ECONOMIC AND SOCIAL SURVEY OF ASIA AND THE PACIFIC 2021
Towards Post-COVID-19 Resilient Economies

Online Annexes

Annex I – Estimating the short-term impact of the COVID-19 pandemic on poverty in Asia and the Pacific

Annex II – Learning from past crises and recoveries: estimating the economic, social, and environmental impacts of financial crises, terms-of-trade shocks, natural disasters and epidemics in Asia and the Pacific

Annex III – Selected COVID-19 policy responses that help build forward better

Annex IV – The macroeconomic model

Annex V – The "business-as-usual" level of spending: a back-of-the-envelope calculation

Annex VI – Public debt sustainability analysis: scenarios, stress tests and contingent liabilities

Annex I
Estimating the short-term impact of the COVID-19 pandemic on poverty in Asia and the Pacific

Several studies have estimated increases in income poverty induced by the COVID-19 pandemic. Because poverty estimates usually lag behind several years due to data collection and processing time, this usually makes it difficult to provide a real-time analysis on poverty in order to evaluate the impact of crises. Poverty "nowcasting" and forecasting have been a common approach to obtain some early estimates of the impact. The basic intuition behind this is that poverty and national welfare aggregates, such as GDP per capita, are intertwined. Hence, current and forecast GDP per capita can serve as a primary input for real-time poverty estimates. Global estimates of the additional number of poor people caused by the COVID-19 pandemic usually rely on this concept.

Estimation by ESCAP of the impact of COVID-19 on income poverty in the Asia-Pacific region follows a similar approach, with refined treatment for Asia-Pacific least developed countries. Adapted from Tateno and Zoundi (forthcoming), this annex reviews commonly used methods for poverty "nowcasting" and provides a summary of the global estimates available on the impact of COVID-19 on income poverty. It then presents the ESCAP approach and modifications introduced to better capture the poverty impact on Asia-Pacific least developed countries, followed by some brief concluding remarks.

Methodological approaches to measuring poverty

Three common methods are applied for real-time poverty estimations (Caruso and others, 2017).

- *Poverty-growth Elasticity (PE)*
  The PE method has often been used by the World Bank (2016) for forecasting poverty. Assuming a sequence in the nomenclature of periods (–2, –1 and 0),[1] the basic concept about PE is to compute the elasticity of poverty-to-GDP per capita between periods –2 and –1 and use that elasticity to estimate poverty in current period 0.

  Let y_i^t equal the total household per capita income in time t, and z the poverty line below which a household is considered poor. Poverty *pov*(y^t) is a function of per capita income and is defined as the proportion of population with household income lower than z; g^t is the GDP per capita in time t; $g_r^{[t-1;t]}$ is the real GDP per capita growth rate between t and t-1; and $\varepsilon^{[t-1;t]}$ is the GDP per capita growth elasticity of poverty between t and t–1. Poverty in current moment 0 is estimated as follows:

[1] As poverty data usually come with large gaps, the nomenclature of period here does not necessarily imply that –2, –1 and 0 are adjacent or subsequent. They are considered in chronological order.

$$pov(y^0) = pov(y^{-1}) * \left(1 + \varepsilon^{[-1;0]} * g_r^{[-1;0]}\right) \quad (1)$$

$\varepsilon^{[-1;0]}$ is unknown because it uses the poverty information in current time 0. To obtain an approximation of $\varepsilon^{[-1;0]}$, poverty elasticity is assumed unique and non-stochastic over time for any poverty measures. This means that the elasticity between −1 and −2 can be used as an approximation for $\varepsilon^{[-1;0]}$. Equation (1) becomes:

$$pov(y^0) = pov(y^{-1}) * \left(1 + \varepsilon^{[-2;-1]} * g_r^{[-1;0]}\right) \quad (2)$$

The accuracy of PE depends on that of GDP per capita and how similar are $\varepsilon^{[-2;-1]}$ and $\varepsilon^{[-1;0]}$.

- *Neutral Distribution Growth (NDG)*
  In the NDG approach, all households' incomes are assumed to be identically affected by GDP per capita growth. However, as GDP per capita is derived from GDP, which encompasses more macroeconomic information unlike households' income, there should be an adjustment factor — denoted as passthrough — between the two. If θ is the passthrough of GDP per capita to survey household income, the poverty estimates in current period 0, according to the NDG method, is derived from:

  $$\tilde{y}_{ig}^0 = y_i^{-1}\left(1 + \theta * g_r^{[-1;0]}\right) \quad (3)$$

  Where $\tilde{y}_{ig}^0$ is household i's income in current time 0 and $pov(\tilde{y}_{ig}^0)$ is the corresponding poverty rate. One of the differences between PE and NDG is that the latter uses household-level microdata — reflected in the subscript *i* — while the former uses aggregated GDP per capita and poverty indicators. The accuracy of poverty estimate using the NDG approach depends on the quality of GDP per capita estimate, the level of similarity of income growth across household (the more similar the more accurate is the poverty estimate), and the level of knowledge about the passthrough. A passthrough of 0.87 has been used by the World Bank (2015) in its global poverty estimate.

- *Quantile Growth Contribution (QGC)*
  QGC assumes a heterogeneity of growth rate along households' income distributions, unlike NDG. In the estimation procedure, households' income is sorted and grouped into quantiles q. The method follows two steps.

  The first step is to estimate the total income of quantile q in current period 0. Given that households' income is sorted and grouped into quantiles q, the total growth of the economy between periods t and t−1 obtained by summing the growth of all quantiles q.

  $$\Delta Y^{[t-1;t]} = \sum_{q=1}^{Q}\left(r_q^{[t-1;t]} * Y_q^{t-1}\right) \quad (4)$$

Where Y^t is the total income of the economy; Y_q^t is total income of quantile q in time t; and $r_q^{[t-1;t]}$ is the quantile q's total income growth rate between t and t–1.

