

Global Macroeconomic Scenarios of the COVID-19 Pandemic: How Useful Were the Pre-Pandemic Scenarios?

Warwick J. McKibbin, AO, FASSA

Centre for Applied Macroeconomic Analysis (CAMA)

Australian National University

and

Centre of Excellence in Population Ageing Research (CEPAR)

Centre for Economic Policy Research (London)

The Brookings Institution, Washington DC

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Series of scenario papers

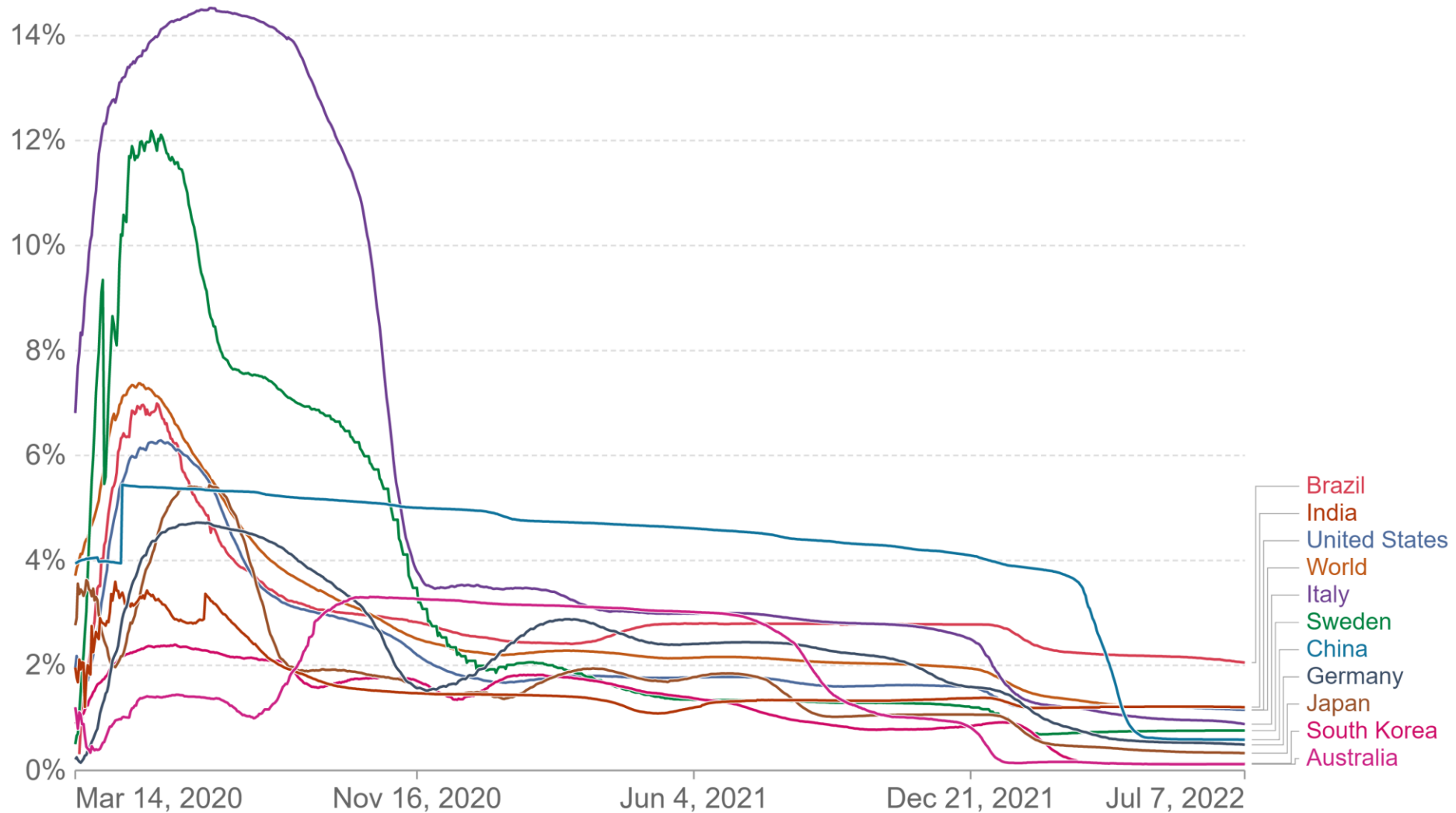
- McKibbin W. and R. Fernando (2021) “The Global Macroeconomic Impacts of COVID-19: Seven Scenarios” Asian Economic Papers vol 20 no 2 pp 1-30. **released February 2020**
- McKibbin W. and R. Fernando (2020) “Global Macroeconomic Scenarios of the COVID-19 Pandemic” COVID Economics: Vetted and Real-Time papers, vol 39. Centre for Economic Policy Research, London. Issue 39, pp 1-58. **released June 2020**
- Fernando R. and W. McKibbin (2021) “Macroeconomic Policy Adjustments due to COVID-19: Scenarios to 2025 with a focus on Asia” in Beirne, J. P. J. Morgan and Tetsushi Sonobe (eds) Covid-19 Impacts And Policy Options: An Asian Perspective. Asian Development Bank Institute, Series on Asian and Pacific Sustainable Development. Tokyo. Pp 399-472. **released December 2020**

Covid Cases and Deaths cumulative to July 7, 2022

- Global Cases 553,461,218
- Global Deaths 6,347,388
- Australia Cases 8,419,675
- Australia Deaths 10,225

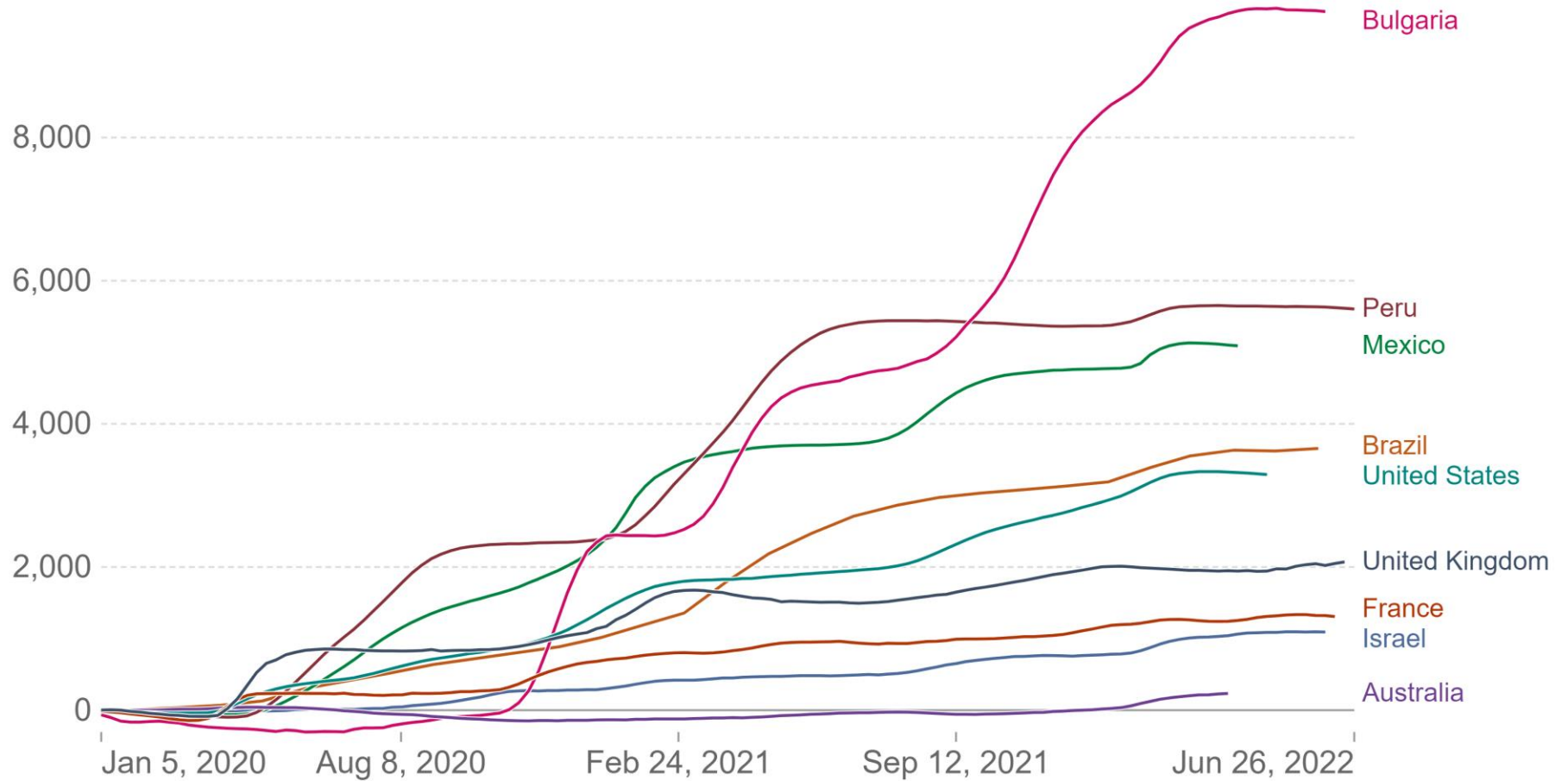
Case fatality rate of COVID-19

The case fatality rate (CFR) is the ratio between confirmed deaths and confirmed cases. The CFR can be a poor measure of the mortality risk of the disease. We explain this in detail at OurWorldInData.org/mortality-risk-covid



Excess mortality: Cumulative number of deaths from all causes compared to projection based on previous years, per million people

The cumulative difference between the reported number of deaths since 1 January 2020 and the projected number of deaths for the same period based on previous years. The reported number might not count all deaths that occurred due to incomplete coverage and delays in reporting.



