# Convergence, Divergence, Switching: *Implications on Inequality Pre-and Post-2007 crisis*

By

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# Motivation

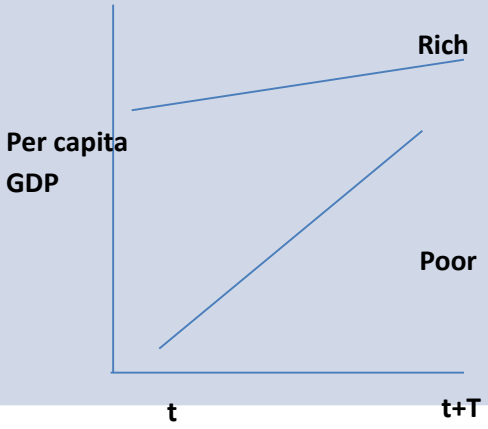
- Rising inequality among countries across the globe: one of the biggest challenges to be addressed by the international authorities.

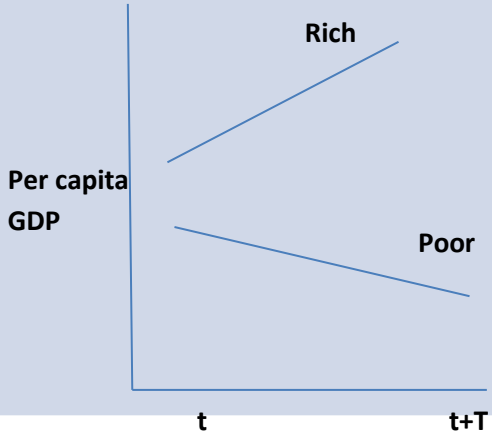
- Difficult to attain same level of income/output for each and every country but attempts to achieve at least minimum level of welfare for poor countries.

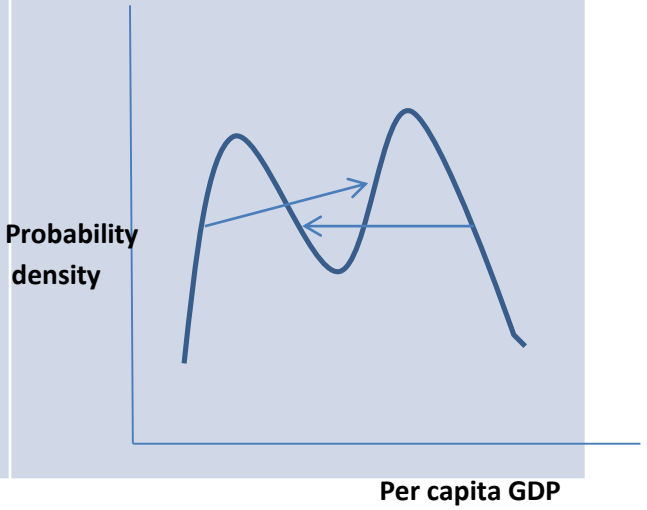
- Inequality in output assessed through the perspective of convergence, divergence, and switching phenomena.

# Definitions

| Convergence | Divergence | Switching |
|---|---|---|
| • Implies that capital poor economies are catching up with capital rich economies, irrespective of their initial incomes or per capita GDP.<br>• Inequality among economies decreasing. | • Implies capital poor economies are getting more poor and capital rich economies are getting more rich in terms of per capita GDP.<br>• Inequality among economies increasing. | • Mobility of economies within the income distribution in terms of switching places/rank, overtaking other economies, stagnating, falling behind, etc. |



# Theory

Neoclassical theory of growth:

- capital labour ratio is inversely proportional to the productivity of capital
- Income per capita will converge due to differences in the rates of return on capital

- Mechanisms behind convergence:

➢ Assumption of the law of diminishing marginal returns

➢ Assumption of labour augmenting technological progress

- Implies that capital poor economies grow faster than the richer ones.