Since the contribution of each quantile to total growth for the current period is unknown, it is assumed to be identical to the preceding period. In denoting S_q as the contribution of quantile q to total income growth, this means that $S_q^{[-1;0]} = S_q^{[-2;-1]}$

The total income of quantile q in current period 0, $\hat{Y}_q^0$ can be specified as follows:

$$\hat{Y}_q^0 = S_q^{[-2;-1]} * \Delta Y^{[-1;0]} + Y_q^{-1} \quad (5)$$

The second step is the estimation of the distribution of $\hat{Y}_q^0$ across households i belonging to quantile q. One way of achieving this is to assume that the amount of income received by every household is a function of their share in the total income within their quantile in period –1.

$$\hat{y}_{iq}^0 = \frac{y_{iq}^{-1}}{Y_q^{-1}} * \hat{Y}_q^0 \quad (6)$$

Replacing $\hat{Y}_q^0$ by its expression in (5)

$$\hat{y}_{iq}^0 = \frac{y_{iq}^{-1}}{Y_q^{-1}} \left(S_q^{[-2;-1]} * \Delta Y^{[-1;0]} + Y_q^{-1} \right) \quad (7)$$

If the growth rate $r_q^{[t-1;t]}$ is the same for all quantiles, $\Delta Y^{[-1;0]}$ in equation (7) can be simplified under the NDG hypothesis to $\theta * g_r^{[-1;0]} * Y^{-1}$; in other words

$$\hat{y}_{iq}^0 = \frac{y_{iq}^{-1}}{Y_q^{-1}} \left(S_q^{[-2;-1]} * \theta * g_r^{[-1;0]} * Y^{-1} + Y_q^{-1} \right) \quad (8)$$

Note that both NDG and QGC are similar methodologies, but under different assumptions: homogeneity versus heterogeneity of income growth across households, respectively.

A review of global estimates on the impact of COVID-19 on income poverty

The analysis of the impact of the pandemic on poverty has mostly been based on the concept of GDP passthrough to income as in NDG and as in Aguilar, Mahler, and Newhouse (2019). There are also other variants and extensions to improve the accuracy of estimates, such as computational general equilibrium model (Laborde, Martin, and Vos, 2020) or machine learning algorithms (Lakhner and others, 2020). Some of the global estimates are summarized in the table below.

Table A1
Global estimates

Author(s)	Sample	Methodology	Example of key findings	
Andy Sumner, Chris Hoy and Eduardo Ortiz-Juarez (UNWIDER)	164 countries	Neutral Distribution Growth (NDG) and a scenarios analysis: low, medium and high global contractions of per capita income (5, 10 and 20 per cent respectively). Estimation using PovcalNet	**5 per cent contraction in per capita incomes** $1.90/day : *+ 80 million* more poor $3.20/day : +*130 million* $5.50/day: Nearly *124 million* **20 per cent contraction in per capita incomes** $1.90/day: *420 million* more poor $3.20/day: *580 million* more poor $5.50/day: *520 million* more poor	**10 per cent contraction in per capita incomes** $1.90/day :*180 million* more poor $3.20/day: *280 million* more poor $5.50/day: *250 million* more poor **South Asia, $1.90/day line** 5 per cent contraction in per capita income: 52.5 per cent more poor 10 per cent contraction in per capita income: 52.8 per cent more poor 20 per cent contraction in per capita income: 54.9 per cent more poor
Giovanni Valensisi (UNWIDER)	164 countries	Neutral Distribution Growth (NDG)	**Less than $1.90:** *68 million* more poor in 2020 alone, globally.	**East Asia and the Pacific** $1.90/day: 4 per cent more poor $3.20/day: 19 per cent more poor $5.50: 42 per cent more poor
David Laborde, Will Martin, and Rob Vos (IFPRI)	140 regions/ countries 285,000 sample households Sample includes 65 per cent of the world's extreme poor	MIRAGRODEP CEG model (and POVANA household dataset and model. Scenarios base	World: 20 per cent or *148 million* additional poor people, at $1.90 South Asia: 15 per cent or *42 million* additional poor people at $1.90	
Christoph Lakner, Daniel Gerszon Mahler, Mario Negre, Espen Beer Prydz (World Bank)	166 countries	Estimation of the impact of COVID-19 using household survey data and growth projections. Machine learning algorithms Modelling the impact of changes in the Gini index on poverty. Projection until 2030	The pandemic-induced global new poor is estimated to be between 119 million and 124 million in 2020. In 2021, the number of additional poor is set to rise to between 143 million and 163 million (preliminary update -A as of January 2021).	
UNCTAD	47 least developed countries	Valensisi (2020) approach (see above)	Global least developed countries: Additional 32 million people will be driven into absolute poverty in least developed countries	

Asian Development Bank **(ADB)**	34 ADB developing countries	A combination of the Global Trade Analysis Project (GTAP) simulation and a scenario analysis.	Extreme poverty line ($1.90/day) - 5 per cent reduction in annual per capita consumption expenditure: an additional 34 million poor - 10 per cent: additional 78 million - 20 per cent: additional 185 million For the GTAP long containment scenario, the number of poor will increase by about 56 million for $1.90/day and 140 million for $3.20/day.
Benoit Decerf, Francisco H. G., Ferreira Daniel G. and Mahler Olivier Sterck (World Bank)	150 countries	Lakner (2020) approach (see above). Different GDP data source, and usage of the World Bank's income class poverty thresholds rather than national poverty thresholds.	At least 68 million additional people thrust into poverty.
Pardee Center for International Futures and UNDP	186 countries	Scenarios analysis using the International Futures tools developed by the Fredrick S. Pardee Center (University of Denver)	Baseline scenario - Additional 94 million poor in 2020. - Extreme poverty by 2030: 905 million High damage scenario: - Additional 207 million people fall into poverty in 2030 on top of those under the Baseline scenario - Extreme poverty by 2030: more than 1 billion “Sustainable Development Goals push” scenario - Targeted intervention would cut the number of people in extreme poverty by 146 million in 2030 relative to current COVID-19 trends and by 340 million by mid-century
World Economic Situation Prospects 2021 (United Nations)	176 countries	World Economic Forecasting Model of the United Nations	The total number of people living in poverty is expected to have increased by 131 million in 2020 alone.