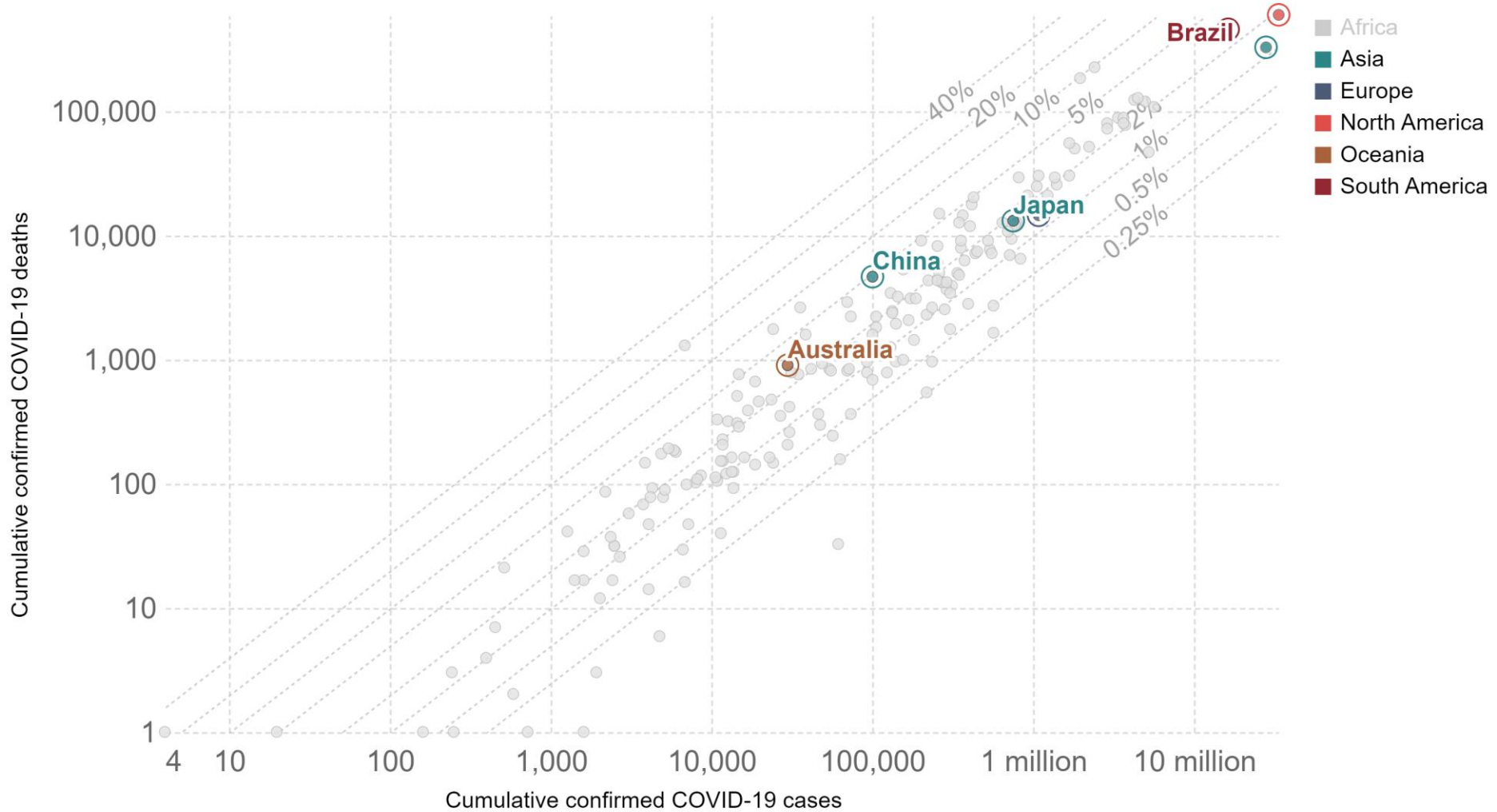
Source: Human Mortality Database (2022), World Mortality Dataset (2022)

OurWorldInData.org/coronavirus • CC BY

Note: Comparisons across countries are affected by differences in the completeness of death reporting. Details can be found at our Excess Mortality page.

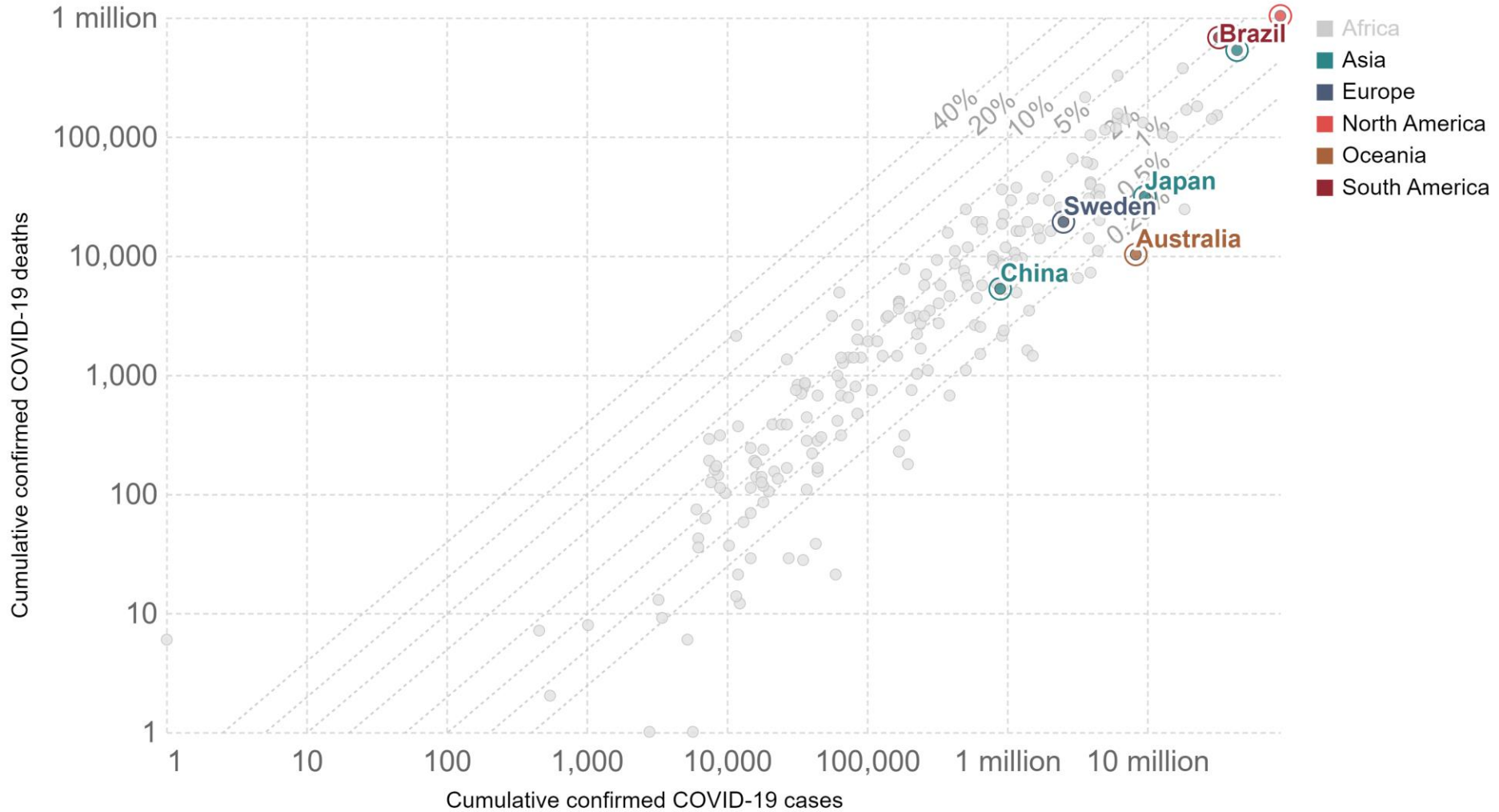
Cumulative confirmed COVID-19 deaths vs. cases, May 30, 2021

Limited testing and challenges in the attribution of cause of death mean the cases and deaths counts may not be accurate. The gray lines show the corresponding case-fatality rates (the ratio between confirmed deaths and confirmed cases).

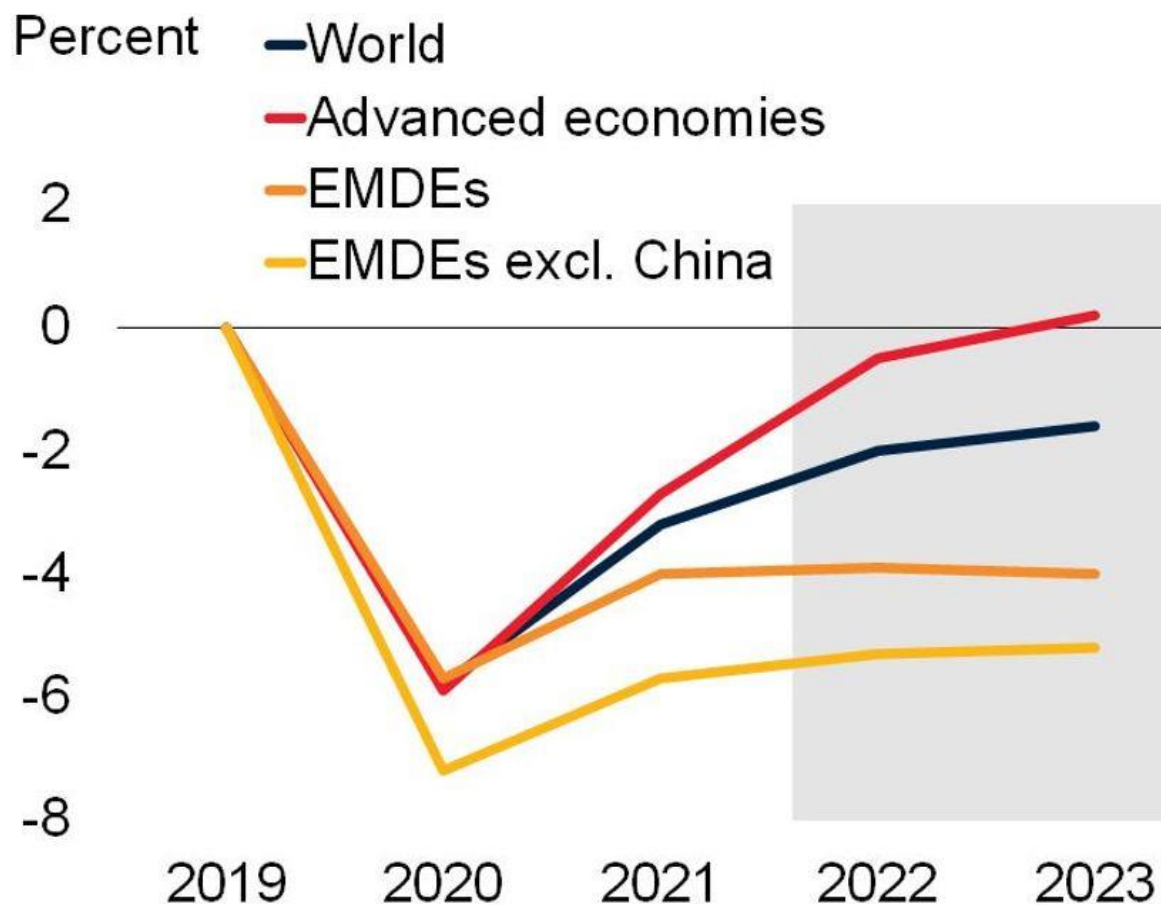


Cumulative confirmed COVID-19 deaths vs. cases, Jul 7, 2022

Limited testing and challenges in the attribution of cause of death mean the cases and deaths counts may not be accurate. The gray lines show the corresponding case-fatality rates (the ratio between confirmed deaths and confirmed cases).



Deviation of output from pre-pandemic trends



Source: Deviation between the latest projections and pre-pandemic trends. World Bank

Vaccine rollout began

- USA 14 December 2020
- Australia 22 February 2021

Based on

- McKibbin W. and R. Fernando (2020) “The Global Macroeconomic Impacts of COVID-19: Seven Scenarios” COVID Economics: Vetted and Real Time papers, vol 10. Centre for Economic Policy Research, London. Pp 116-156.

Overview

- Key messages
- The General Approach
- The Model Used: G-Cubed
- Results
 - 7 scenarios
- Conclusion

Key Messages

- Historical approach of costing pandemics focussing on mortality and morbidity greatly underestimates economic costs.
- Economy wide consequences through change in behaviour and policy responses are large

Key Messages

- Given the size of the true economic costs of a pandemic, there is strong case for substantial investment in prevention as well as investing in the capacity to respond in all countries.