# Measure of convergence

- Beta convergence using growth regression approach: relationship between long term growth and initial levels of income.
- Negative coefficient of beta implies there is a tendency for per capital GDP to equalise across economies
- $\log(\frac{yit}{yi,t-1}) = \alpha + \beta \log(yit) + \varepsilon it$
  - If $\beta < 0$, the data set is said to exhibit "absolute" beta convergence, i.e., there is a long term tendency for per capita GDP to equalise across countries.
  - If $\beta > 0$, there is a possibility of divergence across countries.
  - If $\beta = 0$, this depicts that there is no convergence effect. However, if other right hand variables were considered in the model, then those variables would measure differences in steady state growth rates across countries.

# Empirical evidence

- Empirical evidence of divergence from mid-1980s instead of convergence (Durlauf et al., 2005; Webber, 2009; Temple, 1999; Islam, 2003).

- Moreover, the literature started to reveal a wide variety of growth experiences across the globe such as growth miracles and growth disasters.

- New growth theorists challenged the neoclassical as they suggested the presence of non-diminishing returns on capital which led to increase in the output gap or inequality between rich and poor economies (Romer, 1994).

- The new growth theory advocates the dominance of spillover effect and positive externality that lead to divergence in growth paths across economies, hence increasing inequality (Acemoglu and Restrepo, 2016; Anzoategui et al., 2016; Dosi et al., 2017).