There is no doubt that poverty estimates have shed some light on policy interventions for mitigating the impact of the pandemic. However, the large difference between estimates can raise some concerns as to how far one is getting from the “true” number of poor thrust into poverty. Some of the shortcomings of current estimates are underscored by the authors, which include:

- A high number of assumptions
- Consumption assumed to expand at the same rate as GDP per capita
- The transmission channel focuses only on income. The effects of economic contractions are distribution neutral and do not consider important channels (such as inequality and employment) or regional context (such as least developed countries or emerging economies)
- The distribution of income across households is assumed to be homogeneous and unchanged
- No distinction is made between rural and urban poverty, yet the pandemic has proven to be more pronounced in urban settings
- Policy interventions, such as social protection and cash transfers adopted by most Governments, are usually neglected

- The identical GDP-to-households-income passthrough ratio of 0.87 often used can overestimate or underestimate the impact on income poverty depending on circumstances.

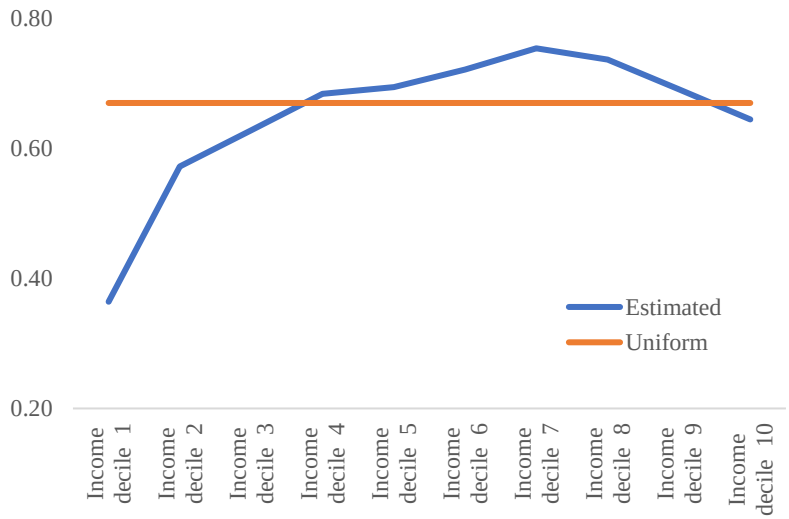
ESCAP approach and results

The estimation by ESCAP on the income poverty impact of the COVID-19 pandemic in Asia and the Pacific sought to address some of the above shortcomings and is based on extended versions of QGC and NCG, given the requirement of both the breadth and the depth of data (i.e. the diversity of potential drivers and the heterogeneity of the sample, respectively).

The primary focus is QGC. As mentioned previously, QGC has the advantage of capturing the heterogeneity among households by assigning different growth rates along the income distribution. This concept of heterogeneity among households is important, particularly for least developed countries, due to the high inequality in those countries; per capita GDP growth does not transmit to income at the same rate along different income deciles. In Bangladesh, for example, the poorest households benefit less from per capita growth compared to those belonging to the highest deciles (figure AI.1).

Figure AI.1

Estimated passthrough ratio from per capita GDP growth to income growth, by income decile, Bangladesh



Source: ESCAP estimation.

For countries for which income distribution data are available on PovcalNet, an extension of QGC is used. For other countries, the estimation is based on an extension of NDG.

The following modifications have been made:

- For the QGC approach, the rate of income growth $r_q^{[t-1;t]}$ is estimated at the decile level to better capture the income growth dynamics of the poor, especially the first (lowest) decile.

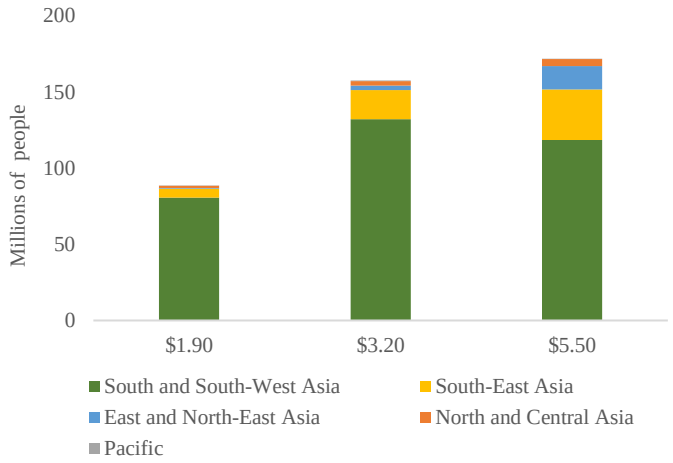
- For the NCG approach, the estimation of households mean income follows equation (3). The estimation of poverty is then approximated by the cumulative distribution function of the lognormal distribution, evaluated at the appropriate poverty benchmarks ($1.90, $3.20 and $5.50 a day) as in the ESCAP COVID-19 response model (ESCAP, 2020). Also, to allow for some distributional impact, inequality is treated as a function of employment and policy intervention, two important aspects of the pandemic. A 1 per cent increase in inequality and a 1.5 per cent increment in government fiscal interventions are assumed. The choice of 1.5 per cent is based on the fact that, while the actual policy interventions could have been higher than 1.5 per cent of GDP in most countries, the World Bank's survey revealed that public social assistance has been poorly targeted in most countries (Sánchez-Páramo and Narayan, 2020), which means that many households received zero or a fraction of the stimulus.

- A passthrough of GDP-to-income was re-estimated for a restricted sample of Asia-Pacific least developed countries, following the World Bank (2015) method. The estimated passthrough coefficient of 0.67 was much lower than the widely used coefficient of 0.87, but similar to the 0.65 used by Valensisi (2020) for the global least developed countries. For the NDG approach, the coefficient of 0.67 is applied for least developed countries, while for the QGC approach, the estimated rate of income growth for each decile is adjusted such that the passthrough of all deciles averages at 0.67.

The application of this framework to all Asia-Pacific developing countries finds that the pandemic could increase the poverty head count by 89 million at the $1.90-a-day poverty line, 158 million at the $3.20-a-day poverty line and 172 million at the $5.50-a-day poverty line by 2021. South Asia, India in particular, accounts for the bulk of this increase in poverty, as the subregion is among the worst affected (figure AI.2). The QGC model covers 18 countries and 55 per cent of the population, compared with the NDG coverage of 18 countries and 44 per cent of the population.

Figure AI.2

Number of people pushed back into poverty due to the COVID-19 pandemic, by subregion



Source: ESCAP estimation.

