e-12 Standard error : 1.830e-12

Model 6 Regressor	GDP Growth(2001-2017)
Intercept	Estimate : 4.13*** Standard error : 1.03e-01
FTA	Estimate : 1.85e-08*** Standard error : 2.97e-09
TR	Estimate : -2.49e-11*** Standard error : 3.4e-12
FDI	Estimate : 3.62e-12*** Standard error : 8.64e-13
FPI	Estimate : -1.83e-12 Standard error : 1.22e-12
India x T	Estimate : 1.33 Standard error : 1.68
India	Estimate : 2.57* Standard error : 1.001
T	Estimate : -0.906e-01*** Standard error : -1.74e-01
FTA x T	Estimate : -1.330e-08 ** Standard error : 4.19e-09
TR x T	Estimate : 1.576e-11** Standard error : 5.15e-12
FDI x T	Estimate : -9.22e-13 Standard error : 1.85e-12
FPI x T	Estimate : 2.06e-12 Standard error : 1.83e-12

<b>Model 7 Regressor</b>	<b>GDP Growth(2001-2017)</b>
Intercept	Estimate : 4.19*** Standard error : 1.04e-1
FTA	Estimate : 6.05e-10 Standard error : 1.66e-9
FDI	Estimate : 2.59e-14 Standard error : 7.17e-13
FPI	Estimate : -3.68e-12** Standard error : 1.21e-12
India x T	Estimate : 1.41 Standard error : 1.7
India	Estimate : 2.45* Standard error : 1.01
T	Estimate : -0.957e-1*** Standard error : -1.76e-1
FTA x T	Estimate : -3.42e-10 Standard error : 2.92e-9
FDI x T	Estimate : -1.06e-13 Standard error : 1.37e-12
FPI x T	Estimate : 2.00e-12 Standard error : 1.65e-12

Model 8 Regressor	GDP Growth(2001-2017)
Intercept	Estimate : 4.2*** Standard error : 1.00e-1
FDI	Estimate : 2.28e-13 Standard error : 4.54e-13
FPI	Estimate : -3.56e-12** Standard error : 1.17e-12
India x T	Estimate : 1.41 Standard error : 1.70
India	Estimate : 2.44* Standard error : 1.01
T	Estimate : -9.56e-1*** Standard error : 1.71e-1
FDI x T	Estimate : 1.04e-13 Standard error : 6.95e-13
FPI x T	Estimate : 2.08e-12 Standard error : 1.53e-12

### Discussions and Concluding Remarks

- The basic premise that correlation between Foreign Tourists Arrivals and GDP growth has decreased after 2011 is itself flawed. We have shown that the correlation has instead increased post 2011.
- According to the cross country regression, India is an outlier with 90% confidence but there has been no change post 2011 as claimed by the paper.
- We observe multicollinearity in the variables FTA and TR in the period 2001-2011 and between FDI and FPI in the period 2012-2017.
- FTA is a significant indicator for predicting GDP growth but India turns out to be an outlier. Specifically for India FTA cannot be used as a significant indicator.

## **References**

- World Bank national accounts data, and OECD National Accounts data files.
- Subramanian, Arvind, 2019, "India's GDP Mis-estimation: Likelihood, Magnitudes, Mechanisms, and Implications"
- Bibek Debroy, Rathin Roy, Surjit Bhalla, Charan Singh, Arvind Virmani , 2019 , "GDP estimation in India- Perspectives and Facts"

## **Appendix**

### Countries/Regions Chosen:

- [1] Arab World
- [2] Argentina
- [3] Armenia
- [4] Australia
- [5] Austria
- [6] Bulgaria
- [7] Belarus
- [8] Bolivia
- [9] Brazil
- [10] Canada
- [11] Central Europe and the Baltics
- [12] Chile
- [13] China
- [14] Colombia
- [15] Costa Rica
- [16] Cyprus
- [17] Czech Republic
- [18] Germany
- [19] Denmark
- [20] Dominican Republic
- [21] East Asia & Pacific (excluding high income)
- [22] Early-demographic dividend
- [23] East Asia & Pacific
- [24] Europe & Central Asia (excluding high income)
- [25] Europe & Central Asia
- [26] Ecuador
- [27] Egypt, Arab Rep.
- [28] Euro area
- [29] Spain
- [30] Estonia

- [31] European Union
- [32] Finland
- [33] France
- [34] United Kingdom
- [35] Georgia
- [36] Greece
- [37] High income
- [38] Hong Kong SAR, China
- [39] Heavily indebted poor countries (HIPC)
- [40] Croatia
- [41] Hungary
- [42] IBRD only
- [43] IDA & IBRD total
- [44] IDA blend
- [45] Indonesia
- [46] India
- [47] Ireland
- [48] Iceland
- [49] Israel
- [50] Italy
- [51] Jamaica
- [52] Jordan
- [53] Japan
- [54] Kazakhstan
- [55] Kenya
- [56] Kyrgyz Republic
- [57] Cambodia
- [58] Korea, Rep.
- [59] Latin America & Caribbean (excluding high income)
- [60] Lao PDR
- [61] Latin America & Caribbean
- [62] Least developed countries: UN classification
- [63] Sri Lanka
- [64] Lower middle income
- [65] Low & middle income
- [66] Lesotho
- [67] Late-demographic dividend
- [68] Lithuania
- [69] Latvia
- [70] Maldives
- [71] Middle East & North Africa
- [72] Mexico
- [73] Middle income
- [74] Malta
- [75] Middle East & North Africa (excluding high income)

[76] Mauritius  
[77] North America  
[78] Namibia  
[79] Netherlands  
[80] Norway  
[81] New Zealand  
[82] OECD members  
[83] Oman  
[84] Panama  
[85] Peru  
[86] Philippines  
[87] Poland  
[88] Pre-demographic dividend  
[89] Portugal  
[90] Post-demographic dividend  
[91] Romania  
[92] Russian Federation  
[93] South Asia  
[94] Singapore  
[95] El Salvador  
[96] Sub-Saharan Africa (excluding high income)  
[97] Sub-Saharan Africa  
[98] Slovak Republic  
[99] Slovenia  
[100] Sweden  
[101] East Asia & Pacific (IDA & IBRD countries)  
[102] Europe & Central Asia (IDA & IBRD countries)  
[103] Thailand  
[104] Latin America & the Caribbean (IDA & IBRD countries)  
[105] Middle East & North Africa (IDA & IBRD countries)  
[106] South Asia (IDA & IBRD)  
[107] Sub-Saharan Africa (IDA & IBRD countries)  
[108] Tunisia  
[109] Turkey  
[110] Tanzania  
[111] Ukraine  
[112] Upper middle income  
[113] United States  
[114] World  
[115] South Africa  
[116] Zambia