General Approach

- Extends the approach developed by Lee and McKibbin (2004) on SARS and McKibbin and Sidorenko (2006) on Avian Influenza
- Start with epidemiological scenarios on
 - Virus infections rates
 - Case mortality rates
 - Morbidity rates
- Map these epidemiological outcomes into different countries based on a range of exposure indicators

General Approach

- Develop a set of shocks to economic variables that are created from the epidemiological assumptions but modified across economies and sectors based on a range of exposure indicators
- Implement the shocks in a global economic model

Modelling a Pandemic

- Major shocks:
 - Reduction in labour force (due to mortality and illness, includes carers)
 - Increase in business costs (differentiated by sector);
 - Disruption of production chains
 - Shift in consumers preferences
 - Re-evaluation of sector and country risks
 - Policy Responses

Epidemiological Scenarios

Scenarios

- 3 scenarios have the COVID-19 outbreak contained in China (temporary) S01, S02, S03
- 3 scenarios are global pandemics following historical epidemiological experiences (temporary) S04, S05, S06
- 1 scenario is assumed to be a permanent/recurring mild pandemic (S07)

Pandemics

- (S04) Hong Kong Flu 1968-69
- (S05) Asian Flu 1957
- (S06) Spanish Flu 1918-19

The Model

G-Cubed Model

- Developed by McKibbin and Wilcoxon since 1991
- Documented in *Handbook of CGE Modeling*, Chapter 17, North Holland
- Used for policy analysis and scenario planning by governments, international agencies, corporations, banks, and academic researchers.

G-Cubed Model

- Hybrid of a dynamic stochastic general equilibrium model (DSGE) as used by central banks and a computable general equilibrium (CGE) model.
- Inter-industry linkages, trade, capital flows, consumption, and investment.
- Annual macroeconomic and sectoral dynamics
- Captures frictions in labor market and capital accumulation
 - Full employment in the long run
 - Labor mobile across sectors but not regions

The G-Cubed (G20) model

Countries (20)

Argentina
Australia
Brazil
Canada
China
Euro zone
France
Germany
Indonesia
India
Italy
Japan
Korea
Mexico
Russia
Saudi Arabia
South Africa
Turkey
United Kingdom
United States

Regions (4)

Rest of the OECD
Rest of Asia
Other oil producing countries
Rest of the world

Sectors (6)

Energy
Mining
Agriculture (including fishing and hunting)
Durable manufacturing
Non-durable manufacturing
Services

Agents in Each Country

A representative household
A representative firm (in each of the 6 production sectors)
Government
Central Bank

Baseline without a pandemic

- Solve the model from 2016 to 2100 under assumptions about
 - » population growth by country;
 - » productivity growth by sector and country;
 - » technological assumptions,
 - » policy rules etc

Implementation of Pandemic Shocks

- Surprise pandemic in 2020
- Agents know the future path of the shocks in 2020.
- 30% of firms and households have rational expectations
- 70% follow a rule of thumb

Creating the Epidemic Shock

- Start with China infection and case mortality rates based on the historical data and estimates based on data to February 15, 2020

Table 2 – Epidemiological Assumptions for China

Scenario		Attack Rate for China	Case-fatality Rate for China	Mortality Rate for China
China only	S01	1%	2.0%	0.02%
	S02	10%	2.5%	0.25%
	S03	30%	3.0%	0.90%
pandemic	S04	10%	2.0%	0.20%
	S05	20%	2.5%	0.50%
	S06	30%	3.0%	0.90%
	S07	10%	2.0%	0.20%

Labor supply shocks

- Mortality is permanent
- Morbidity assume incubation period for COVID-19 is 14 days
 - » assume an average employee in a country would have to be absent from work for 14 days, if infected. Absence from work indicates a loss of productive capacity for 14 days out of working days for a year.

Labor supply shocks

- Morbidity also assumes absenteeism from work due to caregiving family members who are infected.
- Assume that 70 percent of the female workers would be care givers to family members. We adjust the effective attack rate using the proportion of labor force who have to care for school-aged children (70 percent of female labor force participation).

Transmission of the Pandemic across countries

Scenario	Countries Affected	Severity	Attack Rate for China	Case fatality rate China	Nature of Shocks	Shocks Activated	Shocks Activated
						China	Other countries
1	China	Low	1.0%	2.0%	Temporary	All	Risk
2	China	Mid	10.0%	2.5%	Temporary	All	Risk
3	China	High	30.0%	3.0%	Temporary	All	Risk
4	Global	Low	10.0%	2.0%	Temporary	All	All
5	Global	Mid	20.0%	2.5%	Temporary	All	All
6	Global	High	30.0%	3.0%	Temporary	All	All
7	Global	Low	10.0%	2.0%	Permanent	All	All