Concluding remarks

The COVID-19 pandemic has erased years of progress made by Asia-Pacific countries in poverty reduction; countries with a greater share of their population in poverty before the pandemic were more severely affected. The prolonged pandemic threat and lockdowns, increasing inequality and delays in economic recovery may push more people into poverty over time. The pandemic is also challenging Governments' financial capacities –– which was already tight prior to the pandemic –– in sustaining the essential support to the poor in the post-pandemic recovery phase.

The estimates on increases in income poverty in Asia and the Pacific as a result of the pandemic provide insights on the scale of the policy challenges ahead and point to the urgency of supporting an inclusive post-pandemic economic recovery. However, the current estimates are also severely constrained by the availability and quality of data on poverty, which in turn hampers better informed and better targeted policy interventions. Better data collection and timely monitoring of poverty, combined with more proactive poverty reduction efforts leveraging the improved information, would be needed to make up for the negative impact of COVID-19 and accelerate poverty reduction in the future.

Annex II

Learning from past crises and recoveries: estimating the economic, social, and environmental impacts of financial crises, terms-of-trade shocks, natural disasters and epidemics in Asia and the Pacific

Chapter 3 uses a local projection methodology (Jorda, 2005) which has been widely used in the recent literature as a flexible alternative that does not impose the dynamic restrictions embedded in vector autoregression (VAR) specifications.[2] It makes it possible to identify the effects of adverse shocks on GDP per capita and other indicators while controlling for endogeneity or reverse causation. With the use of interaction terms, this method can also help identify whether specific policies and other country characteristics are important and bolster recovery. A similar approach using interaction terms was taken in Cerra, Panizza and Saxena (2013) and Peter, Dahlen and Saxena (2012).

The baseline model is given by:

$$y_{i,t+h} - y_{i,t-1} = \alpha_i + \gamma_i + \beta_1^h E_{i,t} + \beta_2^h (E_{i,t} * P_{i,t}) + \theta M_{i,t} + \varepsilon_{i,t}$$

where y is log of the variable of interest (e.g. GDP per capita), α is country fixed effect, γ is time fixed effect, E is the identified shock (e.g. an epidemic event), P is the policy variable (e.g. government debt), and M is a set of control variables. The equation is estimated for each $h = 0, \ldots, 5$, where $h = 0$ is the year of the shock. Following previous studies, only the essential control variables have been kept.

Adverse shocks

Financial crises

Data for financial crises are based on the Laeven and Valencia (2018) database for the period 1960-2018. *Banking crises* are recorded as having started in a given year if one of the following three conditions are met: (a) the share of non-performing loans is above 20 per cent of total loans; (b) bank closures reach at least 20 per cent of banking system assets; or (c) the cost of restructuring of the banking system exceeds 5 per cent of GDP. *Currency crises* are defined to have occurred if the following two conditions are met simultaneously: (a) at least a 30-per cent depreciation of local currency (from a year earlier); and (b) the magnitude of the depreciation is at least 10 percentage points larger than occurred in the previous year. *Sovereign debt crises* are defined as the occurrence of a sovereign debt default or restructuring. In the case of a restructuring of public debt without default, the crisis year is the year of restructuring. *A rapid debt accumulation episode* is defined as an expansion from trough to peak of total debt-to-GDP ratios by more than one standard deviation, with troughs and peaks identified using the Harding and Pagan (2002) algorithm. Of these, the most frequent and yet relatively short-lived shocks are currency crises. In the main specification, currency events are not included; however, dummies for the 1997 Asian financial crisis are included as an exogenous variable.

[2] Results from estimating an AR(4) process as in Cerra and Saxena (2008) are similar to the local projections.

Terms-of-trade shocks

The source for the terms-of-trade series is the United Nations. Such a shock is defined as an unusual negative value for the (five-year) moving average annual percentage change of the series, following Funke, Granziera and Imam (2008). First, countries are classified by their dependence on the following commodities: agriculture, fuel and minerals. A specific threshold is then calculated for each country group based on the 25th percentile of the above distribution. A separate threshold is calculated for non-commodity exporters. This procedure pinpoints a negative shock for non-commodity exporters if the moving average annual change is below -10 per cent; for agricultural exporters, -7 per cent; for fuel exporters, -11 per cent; and for mineral exporters, -4 per cent.

Natural disasters

The source of the events labelled as natural disasters is the Emergency Events Database (EM-DAT), which is collected by the Centre for Research on the Epidemiology of Disasters (CRED). Data are taken for the period 1960-2018. EM-DAT splits natural disasters into six categories and here three of them are combined as "*climate-related disasters*": climatological (extreme heat and cold, droughts); hydrological (floods); and meteorological (cyclones, storms). Separately considered are *geophysical disasters* (earthquakes, tsunamis and volcanic activity); however the remaining two are not considered: biological events, as epidemics are identified from a different source (see below); and extraterrestrial events, which have limited observations and relevance. EM-DAT defines a natural disaster as an event in which at least one of the following criteria is met: 10 or more people are reported killed; 100 or more people are reported affected; and either a declaration of a state of emergency or a call for international assistance is made. Given this relatively low threshold, "severe natural disasters" are defined here as events which accrue a total damage in terms of GDP after insurance beyond the 90th percentile across all countries.

Epidemics

The main source for identifying countries affected by epidemics is Ma, Rogers and Zhou (2020), who compiled from official sources the death toll and infection rate of six episodes of epidemics in the past 20 years – SARS (2002/03), H1N1 swine flu (2009/10), MERS (2012), Ebola (2014/15) and Zika (2015/16). Specifically, see tables S1, S2 and S7 in Ma, Rogers and Zhou (2020). In this paper, the degree of the severity is calculated by using either the mortality rate or the case-to-population rate. For this analysis, a dummy variable was created to depict any country case with a mortality rate different from zero. Additionally, the identification of a health crisis related to pandemics is taken from the official declaration of the World Health Organization.

Policy variables

The following policy variables are considered to interact with the shock dummy. As a way of examining the effectiveness of policies, each policy variable P is transformed into an indicator variable depending on whether, in year t, the country is above or below a percentile threshold in its distribution in the estimation sample.