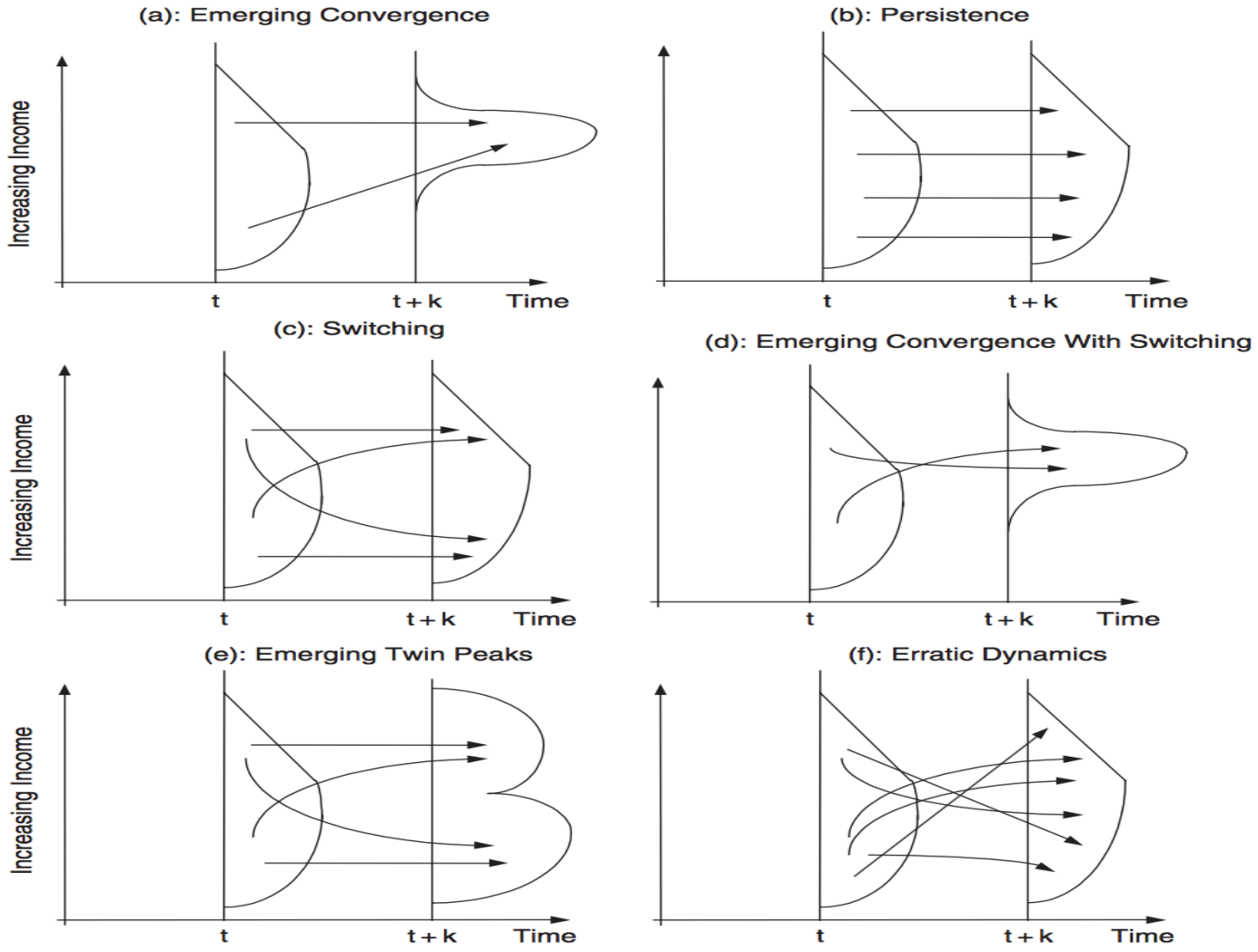
# Distribution dynamics

- Moreover, Quah (1993, 1996, 1997) highlighted the significance of studying all economies together through distribution dynamics
- Negative beta is more suitable to understand the dynamics of a 'typical' country
- Evidence of negative beta convergence is a "statistical fallacy."
- Need to supplement the measure of convergence
- Measure of dispersion of income (σ-convergence): Theoretically dispersion (variance) of relative per capita GDP levels tend to decline across economies over time. $\sigma_{t+T} < \sigma_t$
- The understanding of the shape of the entire distribution not only shed light on process of convergence/divergence, but simultaneously provide insights on the subtleties of inequality across economies by assessing the mobility of countries from one position to another (also called churning within the cross section)

# Intra-distributional dynamics

- Quantifying mobility of economies within the distribution
- Identifying intra-distributional dynamic properties of economies
- Assessment of the relative frequency of concordant pairs of economies (pairs with narrowing differences over a period of time) against the relative frequency of discordant pairs (expanding differentials over time) (Webber and White, 2003, 2005, 2009)
- Measure relative frequency of concordant pairs of economies without switching (convergence with persistence) or with switching
- A magnitude free statistic
- Easy to detect any small but important changes

# Possibilities of emerging intra-distribution dynamics



# The study

- The study investigates per capita GDP for 110 countries from the World Bank database.
- Divides the time period of 1970 to 2016 in two parts: 1970-2006 and 2007-2016 to understand the effect of 2007 global crisis on the dynamics of convergence/divergence.
- The study compares the pre-and post-crisis dynamics to investigate the change in the process of convergence/divergence with/without switching of countries.
- The study calculates percentage of pairs of economies exhibiting each type of concordant/discordant behaviour for pre-and post-crisis period to recognise the type of behavior that dominates before and after the crisis.

# Hypothesis

2007 global financial crisis has a negative impact on the per capita GDP equality across countries.

# The model

Lets assume rich country *(i)* and poor country's *(j)* output per capita ($s_i$ and $s_j$) over periods *t* and *t+T*

$(s_{i,t}/ s_{j,t})^{X}_{i,j} = (s_{i,t+T}/ s_{i,t+T})$

Assume, $s_i > s_j > 0$
By defining $X_{ij}$ as a solution for above equation and taking logarithms on both sides:

$$X_{i,j} = \frac{\log(s_{i,t+T}) - \log(s_{j,t+T})}{\log(s_{i,t}) - \log(s_{j,t})}$$

If,
$X_{i,j} > 1$ then countries *i* and *j* exhibit divergence in ratio without switching = Type I