Indexes uses to scale
epidemiological Shocks

Labor Supply Shock

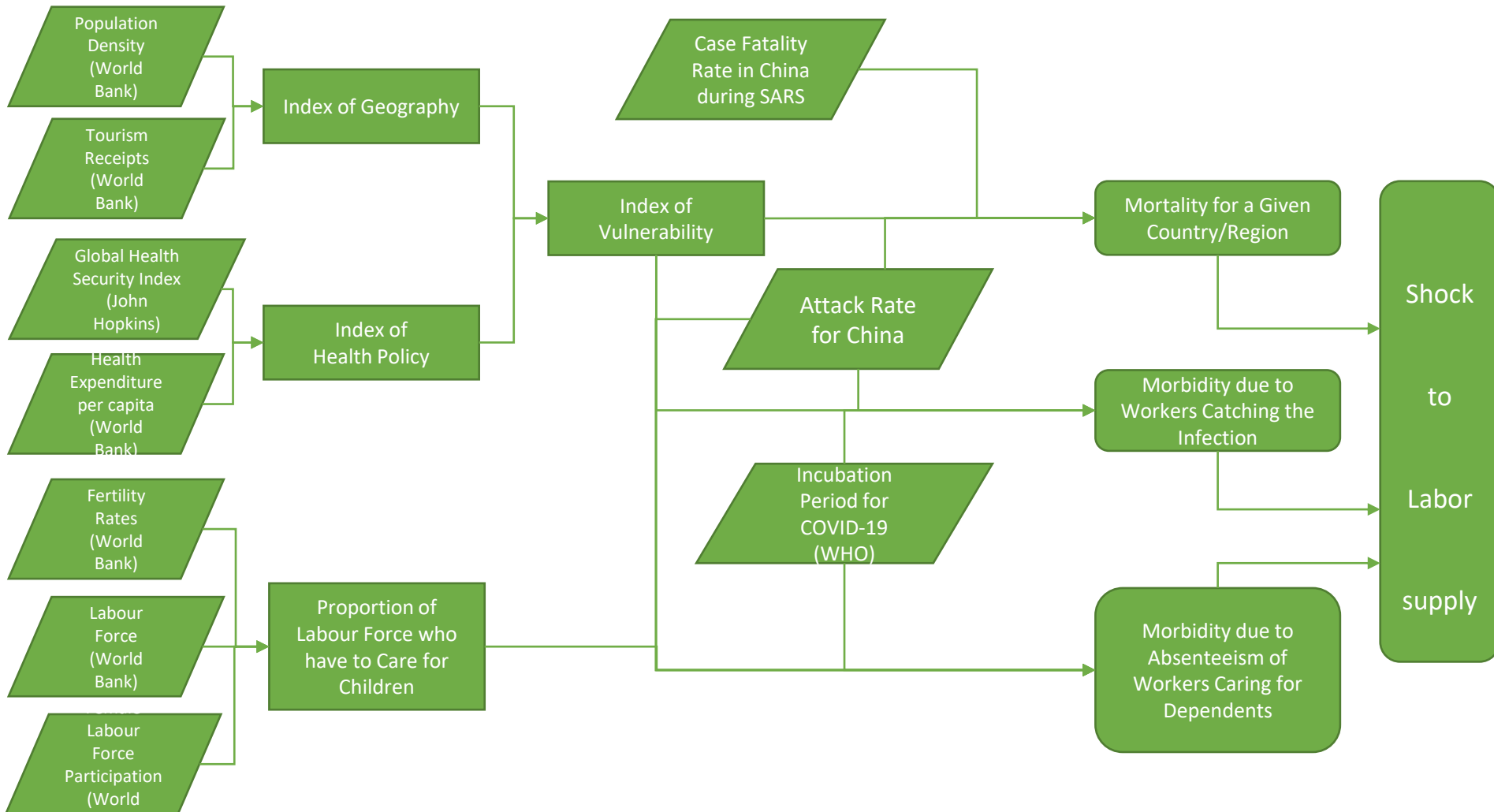


Figure 1 - Index of Geography relative to China

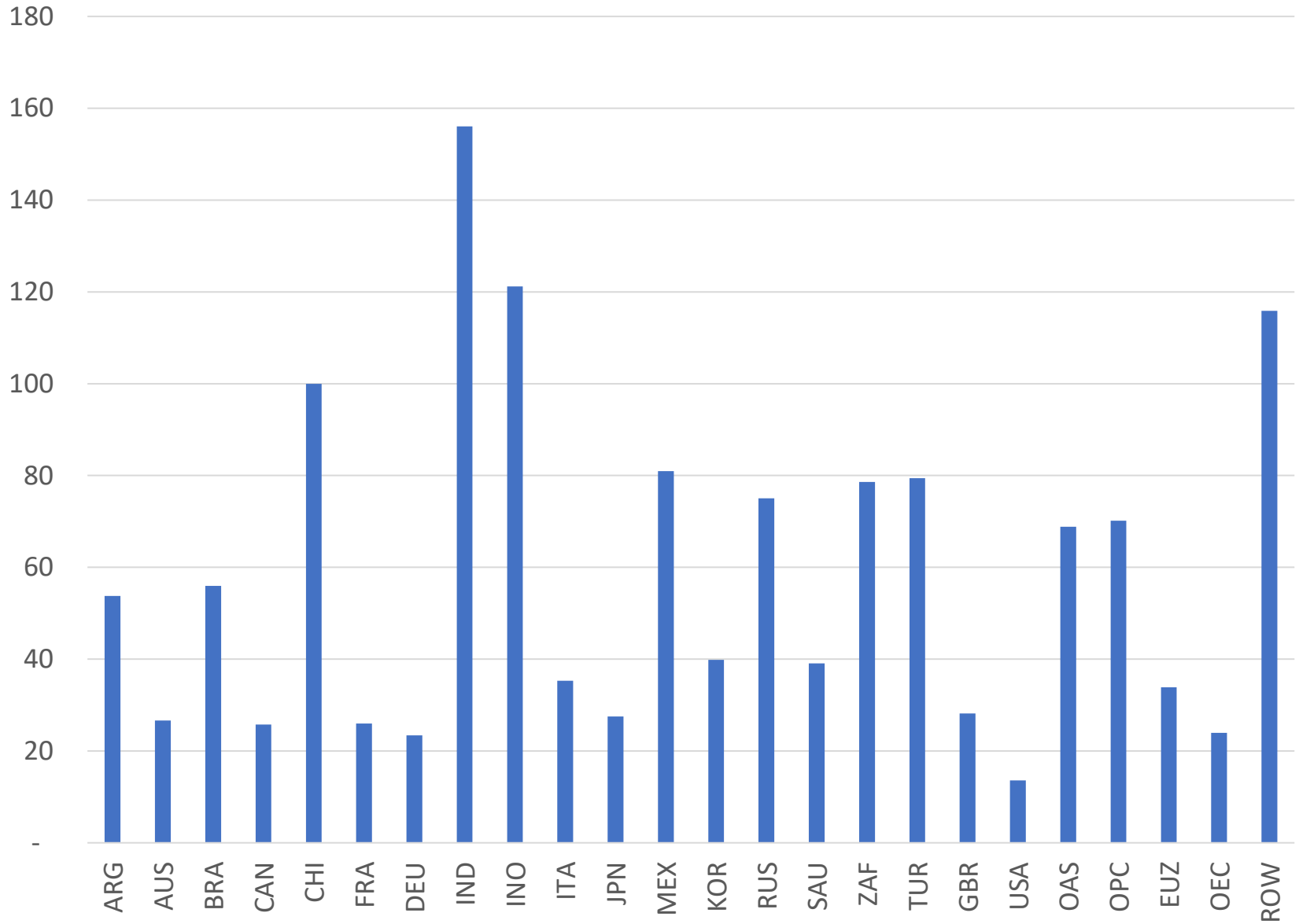
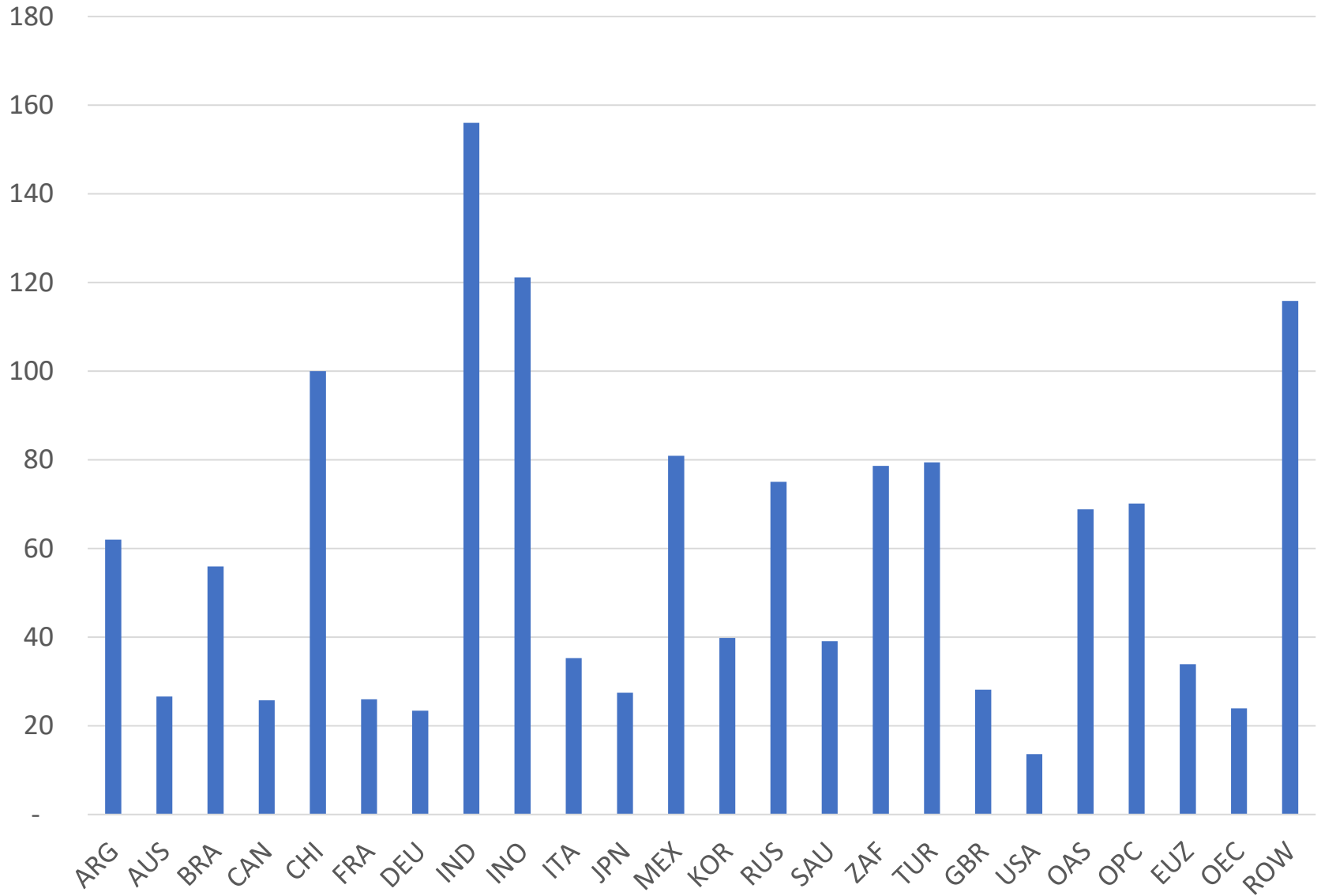


Figure 2 - Index of Health Policy relative to China

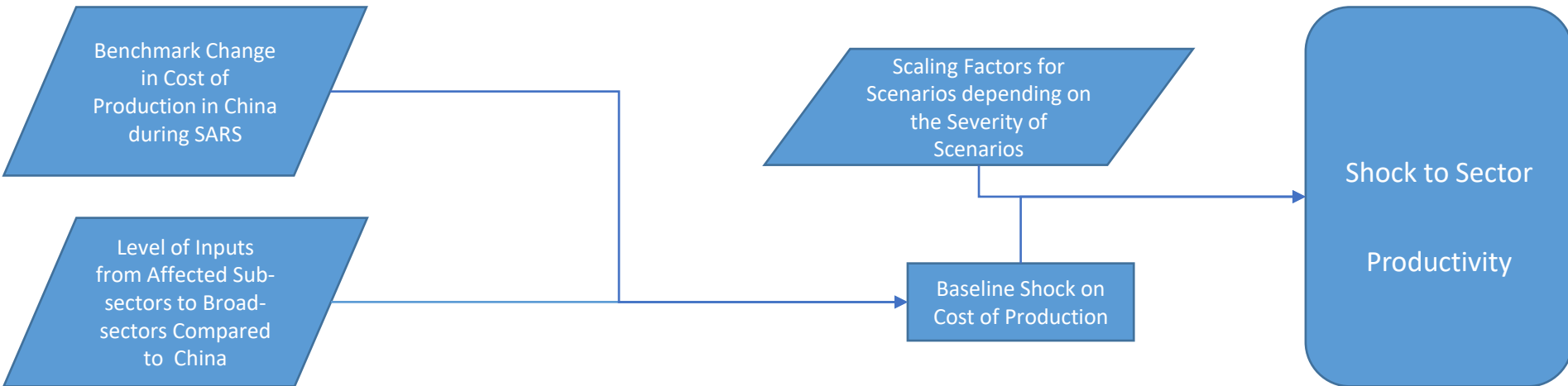


Indexes to create the additional
economic shocks

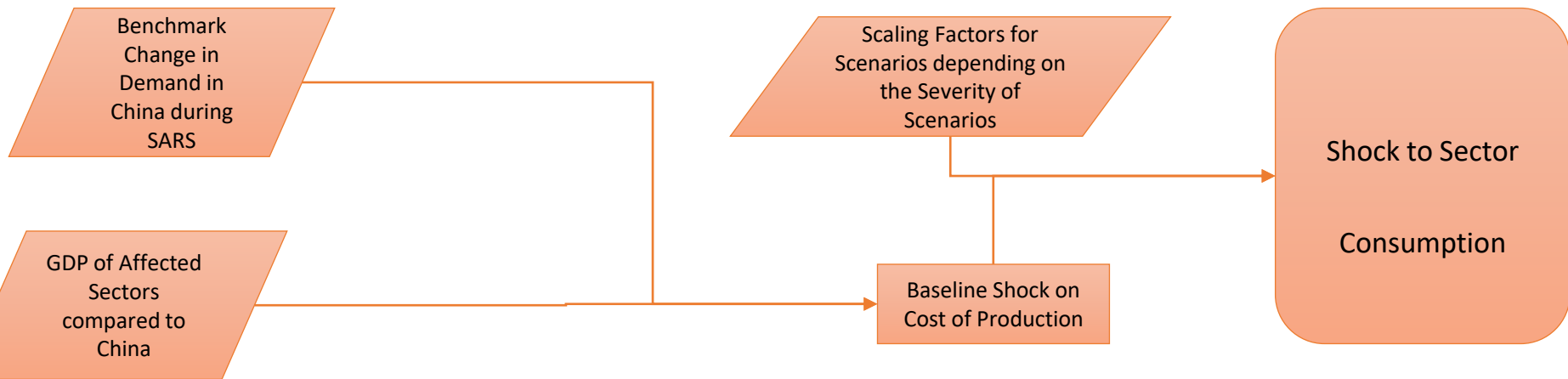
All shocks

- Reduced labor supply
- Increase costs of doing business (negative TFP)
- Increase in equity risk premium
- Change in consumption preferences