The policy variables were selected based on a thorough literature review, including on the composition of resilience indices. A UNU-WIDER resilience index consists of variables on four areas: macroeconomic stability (fiscal balance, inflation rate, unemployment rate, external debt-

to-GDP ratio); market efficiency (regulation of credit, labour and business); good governance (judicial independence, protection of intellectual protection rights etc.); and social development (education and health components of HDI) (Briguglio and others, 2008). More recently, Rojas-Suarez (2015) developed an index of resilience based on two dimensions: a country's capacity to withstand the impact of an adverse shock, including current account balance and the ratio of short-term external debt to international reserves, and its capacity to rapidly implement policies to counteract the effects of the shock on economic and financial stability, such as fiscal balance, public debt, deviation of inflation from announced target and a measure of financial fragility.

Swiss Re (2019) developed a macroeconomic resilience index with nine components, listed according to weights: fiscal space (government debt, sovereign credit rating, current account, primary balance, foreign exchange pressure, reserves to import ratio); monetary policy space (distance of interest rates to zero lower bound, central bank independence, policy differential against the United States Federal Reserve Board); banking industry backdrop (perception on capital buffers, sustainability of business models etc.); labour market efficiency (flexibility of wage determination, hiring and firing practices etc.); financial market development (financial depth, access and efficiency); economic complexity (sophistication and variety of goods produced and exported); insurance penetration (ratio of total direct insurance premiums to GDP); human capital; and low-carbon economy.

Table A2.1

Policy variables

Macrofinancial variables	
Fiscal	Fiscal balance (percentage of GDP)
	Government debt (percentage of GDP)
Monetary	Inflation (percentage)
	Real broad money growth (percentage)
Financial	Capital requirement, percentage of risk-weighted assets
	Financial development index (IMF)
External	Foreign exchange reserves, in months of imports
	Foreign exchange reserves, percentage of short-term external debt
	Capital account liberalization index (Chinn and Ito, 2006)
	Exchange rate regime (Ilzetzki, Reinhart and Rogoff, 2018)
Other variables	
External finance	Personal remittances received (percentage of GDP)
	Net ODA received (percentage of government expense)
Human capital and inclusive development	Human capital index (World Bank)
	Government health expenditures (WHO estimates)
	Government social protection expenditures (ADB estimates)
	Vulnerable employment, percentage of total employment (ILO-modelled estimates)
	Gini coefficient (SWIID)
Infrastructure and innovation	Quality of infrastructure index (World Economic Forum)
	Economic complexity index (Hausmann and others, 2011)
Governance	Government effectiveness (Worldwide Governance Indicators)
	Political stability (Worldwide Governance Indicators)
	Voice and accountability (Worldwide Governance Indicators)

Dependent variables

The following dependent variables are considered. On poverty and inequality data, it should be noted that most developing countries do not field household income surveys every year, and therefore changes from one year to the next are based on extrapolation, resulting in additional estimation errors. The data sources and definitions are as follows.