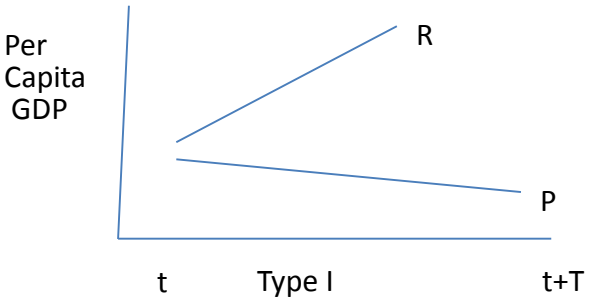
$0 < X_{i,j} < 1$ then countries *i* and *j* exhibit convergence in ratio without switching = Type II

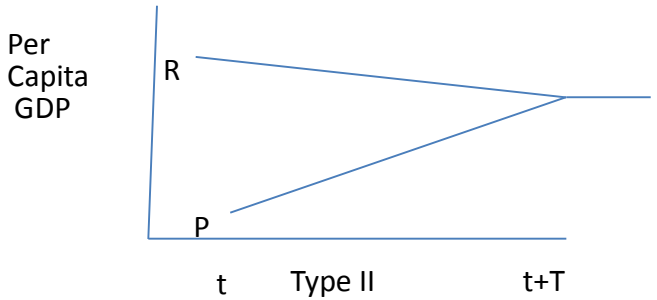
$-1 < X_{i,j} < 0$ then countries *i* and *j* exhibit convergence in ratio with switching = Type III

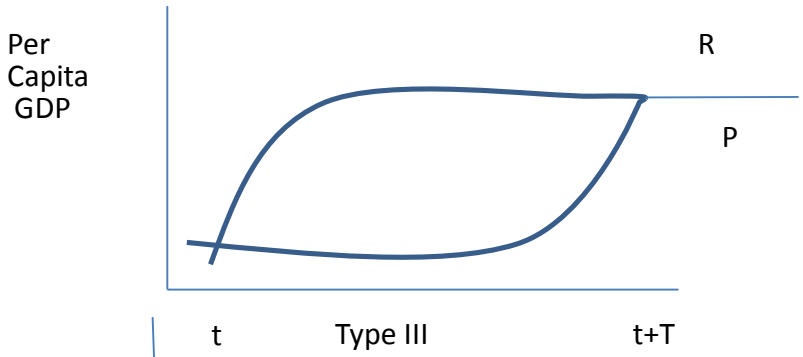
$-1 > X_{i,j}$ then countries *i* and *j* exhibit divergence in ratio with switching = Type IV

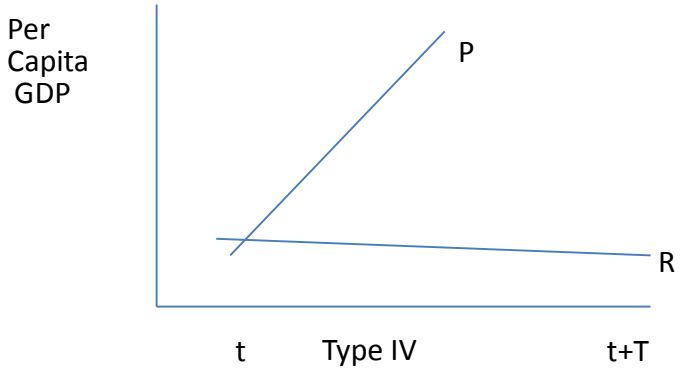
$X_{i,j} = 0$ then the countries have already merged and there cannot be any further convergence = Type V