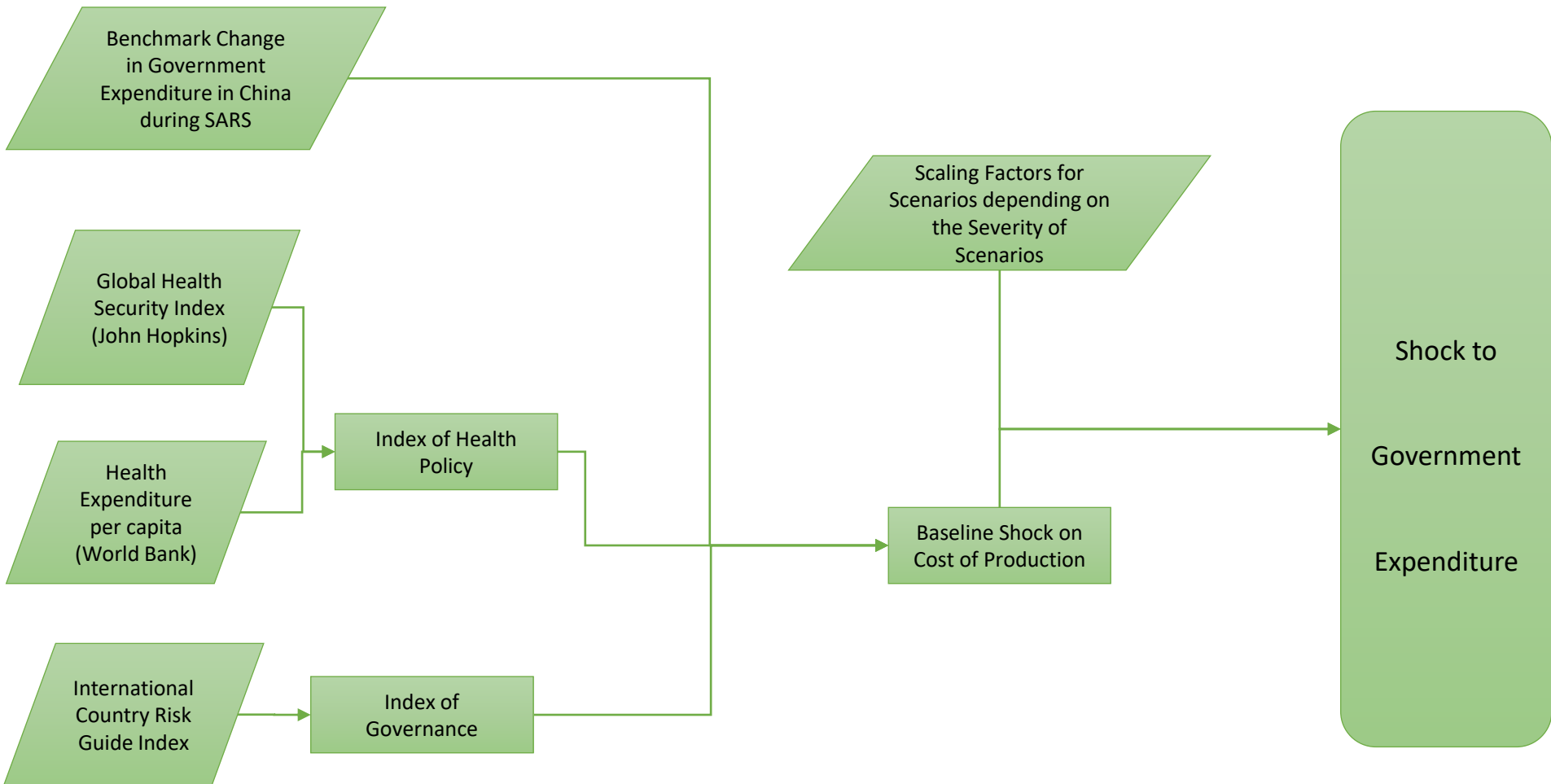
Sectoral Productivity/cost shock



Shock to consumption preferences



Shock to Government Spending



Shock to Equity Risk Premia

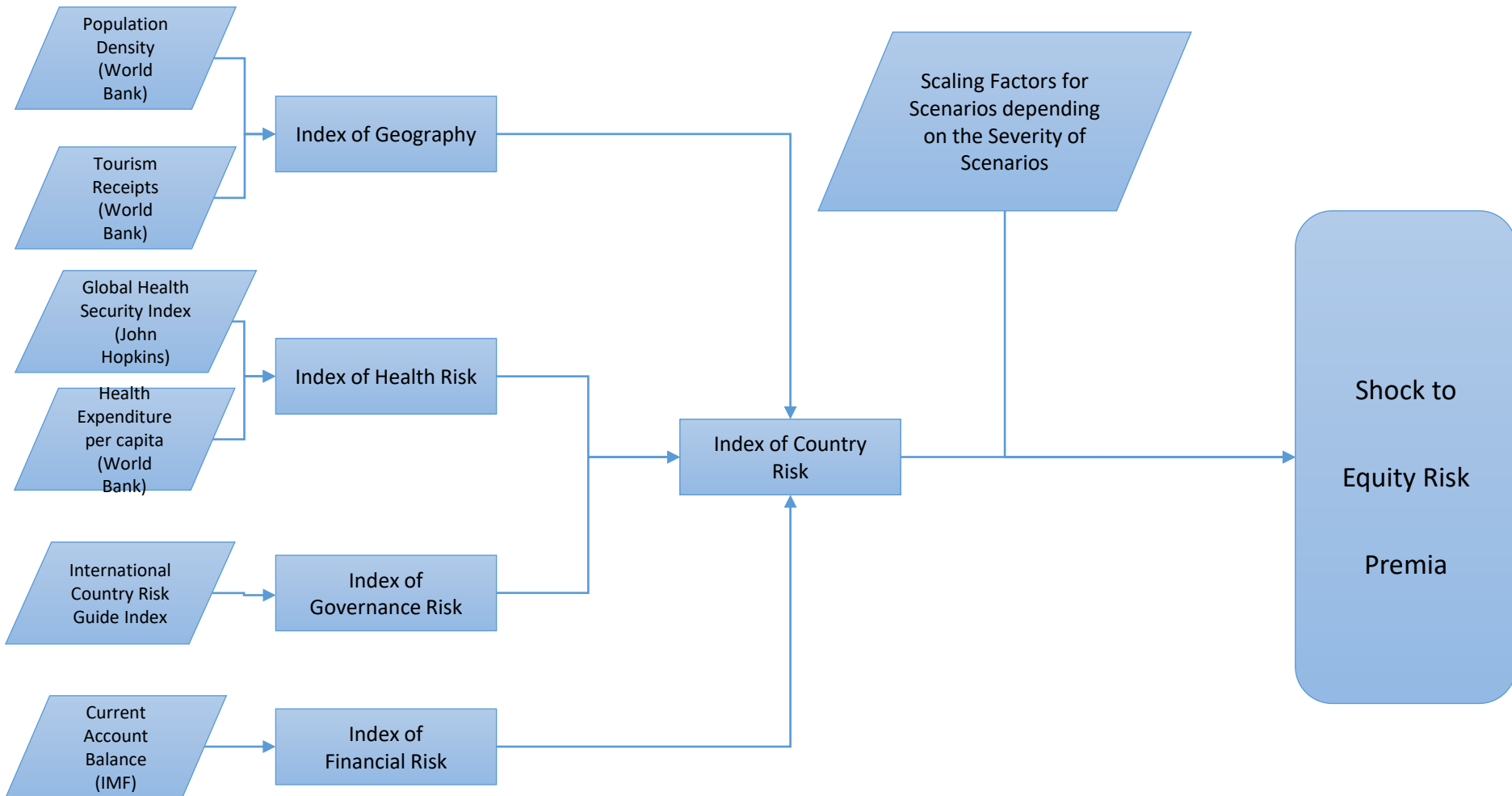


Figure 3 - Index of Governance relative to the US

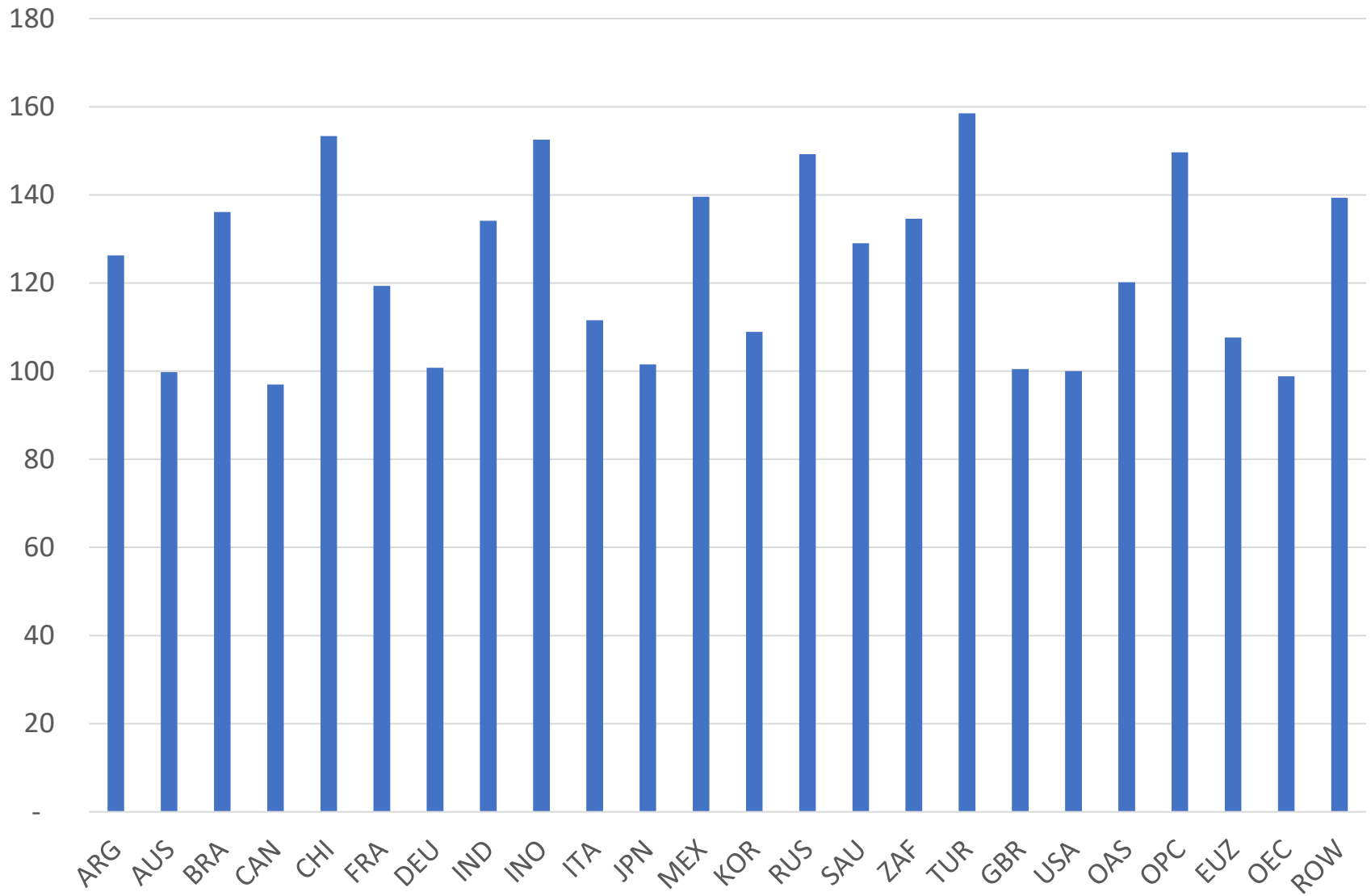


Figure 4 - Index of Financial Risk relative to the US