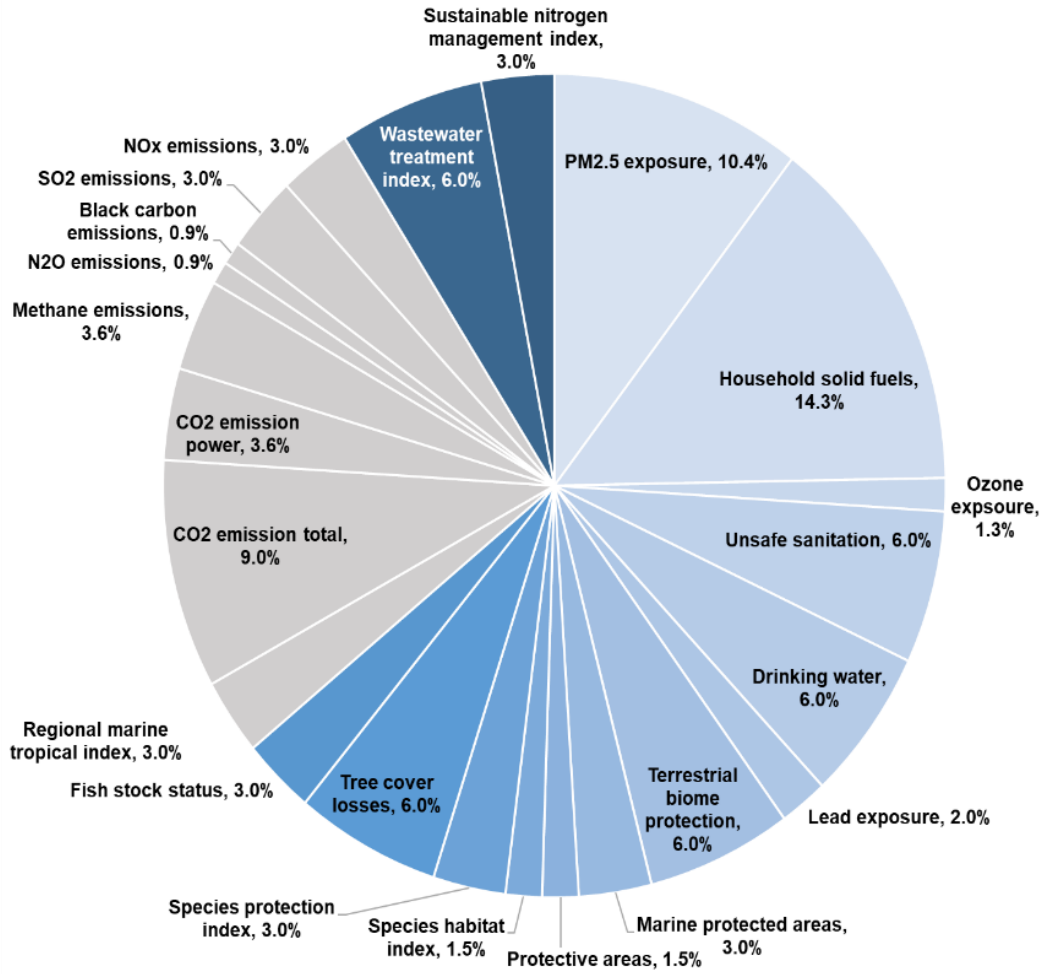
Table A2.2
Dependent variables

	Dependent variable	Definition	Source
1	Log of GDP per capita	The natural logarithm of GDP (measured as GDP in constant local currency units) series: ANY_GDP_MKTP_KN. The series of GDP is divided by the size of population. Series: ASP_POP_TOTL.	World Bank
2	Log of household consumption	Series measured as consumption at constant national 2011 prices	Penn World Tables 9.1
3	Log of investment	Series measured as investment expenditure at constant national 2011 prices	Penn World Tables 9.1
4	Log of government	Series measured as government expenditure at constant national 2011 prices	Penn World Tables 9.1
5	Gini coefficient	Gini (household) market income, (pre-tax, pre-transfer)	SWIID Source Data 8.3. (https://fsolt.org/blog/2017/07/28/the-swiid-source-data.html)
6	Log of human capital index	Human capital index, based on years of schooling and returns to education	Penn World Tables 9.1
7	Unemployment	Unemployment age (youth, adults): 15-64 years	International Labour Organization
8	Poverty	Population living below $1.90 PPP) (percentage)	ESCAP Statistics
9	Cyclically adjusted balance as percentage of potential GDP	The budget balance that would obtain when GDP is at potential. The adjustment requires removing the endogenous components of spending and revenues.	A cross-country dataset of fiscal space (World Bank)
10	Log of environment performance index	Constructed series from raw data, covering 76 per cent of the original series	Raw data from Wendling and others (2020) (https://epi.yale.edu/)

Construction of the Environmental Performance Index from raw data

Given that the original Environmental Performance Index (EPI) does not come in time series format, time series was constructed from raw data. This new index covers 76 per cent of the original EPI in terms of weight. The new index consists of 8 issue categories and 15 performance indicators, under the broad themes of environmental health and ecosystem vitality. *Environmental health* covers the following categories and indicators: (a) air quality (PM2.5 exposure, household solid fuels and ozone exposure); (b) sanitation and drinking water (unsafe sanitation and drinking water); and (c) heavy metals (lead exposure). *Ecosystem vitality* covers the following categories and indicators: (d) biodiversity and habitat (terrestrial biome protection, marine protected areas, protected areas representativeness index, species habitat index and the species protection index); (e) forest (tree cover losses); (f) fisheries (fish stock status); (g) water resources (wastewater treatment index); and (h) agriculture (sustainable nitrogen management index). Excluded from the original EPI are eight performance indicators under the climate change, air pollution, and fisheries categories, as shown in light tan in the figure below. These foregone indicators have a weight of 33 per cent in the original EPI.

Figure A2.1
Index components and weights



Source: ESCAP, based on Yale Center for Environmental Law and Policy.
Note: CO_2 = carbon dioxide; SO_2 = sulfur dioxide; NOx = nitrous oxides; and N_2O = nitrous oxide.

Control variables

Following the literature, the following variables are controlled in the regression analysis.

Table A2.3
Control variables

	Exogenous variable	Definition	Source
1	Trade over GDP	Size of exports and imports in relation to GDP	World Bank
2	Inflation	Change in annual prices	World Bank
3	Civil war	Magnitude score of episode(s) of civil warfare involving that State in that year	The Polity V dataset covers all major, independent States in the global system over the period 1800-2018 (i.e. States with a total population of 500,000 or more in the most recent year; currently 167 countries)
4	US crises	1 if NBER recession indicators >=5. NBER-based recession indicators for the United States from the period following the peak through the trough, +1 or 0, monthly, not seasonally adjusted	FRED dataset
5	Asian financial crisis	1997 Asia financial crisis. Dummy for Indonesia, Malaysia, Philippines, Republic of Korea, Singapore and Thailand	Corseti, Pesenti and Roubini (1999)
6	Log of GDP per capita	The natural logarithm of GDP (measured as GDP per capita in constant United States dollar units).	World Bank
7	Regional dummies	Dummies for East and North-East Asia; North and Central Asia; Pacific; South and South-West Asia; and South-East Asia.	ESCAP
8	Sudden stops episodes	Sudden stops are when capital inflows dry up abruptly	Eichengreen and Gupta (2016)

Country coverage

Below are the **Asia-Pacific economies** considered in the analysis, organized by ESCAP subregion. Depending on data availability, the actual sample could vary.

Table A2.4

Country and area coverage

East and North-East Asia	China; Democratic People's Republic of Korea; Hong Kong, China; Japan; Macau, China; Mongolia; and Republic of Korea
North and Central Asia	Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Russian Federation, Tajikistan, Turkmenistan and Uzbekistan
Pacific	American Samoa, Australia, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, New Caledonia, New Zealand, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu
South and South-West Asia	Afghanistan, Bangladesh, Bhutan, India, Iran (Islamic Republic of), Maldives, Nepal, Pakistan, Sri Lanka and Turkey
South-East Asia	Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste and Viet Nam

Based on UNCTAD (2019), 23 Asia-Pacific economies are classified as dependent on agricultural, fuel or mineral exports.

Table A2.5

Commodity-dependent countries

Agricultural	Afghanistan, Fiji, Kiribati, Maldives, Micronesia, Myanmar, New Zealand, Palau, Tonga and Vanuatu
Fuel	Azerbaijan, Brunei Darussalam, Iran (Islamic Republic of), Kazakhstan, Russian Federation, Timor-Leste and Turkmenistan
Mineral	Armenia, Australia, Kyrgyzstan, Mongolia, Nauru and Papua New Guinea

Source: ESCAP, based on UNCTAD (2019).

Exogeneity

Following previous studies (e.g. Cerra and Saxena, 2008), the possibility is considered that a crisis may occur because economic agents may expect a future slowdown. Forecasts of real GDP growth published in the IMF World Economic Outlook are used because they have greater country coverage than alternatives, such as Consensus Forecasts. For each type of crisis, the difference between the previous year's forecast of growth and the actual growth outturn is used on the crisis dummy indicator. Table A2.6 shows that, prior to a financial crisis or natural disaster, forecasts were actually optimistic about growth. This is also the case for terms of trade shocks, although not statistically significant. In the case of epidemics, the wrong signs are statistically insignificant, but it can be safely assumed that epidemics typically occur as a surprise.