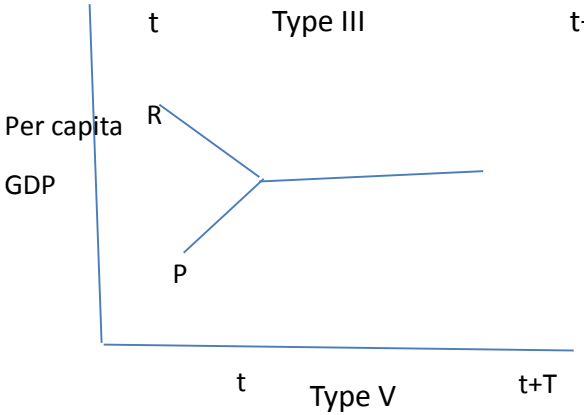
# Behaviour exhibited by countries

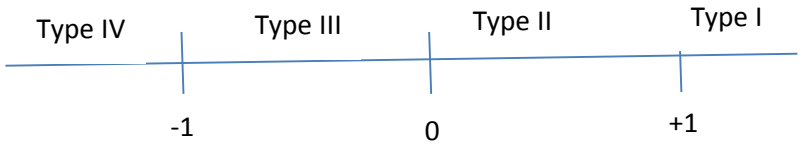


# Result

| | | Percentages | | |
|---|---|---|---|---|
| | | **1970 - 2016** | **1970 - 2006** | **2007 - 2016** |
| *Type I* | *Divergence without switching* | 55% | 52% | 41% |
| *Type II* | *Convergence without switching* | 32% | 30% | 56% |
| *Type III* | *Convergence with switching* | 6% | 12% | 1% |
| *Type IV* | *Divergence with switching* | 7% | 6% | 2% |

The percentage of pairs of countries that have converged/diverged with/without switching

We did not get any evidence of Type V behaviour, i.e., the countries have already merged and there cannot be any further convergence, that's why we dropped Type V from the table.

# Discussion

It is evident that after the 2007 crisis some poor countries may have done far better than the pre-crisis level to come closer to the richer nations because:

- Resilience: the poor countries themselves altered policies to attract funds and adapt to the change quickly
- South-South flows: their share of total flows to developing economies has more than doubled compared with the pre-crisis period (Brazil, Mexico, Russia, China, Algeria, Iraq, Mexico, Saudi Arabia, etc.)

# Limitations

- Time
- Geography

Future research

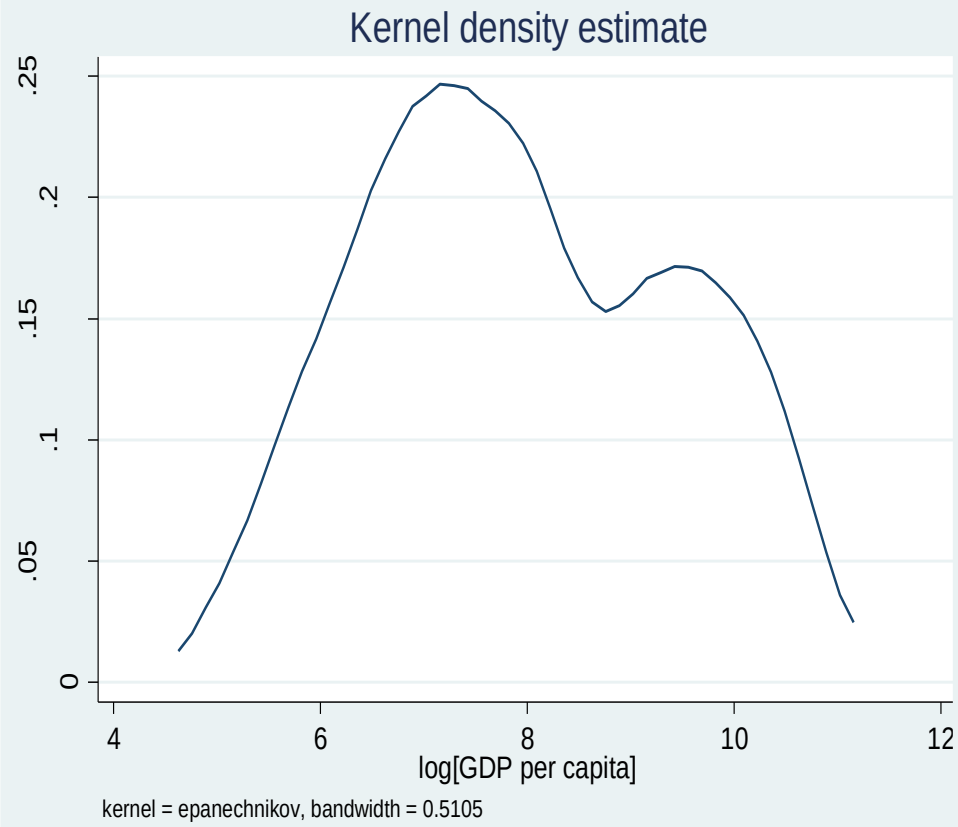
- Analysis based on yearly data
- Analysis based on countries within continents