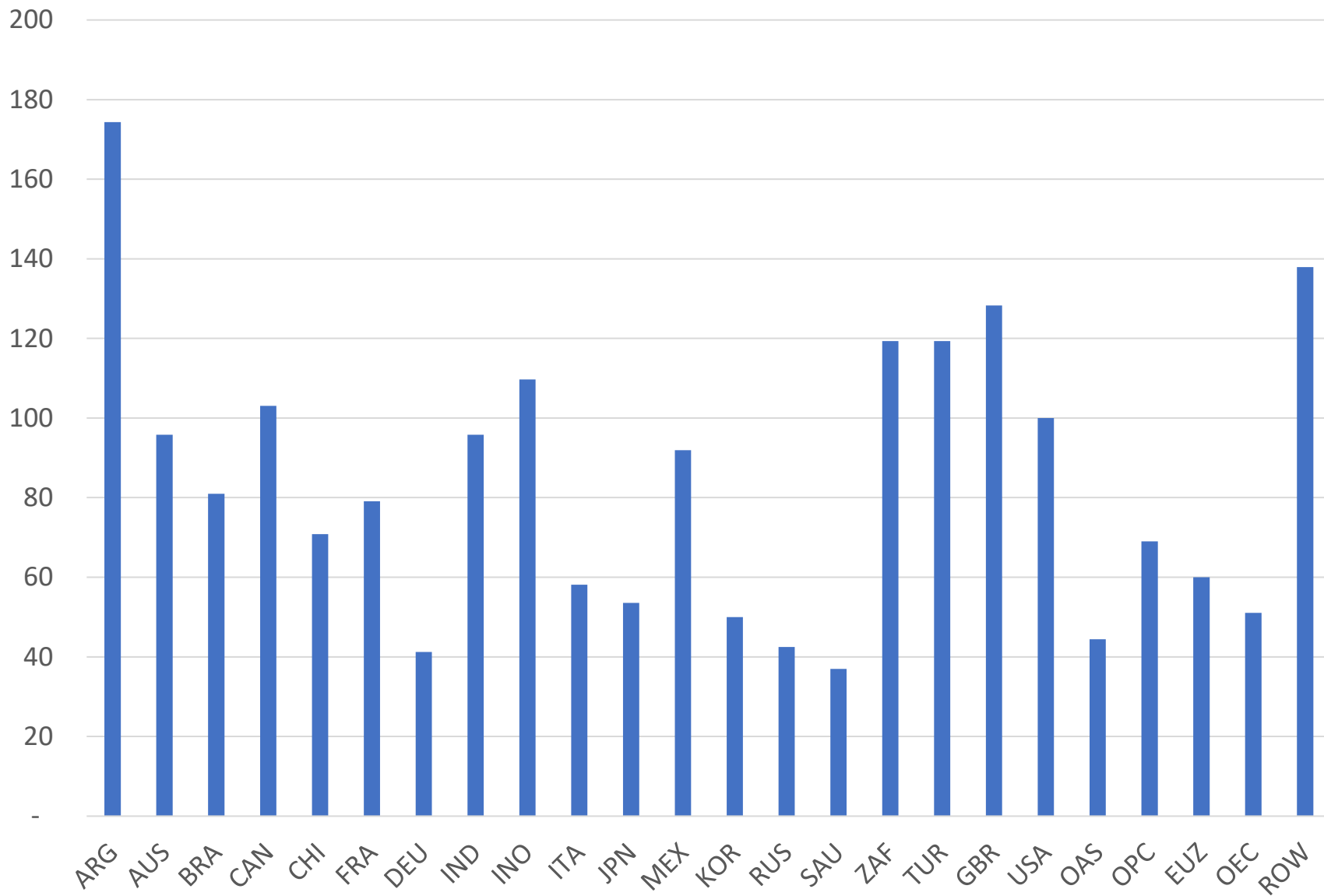


Figure 5 - Index of Health Policy relative to the US

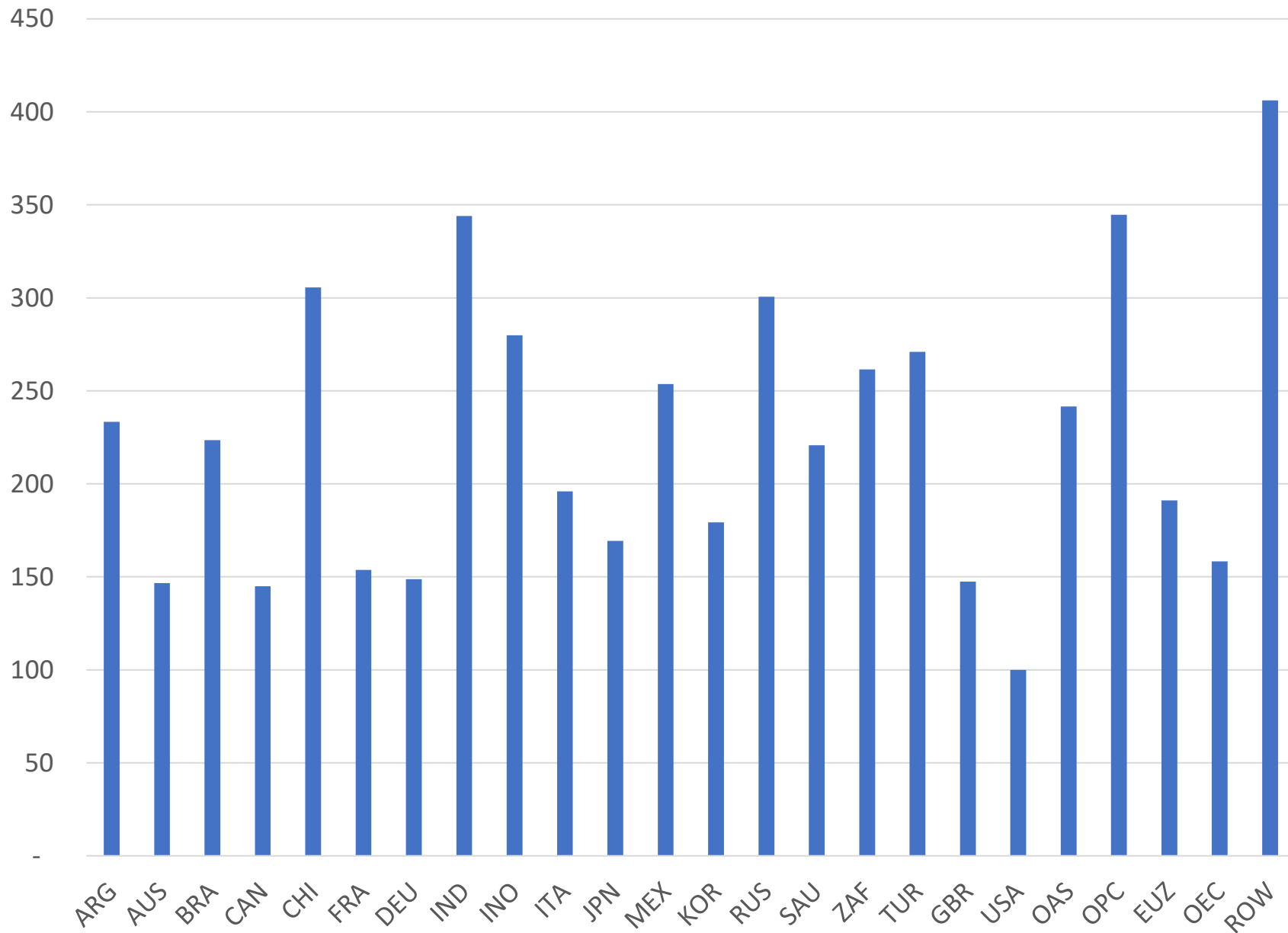
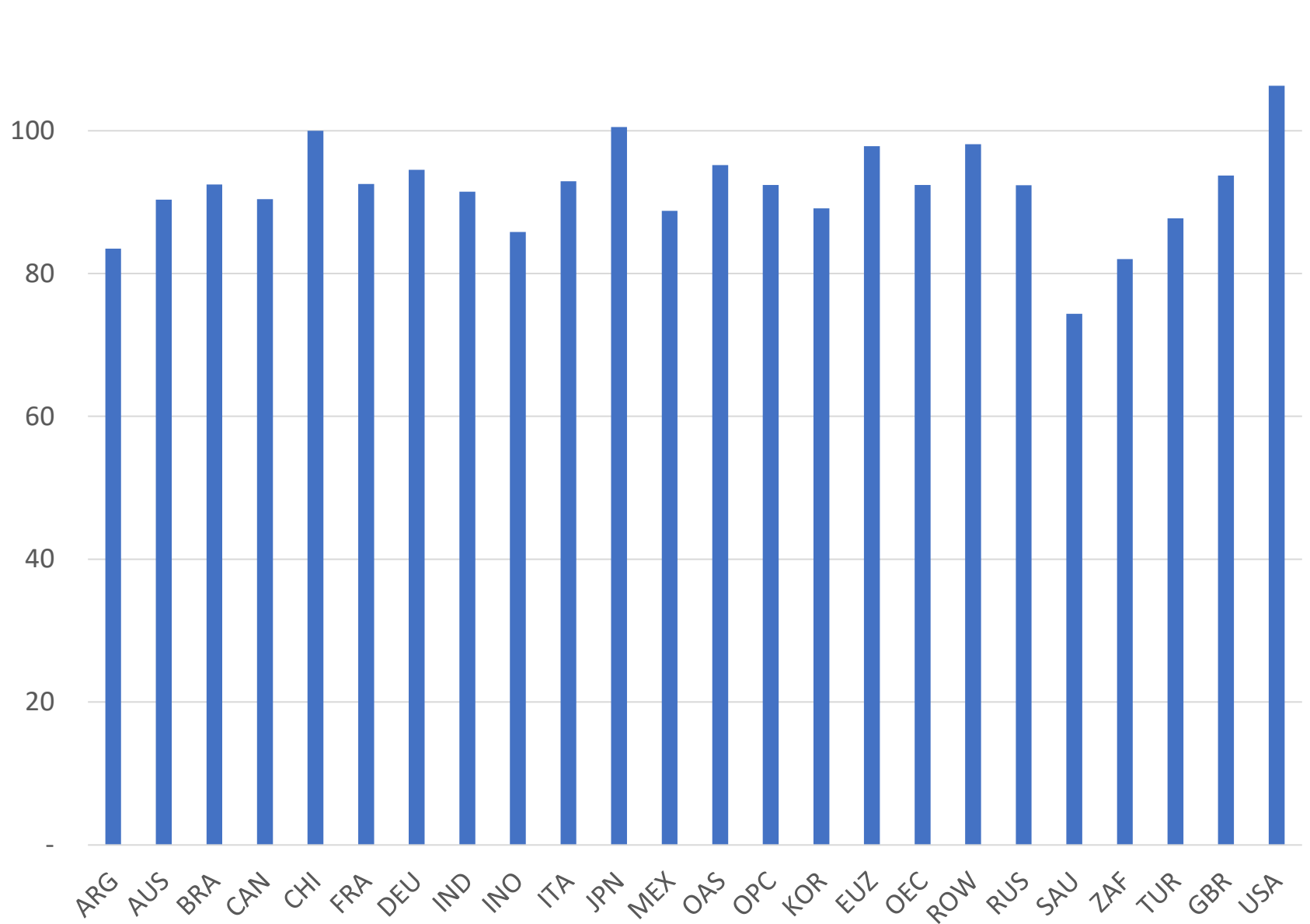


Figure 7 - Index of Sector Exposure to Exposed Activities



Results

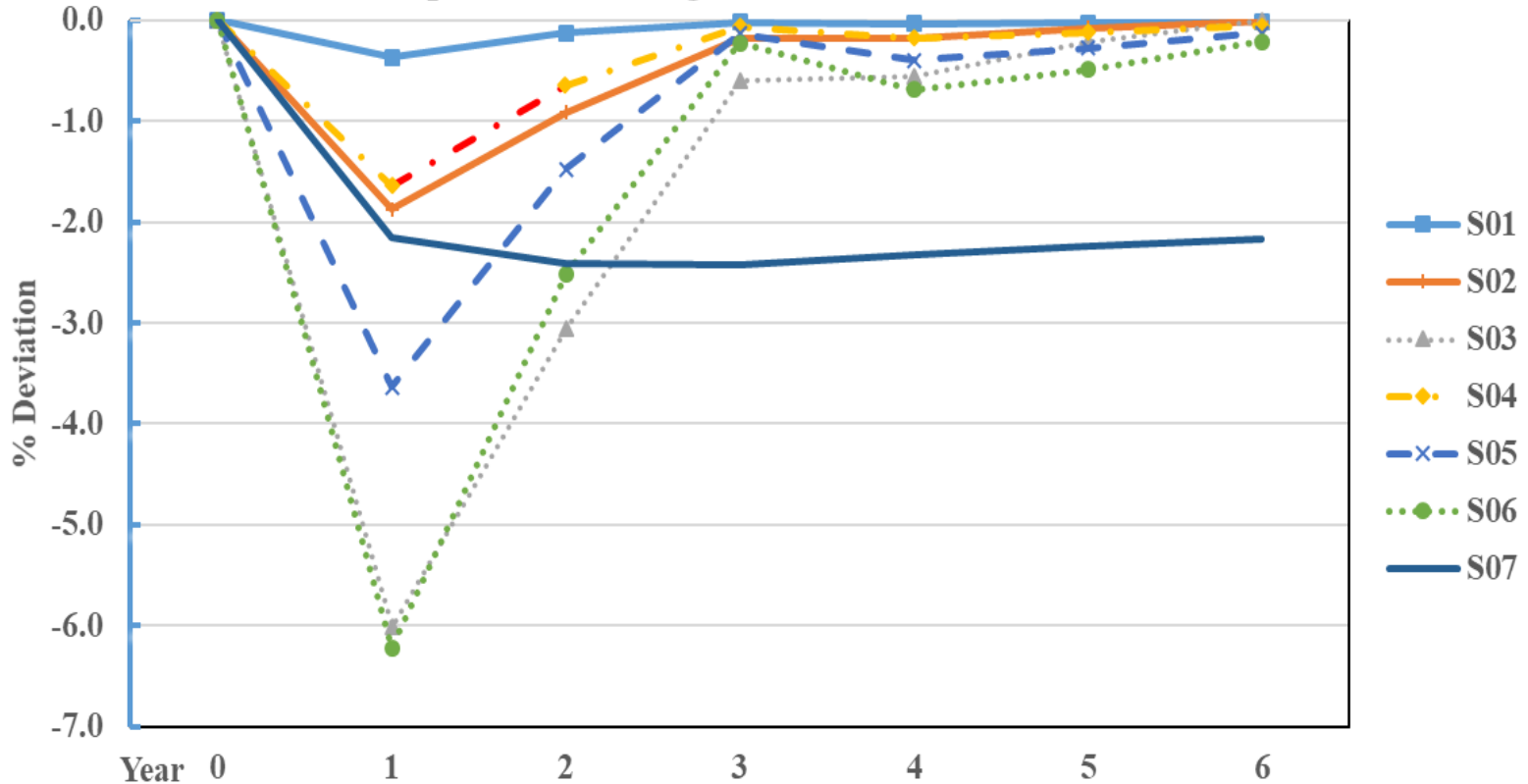
Table 9 – Impact on populations under each scenario