Table A2.6
World Economic Outlook forecast errors for GDP growth

	Financial crises	Terms-of-trade shocks	Natural disasters	Epidemics
Current year expectation (April)	1.232765**	0.3535048	2.463275***	-0.640652
Standard errors	0.5270698	0.3911496	0.6779252	0.6605107
Number of countries	48	46	48	48
Number of observations	1 247	962	1 247	1 247
Current year expectation (October)	.5208999*	0.3423355	2.389756***	-0.837531
Standard errors	0.3064644	0.3319316	0.5711095	0.5391167
Number of countries	48	46	48	48
Number of observations	1 250	963	1 250	1 250
Next year expectation (April)	2.735886***	0.3419371	2.791685***	-0.4142946
Standard errors	0.8222126	0.4210465	0.4964105	0.8074648
Number of countries	48	46	48	48
Number of observations	1 203	947	1 203	1 203
Next year expectation (October)	4.156578**	0.2925505	2.645739	-0.4957872
Standard errors	1.594782	0.3720102	0.4696768	0.8125262
Number of countries	48	46	48	48
Number of observations	1 206	948	1 206	1 206

Source: ESCAP.
Note: Asterisks *** denote statistical significance at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level.

Annex III

Selected COVID-19 policy responses that help build forward better

Ensuring women's economic security. In such countries as Afghanistan, Armenia, China, Kazakhstan and the Russian Federation, Governments have provided financial assistance to sectors that disproportionally employ more women than men, such as agriculture, retail trade, restaurants and hotels. Armenia, Indonesia, Myanmar, the Russian Federation and Turkey have offered financial support to pregnant women, especially those unemployed, and mothers with young children. Meanwhile, Azerbaijan, Georgia and Sri Lanka have distributed food and hygiene kits to women-headed households. In India, cash transfers were given to 200 million women with a financial inclusion account, while Turkey introduced grants for women cooperatives. To promote women entrepreneurs, Georgia eased barriers to enable more women to apply for grants. Finally, under an emergency cash programme, Pakistan raised the benefits provided to 4.5 million women.

Supporting unpaid care. Australia, Cook Islands, New Zealand and the Republic of Korea provided financial assistance and/or allowed extra leave days to people who needed to take care of COVID-19-infected family members and children due to school closures. In the Russian Federation, parents who lost job are entitled to cash payments, while Uzbekistan prohibited the termination of employment for employees with young children. Meanwhile, New Zealand provided wage subsidies for those who are required to self-isolate, while Uzbekistan required that wages during the time of quarantine are fully paid. Finally, China arranged home-based services for elderly persons whose caretakers are in quarantine, while some Indian states provided older people with food and medication.

Promoting renewable energy (Vivid Economics, 2020). Australia raised investments in renewable energy zones and technologies; China plans for a biomass power plant; Indonesia subsidizes the use of biodiesel fuels and reduces taxes for renewable energy projects; India waived charges for interstate transmission of wind and solar power, granted loans to farmers to implement solar technologies and extended financing to Sri Lanka for the construction of solar infrastructure; and Turkey adopts a green tariff for power derived from renewable energy and plans to increase solar energy production capacity. Relatedly, China also carried out building renovations for older people to improve the efficiency of energy use. Initiatives on electric vehicles (EV) are also gaining momentum. In China, the Government extended the national EV subsidy programme, reduced permit requirements for new EVs and funded EV-charging infrastructure. India also supports the use of EVs in New Delhi, intends to increase electrification of trains and provide new charging stations for electric buses.

Protecting biodiversity (OECD, 2020). China prohibits commercial breeding and trade in most wild animal species for food consumption, while Viet Nam strengthens the enforcement of wildlife policies. Meanwhile, India allocated $800 million to provide jobs for tribal communities in forest management and wildlife protection. Finally, New Zealand launched a $900-million job programme to protect and restore habitat on conservation lands.

Annex IV

The macroeconomic model

The country models are characterized by a short-run Keynesian demand side and a long-run neo-classical supply side. In the model, households consume, save and supply labour, while firms produce output, hire labour and invest. Governments pursue fiscal policy by spending and taxing, while monetary authorities conduct monetary policy by setting the short-term interest rate and exchange rate policy. The balance of demand and supply, together with tax policy, global commodity prices and other imported prices, determine inflation. Higher prices constrain consumption and dampen the net trade balance. Most behavioural relationships are specified in an error-correction framework to distinguish short- and long-term dynamics.

In the short run, GDP is driven by aggregate demand, which comprises consumption, investment and net trade. Household consumption depends on real personal disposable income, financial inclusion (proxied by the share of population with a bank account) and the gap between actual and expected inflation rates. Private investment is determined by potential output, user cost of capital, financial inclusion and gross domestic income (which captures terms-of-trade shocks). In this model, a large part of government consumption and investment is assumed to be policy shocks. Exports depend on external demand and relative non-commodity export prices, both of which are derived from a global bilateral trade matrix. Finally, imports depend on domestic demand, output gap, relative price of imported goods and oil imports.

In the long term, each country's potential output level is driven by its aggregate supply, which is determined by the labour force, capital stock, energy demand, energy efficiency, trend productivity growth and damage from climate shocks. Considered under labour force are demographic factors and the labour force participation rate. The capital stock is driven by the accumulation of investment, after allowing for depreciation. The capital depreciation rate depends on global carbon emissions to capture the impact of climate change on the erosion of capital. Total energy demand depends on output, energy prices and energy efficiency. Trend productivity growth is modelled as a function of the global productivity frontier (which is related to global trade), government expenditure on health, inequality and air pollution. Finally, damage from climate shocks is exogenous, although in this study it is linked to some policy shocks.

In the fiscal module, government spending is disaggregated into spending on social protection, spending on health, spending on environmental protection, fossil fuel subsidies, other government consumption, other government investment and interest payments. Government revenue is disaggregated into income tax revenue, corporate tax revenue, indirect tax revenue, taxes on international transactions, carbon tax revenue, commodity revenue and other net revenue. The fiscal deficit feeds into government debt stock. In the model, an increase in the government debt-to-GDP ratio leads to a higher risk premium for that country. Countries with a higher initial level of risk premiums would be more sensitive to any rise in public debt. The risk premium feeds into borrowing costs, which results in lower investment and higher inflation.