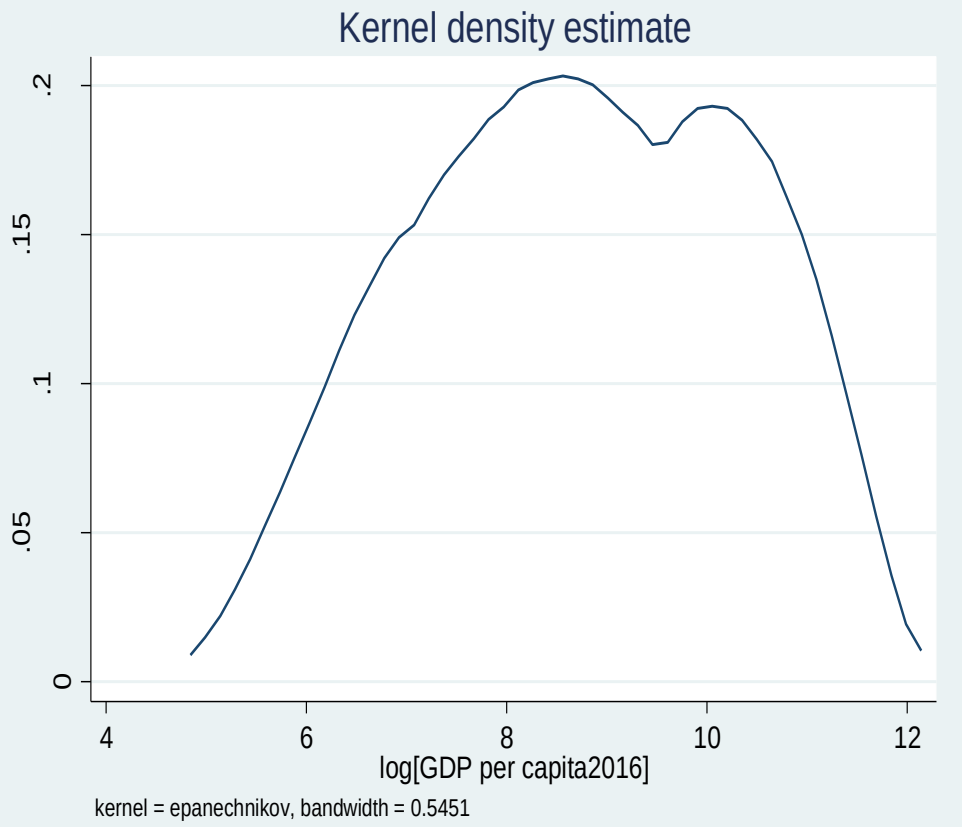
# Conclusion

- Type I behaviour prominent pre-crisis
- Type II behaviour prominent post-crisis
- Indicating developing countries converging with developed ones with persistence in positions/ranks post crisis
- Equality in per capita GDP increasing post crisis
- Suggesting a rejection of the hypothesis framed earlier
- Speculation: Foreign investment flows looking for tax heaven
- Limitation: Time and Geography