Country/Region	Population (Thousands)	Mortality in First Year (Thousands)						
		S01	S02	S03	S04	S05	S06	S07
Argentina	43,418	-	-	-	50	126	226	50
Australia	23,800	-	-	-	21	53	96	21
Brazil	205,962	-	-	-	257	641	1,154	257
Canada	35,950	-	-	-	30	74	133	30
China	1,397,029	279	3,493	12,573	2,794	6,985	12,573	2,794
France	64,457	-	-	-	60	149	268	60
Germany	81,708	-	-	-	79	198	357	79
India	1,309,054	-	-	-	3,693	9,232	16,617	3,693
Indonesia	258,162	-	-	-	647	1,616	2,909	647
Italy	59,504	-	-	-	59	147	265	59
Japan	127,975	-	-	-	127	317	570	127
Mexico	125,891	-	-	-	184	460	828	184
Republic of Korea	50,594	-	-	-	61	151	272	61
Russia	143,888	-	-	-	186	465	837	186
Saudi Arabia	31,557	-	-	-	29	71	128	29
South Africa	55,291	-	-	-	75	187	337	75
Turkey	78,271	-	-	-	116	290	522	116
United Kingdom	65,397	-	-	-	64	161	290	64
United States of America	319,929	-	-	-	236	589	1,060	236
Other Asia	330,935	-	-	-	530	1,324	2,384	530
Other oil producing countries	517,452	-	-	-	774	1,936	3,485	774
Rest of Euro Zone	117,427	-	-	-	106	265	478	106
Rest of OECD	33,954	-	-	-	27	67	121	27
Rest of the World	2,505,604	-	-	-	4,986	12,464	22,435	4,986
Total	7,983,209	279	3,493	12,573	15,188	37,971	68,347	15,188

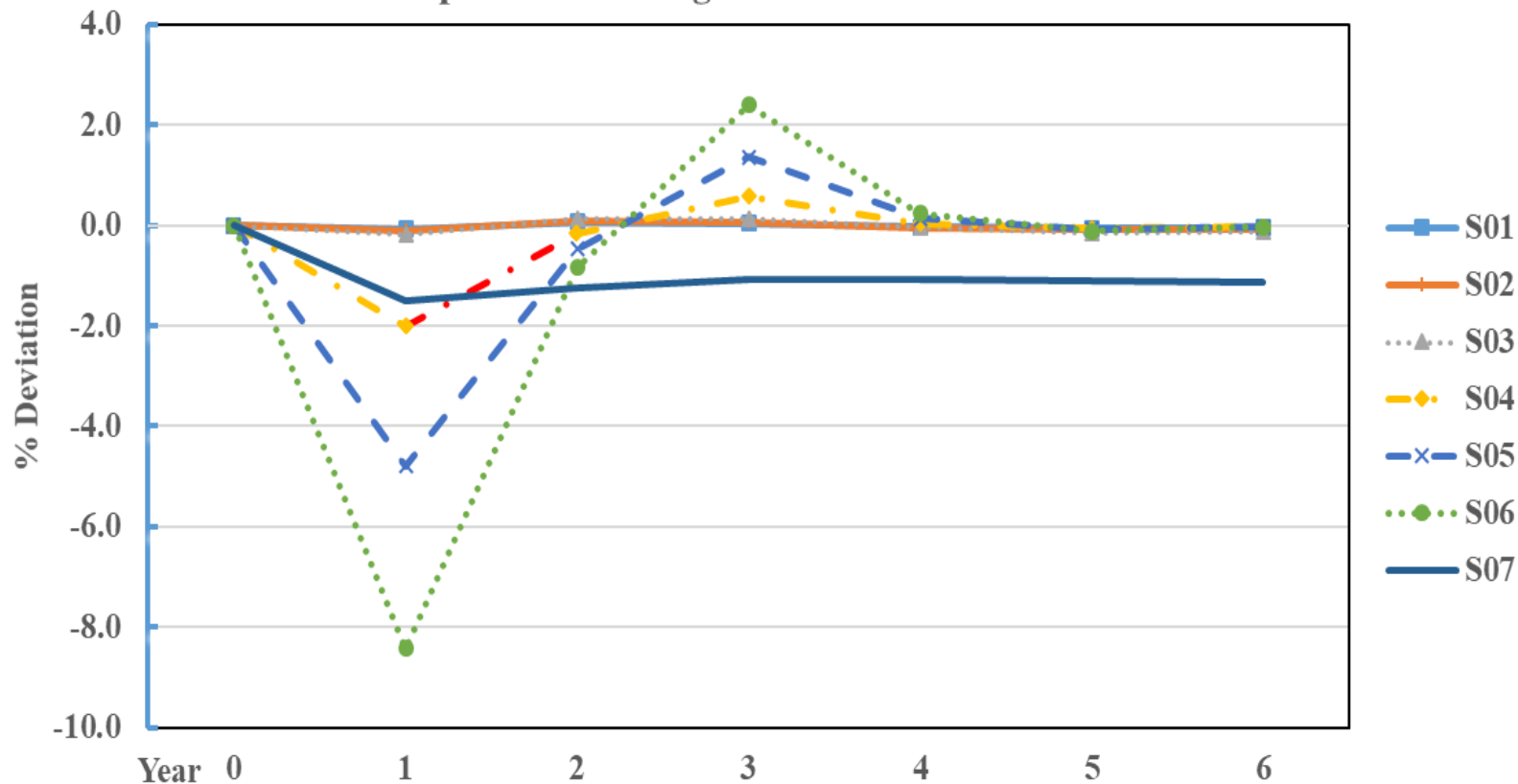
Table 10 - GDP loss in 2020 (% deviation from baseline)

Country/Region	S01	S02	S03	S04	S05	S06	S07
AUS	-0.3	-0.4	-0.7	-2.1	-4.6	-7.9	-2.0
BRA	-0.3	-0.3	-0.5	-2.1	-4.7	-8.0	-1.9
CHI	-0.4	-1.9	-6.0	-1.6	-3.6	-6.2	-2.2
IND	-0.2	-0.2	-0.4	-1.4	-3.1	-5.3	-1.3
EUZ	-0.2	-0.2	-0.4	-2.1	-4.8	-8.4	-1.9
FRA	-0.2	-0.3	-0.3	-2.0	-4.6	-8.0	-1.5
DEU	-0.2	-0.3	-0.5	-2.2	-5.0	-8.7	-1.7
ZAF	-0.2	-0.2	-0.4	-1.8	-4.0	-7.0	-1.5
ITA	-0.2	-0.3	-0.4	-2.1	-4.8	-8.3	-2.2
JPN	-0.3	-0.4	-0.5	-2.5	-5.7	-9.9	-2.0
GBR	-0.2	-0.2	-0.3	-1.5	-3.5	-6.0	-1.2
ROW	-0.2	-0.2	-0.3	-1.5	-3.5	-5.9	-1.5
MEX	-0.1	-0.1	-0.1	-0.9	-2.2	-3.8	-0.9
CAN	-0.2	-0.2	-0.4	-1.8	-4.1	-7.1	-1.6
OEC	-0.3	-0.3	-0.5	-2.0	-4.4	-7.7	-1.8
OPC	-0.2	-0.2	-0.4	-1.4	-3.2	-5.5	-1.3
ARG	-0.2	-0.3	-0.5	-1.6	-3.5	-6.0	-1.2
RUS	-0.2	-0.3	-0.5	-2.0	-4.6	-8.0	-1.9
SAU	-0.2	-0.2	-0.3	-0.7	-1.4	-2.4	-1.3
TUR	-0.1	-0.2	-0.2	-1.4	-3.2	-5.5	-1.2
USA	-0.1	-0.1	-0.2	-2.0	-4.8	-8.4	-1.5
OAS	-0.1	-0.2	-0.4	-1.6	-3.6	-6.3	-1.5
INO	-0.2	-0.2	-0.3	-1.3	-2.8	-4.7	-1.3
KOR	-0.1	-0.2	-0.3	-1.4	-3.3	-5.8	-1.3