In addition to economic relationships, the model has additional channels to capture interactions with key social and environmental variables, such as poverty, income inequality, carbon emissions and air quality. Behavioural relationships are guided by the literature. For example, losses associated with climate shocks are underpinned by benchmarks contained in World Bank (2019), in which an investment in resilience valued at 1 per cent of GDP reduces annual damage by 5 per

cent. Other major studies that are used for developing relationships among the variables include Botev, Egert and Jawadi (2019), Briceño-Garmendia, Estache and Shafik (2004), ECB (2017), Griscom and others (2017), IEA (2019, 2020), OECD (2019) and Wang (2015).

The poverty model is based on the assumption that income follows approximately a log-normal distribution. The cumulative density function of log income is calculated based on estimates of mean income and income inequality and evaluated at the poverty benchmarks of $1.90/day and $5.50/day. Income inequality is measured according to the after-tax Gini coefficient. It declines in response to a rise in government spending on social protection, or a rise in financial inclusion.

Carbon emissions depend on the composition of energy consumption, which in turn depends on the relative (after carbon tax) price of coal, gas, oil and renewables. Air pollution also depends on the composition of energy consumption, especially the consumption of coal.

The model is fully global in scope. It comprises 46 individual full-country models for the Asia-Pacific region, smaller models of 9 key trading partners outside the region, plus aggregate models for the remaining global economies grouped into 4 regions. The individual country models are linked together via trade, remittances, financial markets and global energy markets. The model is run on the EViews statistical software.

Annex V

The "business-as-usual" level of spending: a back-of-the-envelope calculation

We gauge the portion of additional investment needs that a country may be able to afford if its financial resources are assumed to increase at the pace observed in recent years. First, a country's level of financial flows is calculated as the sum of eight types of flows that can be used for development purposes.[3] These include government revenue excluding grants, net official development assistance (ODA) and official aid received, net fiscal borrowing, domestic credit to the private sector, net foreign direct investment (FDI) inflows, net flows of private non-guaranteed external debt, net portfolio investment and personal remittances received. The average values during the period 2015-2019 are used. Then, the projected increase in annual financial flows is calculated, based on respective growth rates of these flows during the period 2016-2019. Finally, a country's business-as-usual level of spending is determined as a ratio of its projected increase in financial flows per year and its additional investment needs per year.

Example: if country A's financial flows stood at 80 per cent of its GDP on average during the period 2015-2019 and these flows grew by 5 per cent per year on average during the period 2016-2019, then the projected increase in financial flows would be 4 per cent of GDP per year. Given this, if country A's additional annual investment needs for the building-forward-better package are estimated at 10 per cent of GDP, then the business-as-usual spending level is about 40 per cent of its investment needs.

Based on 41 developing Asia-Pacific countries with available data, the result suggests that, on average, the business-as-usual level stands at about 38 per cent of its additional investment needs. Such a ratio is below 10 per cent in such countries as Afghanistan, the Lao People's Democratic Republic and Myanmar due to both their large investment needs and small financial flows.

Clearly, the estimated business-as-usual levels of spending should be viewed as tentative for several reasons. First, they could be overestimated due to double counting, e.g. corporate profits earned from an FDI-financed project also contribute to government revenue. Second, they could be underestimated as there are other types of financial flows not captured here that can be used for development purposes, e.g. revenue from State-owned enterprises and donations from foundations. Third, the projected increase in financial flows is based on each country's past trend but this is likely to change given changing global and country situations, e.g. the strength that financial inflows to Asia-Pacific economies recover after the COVID-19 pandemic is over.[4] Finally, in going forward, if countries manage to utilize better their financial resources for development purposes, then additional investment needs may be met by a lower-than-expected level of financial flows. This is possible when more FDI, portfolio investments and domestic credits are channelled towards sustainability-oriented industries and firms.[5] Another example is when the issuance of diaspora bonds helps to better leverage private remittances for development.

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[3] These and other types of financial flows are used to assess the country-level financing landscape for development. See UNDP (2019).

[4] The COVID-19 pandemic has dampened financial flows into the region, e.g. government revenue amid commodity price falls, FDI flows due to shrinking domestic demand and excess production capacity, portfolio inflows amid capital flight to safe havens, workers' remittances as a result of lockdowns and economic recessions in host countries and potentially ODA owing to weaker fiscal conditions in donor countries.

[5] For some policy options, see UN Global Compact (2019).

Annex VI

Public debt sustainability analysis: scenarios, stress tests and contingent liabilities

	Scenarios	Details
1.	Building-forward-better (BFB) package	A combination of the social services, digital access and green development packages (see section 3 of chapter 4 for more details).
2.	COVID-19 fiscal responses	Increased public spending to cope with the pandemic, based on differences in the projected government debt-to-GDP ratio in the October 2019 and October 2020 editions of the IMF World Economic Outlook databases.
3.	Combined BFB and COVID-19 spending	A combination of the first and second scenarios.
	Stress tests	**Details**
1.	Slower economic growth	Real GDP growth in the baseline scenario is reduced by 1 standard deviation in 2021 and 2022.
2.	Weaker exchange rate	One-time 20 per cent nominal depreciation of the domestic currency in 2021.
3.	Higher interest rate	Nominal interest rate increases by 200 basis points in 2021.
	Contingent liabilities	**An increase in the liabilities is assumed to be equivalent to:**
1.	Financial sector	10 per cent of each country's bank assets: applied to all Asia-Pacific countries with available data from the World Bank's Global Financial Development database.
2.	Natural disaster	Average contingent liability due to natural disasters in Asia-Pacific countries in Bova and others (2016): applied to Asia-Pacific countries rated at "high" or "medium" risk in Kopits, Ferrarini and Ramayandi (2016).
3.	State-owned enterprise (SOE) debt	Average contingent liability due to SOE debts in Asia-Pacific countries in Bova and others (2016): applied to Asia-Pacific countries rated at "high" or "medium" catastrophic risk in Kopits, Ferrarini and Ramayandi (2016).
4.	Subnational government operations	Average contingent liability due to subnational government operations in global economies in Bova and others (2016): applied to Asia-Pacific countries rated at "high" or "medium" catastrophic risk in Kopits, Ferrarini and Ramayandi (2016).
5.	Public-private partnership (PPP) projects	35 per cent of each country's PPP capital stock: applied to all Asia-Pacific countries with available data from the World Bank's World Development Indicators database.

Source: ESCAP.

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