# Suggestions

# Distribution dynamics



# 2007-16

| Country Name | Type I | Type II | Type III | Type IV |
|---|---|---|---|---|
| Algeria | 0.78 | 1 | 0.72 | 1.16 |
| Andorra | 0.34 | 1.26 | 1.44 | 2.89 |
| Argentina | 0.62 | 1.13 | 1.44 | |
| Australia | 0.84 | 0.98 | | 0.58 |
| Austria | 0.52 | 1.17 | 0.72 | 1.73 |
| Bahamas, The | 0.58 | 1.13 | 0.72 | 1.73 |
| Bangladesh | 0.44 | 1.23 | 0.72 | 1.73 |
| Belgium | 0.56 | 1.16 | 1.44 | 0.58 |
| Belize | 0.97 | 0.88 | | 1.16 |
| Benin | 1.11 | 0.78 | | 1.16 |
| Bermuda | 2.21 | | | |
| Bolivia | 0.86 | 0.92 | 0.72 | 1.73 |
| Botswana | 0.9 | 0.92 | 0.72 | 0.58 |
| Brazil | 0.58 | 1.14 | 1.44 | 0.58 |
| Burkina Faso | 0.95 | 0.9 | 0.72 | 0.58 |
| Burundi | 2.03 | 0.13 | | |
| Cameroon | 0.97 | 0.85 | 0.72 | 1.73 |
| Canada | 0.6 | 1.13 | 0.72 | 1.16 |
| Central African Republic | 2.11 | 0.01 | 1.44 | 1.16 |
| Chad | 1.29 | 0.63 | 1.44 | 0.58 |
| Chile | 0.97 | 0.91 | | 4.62 |
| China | 1.03 | 0.67 | 3.6 | 1.16 |
| Colombia | 0.9 | 0.9 | 1.44 | |
| Congo, Dem. Rep. | 0.62 | 1.13 | 0.72 | 0.58 |
| Congo, Rep. | 0.86 | 0.97 | | 0.58 |
| Costa Rica | 0.99 | 0.85 | 1.44 | 0.58 |
| Cote d'Ivoire | 0.82 | 0.95 | 0.72 | 1.73 |
| Cuba | 2.21 | | | |
| Denmark | 0.36 | 1.34 | | 0.58 |
| Dominican Republic | 1.03 | 0.82 | 1.44 | 0.58 |
| Ecuador | 0.92 | 0.88 | 0.72 | 1.73 |
| Egypt, Arab Rep. | 0.92 | 0.92 | 0.72 | |
| El Salvador | 0.76 | 0.98 | 2.88 | 0.58 |
| Fiji | 0.8 | 1 | | 1.16 |
| Finland | 0.36 | 1.26 | 1.44 | 2.31 |
| France | 0.6 | 1.17 | | |

| | | | | |
|---|---|---|---|---|
| Gabon | 0.6 | 1.12 | 1.44 | 1.16 |
| Gambia, The | 1.65 | 0.38 | 0.72 | 0.58 |
| Georgia | 0.86 | 0.9 | 2.16 | 1.73 |
| Germany | 0.7 | 1.06 | 2.16 | |
| Ghana | 0.58 | 1.1 | 1.44 | 2.31 |
| Greece | 0.54 | 1.16 | 1.44 | 1.16 |
| Greenland | 2.21 | | | |
| Guatemala | 0.74 | 1.01 | | 2.31 |
| Guinea-Bissau | 1.21 | 0.7 | | 1.16 |
| Guyana | 0.88 | 0.91 | 0.72 | 1.73 |
| Honduras | 0.92 | 0.91 | 0.72 | 1.16 |
| Hong Kong SAR, China | 0.99 | 0.87 | 0.72 | 0.58 |
| Iceland | 0.6 | 1.12 | 0.72 | 1.73 |
| India | 0.56 | 1.12 | 2.16 | 2.89 |
| Indonesia | 0.84 | 0.91 | 1.44 | 1.73 |
| Iran, Islamic Rep. | 0.6 | 1.12 | | 1.16 |
| Iraq | 0.99 | 0.82 | 0.72 | 2.31 |
| Ireland | 1.67 | 0.38 | | 0.58 |
| Israel | 0.82 | 0.98 | 0.72 | 0.58 |
| Italy | 0.52 | 1.23 | | |
| Jamaica | 0.97 | 0.81 | 2.88 | 1.73 |
| Japan | 0.62 | 1.12 | 0.72 | 1.16 |
| Kenya | 0.97 | 0.88 | 1.44 | |
| Kiribati | 1.25 | 0.65 | 2.16 | 0.58 |
| Korea, Rep. | 1.11 | 0.76 | 0.72 | 1.16 |
| Lesotho | 0.82 | 0.97 | 1.44 | 0.58 |
| Liberia | 1.07 | 0.81 | 0.72 | 0.58 |
| Luxembourg | 0.3 | 1.39 | | |
| Madagascar | 1.97 | 0.15 | 0.72 | 0.58 |
| Malawi | 0.95 | 0.9 | | 1.16 |
| Malaysia | 0.99 | 0.84 | 1.44 | 1.16 |
| Mali | 1.17 | 0.75 | | 0.58 |
| Malta | 1.21 | 0.69 | 0.72 | 1.16 |
| Mauritania | 1.27 | 0.6 | 1.44 | 2.31 |
| Mexico | 0.56 | 1.14 | 1.44 | 1.16 |
| Myanmar | 0.46 | 1.19 | 3.6 | 0.58 |
| Nepal | 0.7 | 1.06 | 0.72 | 1.16 |
| Netherlands | 0.5 | 1.2 | 1.44 | 0.58 |
| Nicaragua | 0.82 | 1 | | 0.58 |
| Nigeria | 0.88 | 0.94 | 0.72 | 0.58 |
| Norway | 0.36 | 1.35 | | |
| Oman | 0.62 | 1.16 | | |