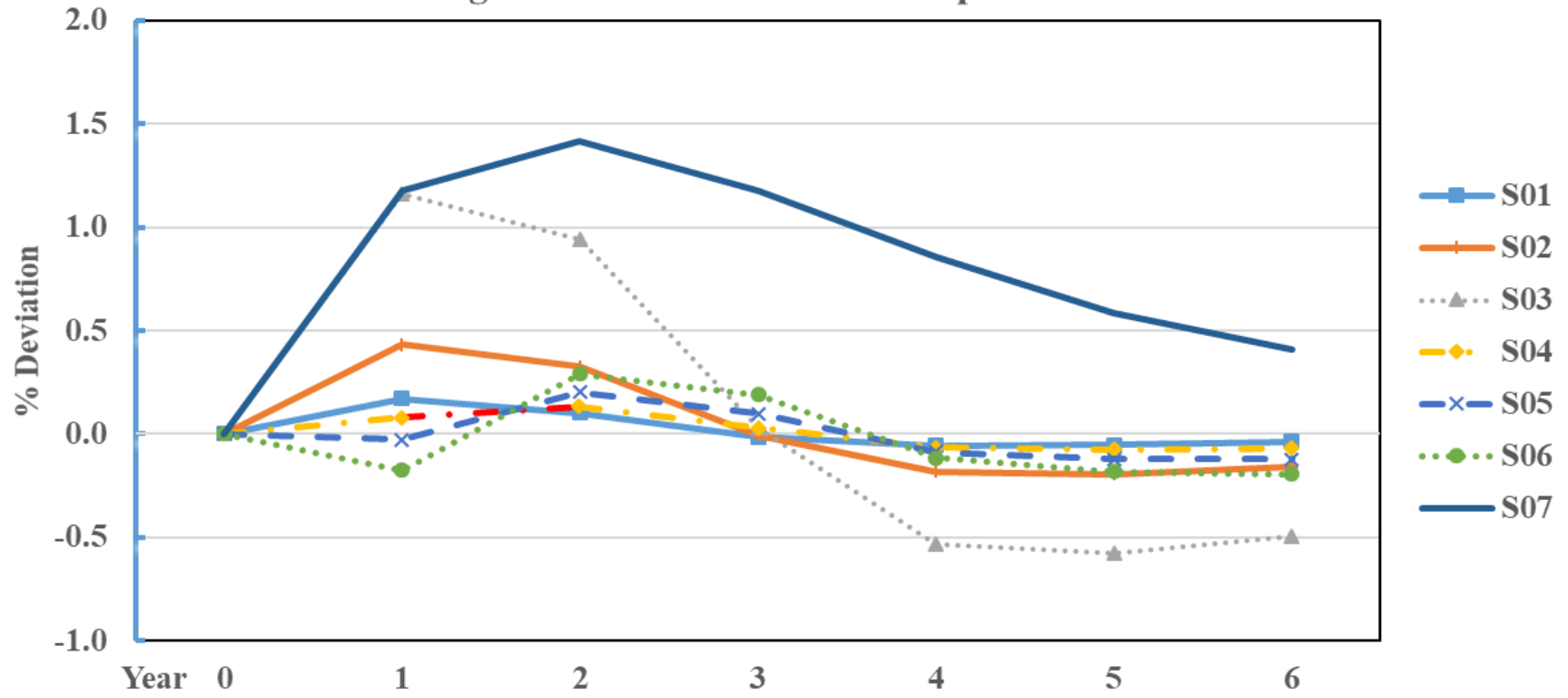
Proportional Change in Real GDP: China



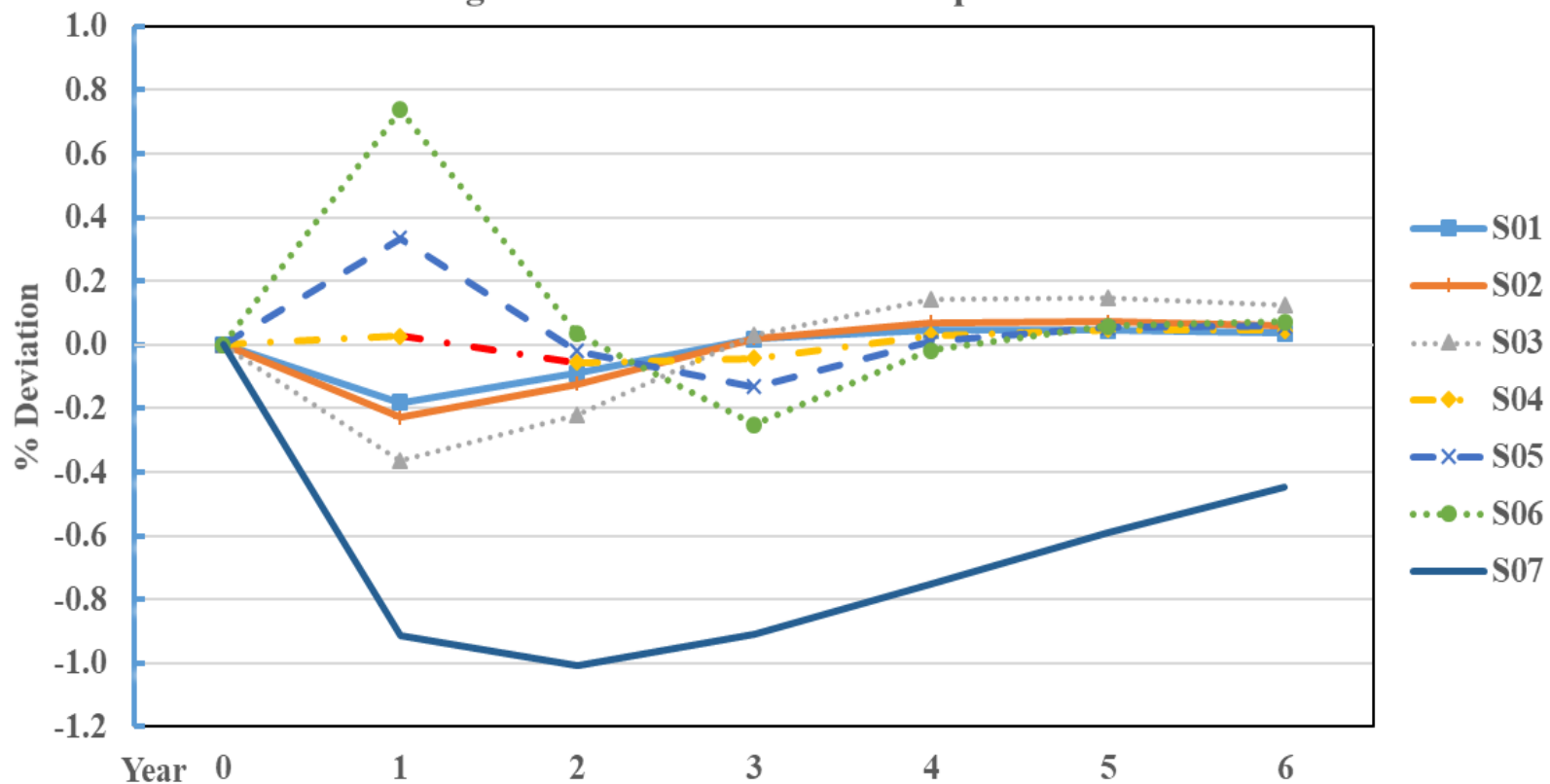
Proportional Change in Real GDP: USA



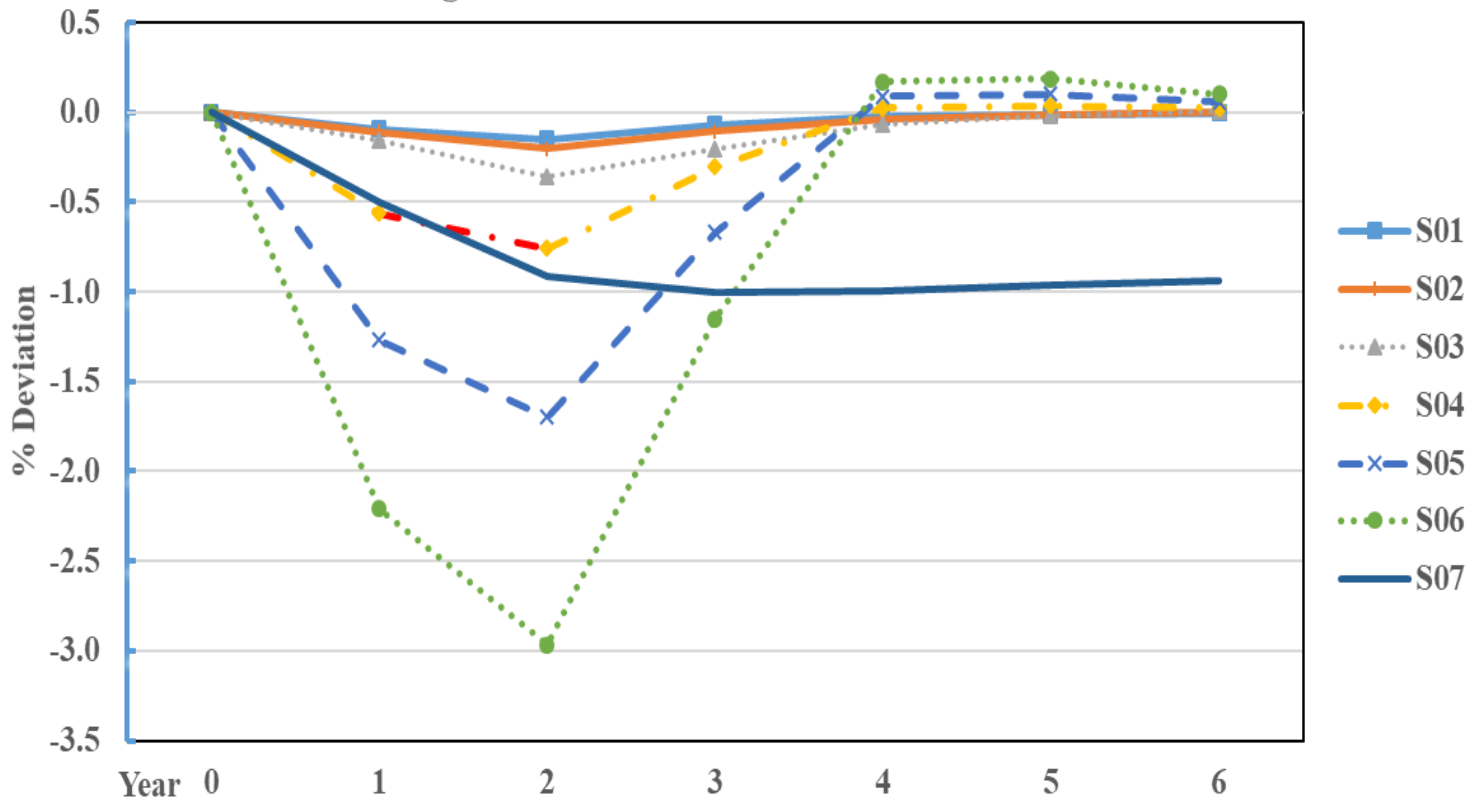
Change in Trade Balance as a Proportion of GDP: China



Change in Trade Balance as a Proportion of GDP: USA



Change in Short-term Real Interest Rate: USA



Subsequent studies

- McKibbin W. and R. Fernando (2020) “Global Macroeconomic Scenarios of the COVID-19 Pandemic” COVID Economics: Vetted and Real-Time papers, vol 39. Centre for Economic Policy Research, London. Issue 39, pp 1-58.
- Used data as of 20 May 2020
 - » Incorporated actual epidemiological data as of 20 May, 2020
 - » Estimated pandemic waves based on data to 20 May 2020
 - » Incorporated shutdowns and scenarios of recurring waves including a possible vaccine in 2021
 - » Incorporated actual fiscal responses

Subsequent studies

- Fernando R. and W. McKibbin (2021) “Macroeconomic Policy Adjustments due to COVID-19: Scenarios to 2025 with a focus on Asia” in Beirne, J. P. J. Morgan and Tetsushi Sonobe (eds) Covid-19 Impacts And Policy Options: An Asian Perspective. Asian Development Bank Institute, Series on Asian and Pacific Sustainable Development. Tokyo. Pp 399-472.
- Used data as of December 2020
 - » Incorporated actual epidemiological data as of December
 - » Incorporated shutdowns and recurring waves
 - » Updated actual fiscal responses

Summary

- Failure to Act even in the case of a relatively mild pandemic can lead to very large economic costs.
- Countries have a small window to stop the pandemic from spreading
- Most of the economic loss is due to behavioral changes in response to the pandemic
- In the first study we didn't model shutdowns or mandated closures but adding this increased the costs but most costs due to behavior changes.

Further information on G-Cubed

www.gcubed.com