| | | | | |
|---|---|---|---|---|
| Pakistan | 1.07 | 0.81 | 0.72 | 0.58 |
| Panama | 1.25 | 0.62 | 2.88 | 1.16 |
| Papua New Guinea | 0.86 | 0.94 | | 1.73 |
| Paraguay | 0.9 | 0.9 | 2.88 | |
| Peru | 1.03 | 0.81 | 1.44 | 1.16 |
| Philippines | 0.84 | 0.97 | 0.72 | 0.58 |
| Portugal | 0.58 | 1.14 | | 1.73 |
| Puerto Rico | 0.58 | 1.17 | | 0.58 |
| Rwanda | 0.36 | 1.29 | 1.44 | 1.16 |
| Saudi Arabia | 0.78 | 1.03 | 0.72 | |
| Senegal | 1.11 | 0.78 | 1.44 | |
| Seychelles | 1.05 | 0.82 | 1.44 | |
| Sierra Leone | 0.9 | 0.92 | 0.72 | 0.58 |
| Singapore | 1.09 | 0.69 | 2.16 | 3.47 |
| South Africa | 0.64 | 1.12 | 0.72 | 0.58 |
| Spain | 0.56 | 1.19 | 0.72 | |
| Sri Lanka | 0.86 | 0.92 | 1.44 | 1.16 |
| St. Vincent and the Grenadines | 0.64 | 1.1 | 1.44 | 0.58 |
| Sudan | 0.76 | 1.04 | 0.72 | |
| Swaziland | 0.76 | 0.98 | 2.16 | 1.16 |
| Sweden | 0.76 | 1.06 | | |
| Thailand | 0.92 | 0.9 | 1.44 | 0.58 |
| Togo | 1.05 | 0.84 | 0.72 | |
| Trinidad and Tobago | 0.62 | 1.16 | | |
| Tunisia | 0.8 | 1.01 | | 0.58 |
| Turkey | 1.15 | 0.76 | 0.72 | |
| United Kingdom | 0.54 | 1.22 | | |
| United States | 0.72 | 1.06 | 1.44 | |
| Uruguay | 1.31 | 0.63 | 0.72 | 0.58 |
| Venezuela, RB | 2.21 | | | |
| Zambia | 0.84 | 0.94 | 0.72 | 1.73 |
| Zimbabwe | 0.86 | 0.94 | 0.72 | 1.16 |
| ---------- | ---------- | ---------- | ---------- | ---------- |
| Total | 100 | 100 | 100 | 100 |