Online Annex 2.1. Inequality, Social Mobility, and Educational Outcomes[1]

A. Analysis of Intergenerational Mobility, Income Inequality, and Access to Opportunities

The main text of the *Fiscal Monitor* (section II) reports that increasing years of schooling improves intergenerational mobility in education, and that income inequality is an important determinant of access to education. This annex presents further details on the data, methodology, and results.

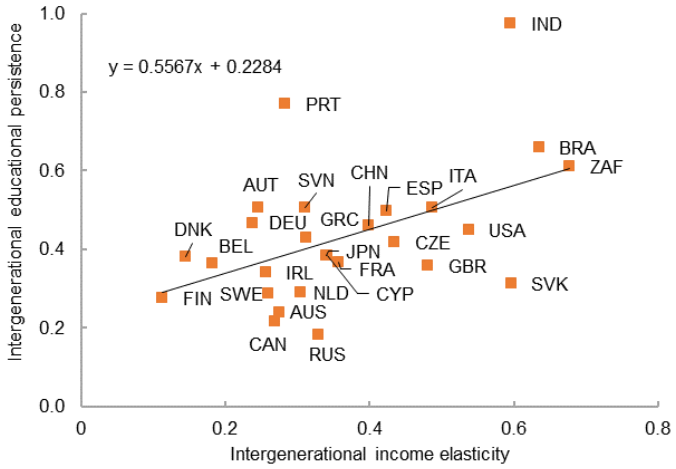
The following variables are used, with data sources in brackets: estimates of intergenerational educational persistence (IGP, World Bank's Global Database of Intergenerational Mobility), for 100 countries for the 1960s and 1970s birth cohorts and 129 countries for the 1980s birth cohort; initial income per capita (PCY, World Bank's World Development Indicators); Gini coefficients ("All the Ginis" data), gross or net depending on availability; years of educational attainment (Barro and Lee 1994); index of access to finance (IMF Financial Development Index); mobile and fixed-line phone penetration, as proxy for access to technology (International Telecom Union, ITU).

The empirical analysis is based on a regression approach:

$$IGP_i = b_0 + b_1 Gini_{i,k} + b_2 PCY_{i,k} + b_3 X_{i,k} + e_{i,},$$

Here, k is a period that is sufficiently lagged with respect to the years of peak educational attainment for the cohort to capture initial conditions for the cohort in country i. The inclusion of long lags of the explanatory variables also attenuates potential concerns of reverse causality. Thus, the 1980s would broadly correspond to when the 1960s birth cohort achieves its peak educational attainments; and measures of access to education in the 1970s or earlier would capture the corresponding initial conditions. The inclusion of the Gini coefficient captures the observed relationship between high income inequality and low intergenerational mobility.[2] It is included with a substantial lag with respect to peak education attainment years of the cohort, to give empirical form to the proposition in Corak (2013), whereby inequality affects intergenerational mobility through its impact on access to opportunity.

Online Annex Figure 2.1.1. Correlation of IGE and IGP (1960s Cohort)



Sources: World Bank's Global Database of Intergenarational Mobility 2018; and IMF staff calculations.

Two findings emerge (Online Annex Table 2.1.1): (i) a Gatsby curve

[1] This Online Annex was prepared by Adil Mohommad of the Research Department.

[2] This relationship, known as the Great Gatsby curve, is usually shown as the positive relationship between intergenerational income elasticity (IGEI) and income inequality (high income inequality corresponding to lower mobility). IGP serves as a proxy for IGEI, given a high degree of correlation (Online Annex Figure 2.1.1), although the extent to which this is appropriate would depend on how closely educational and labor market outcomes are tied together. Narayan and other (2018) show that this correlation tends to be greater in countries with higher labor force participation. This relationship may also be stronger in countries with a larger premium on educational attainment.

relationship is detected with respect to income inequality and educational persistence; and (ii) the coefficients on educational spending and educational attainment are statistically significant and have the anticipated sign. Thus, the better the initial conditions of access to education, the less a given cohort's education attainment is correlated with that of the parents' generation. Access to ICT technology (fixed-line phone penetration) is also negatively and significantly related to IGP, whereas the coefficient on access to finance is not significant. The relationship between access to education and technology opportunities and intergenerational mobility is also economically significant:

- *Education.* Based on Online Annex Table 2.1.1, a 1-standard deviation increase in initial education spending (1.6 percent of GDP in 1970) is associated with a 0.08-point lower level of IGP. A 1-standard deviation increase in years of education (2¾ years in 1970) is associated with a 0.18-point reduction in IGP—a sizable move from the third quartile to nearly the median of the distribution of IGP for the 1960 cohort.
- *Technology.* A 1-standard deviation rise in the average rate of penetration of fixed-line phones (1.5 phones per 100 population per year) is associated with a 0.07-point reduction in IGP.

Online Annex Table 2.1.1. IGP Income Inequality, and Access to Opportunity

		Education spending	Years of schooling	Access to finance	Fixed phone penetration	Mobile phone penetration	All factors
Dependent variable	*IGP*	*IGP*	*IGP*	*IGP*	*IGP*	*IGP*	*IGP*
Gini 1/	0.006**	-0.002	0.002	0.006**	0.004*	0.005*	-0.005
	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)
Real per-capita income (log) 2/	-0.064***	-0.073***	0.024	-0.078***	-0.033	-0.053***	0.032
	(0.017)	(0.020)	(0.027)	(0.023)	(0.026)	(0.020)	(0.048)
Education spending 3/		-4.818**					-3.853
		(2.122)					(2.587)
Schooling attainment 4/			-0.067***				-0.045*
			(0.017)				(0.024)
Access to finance 5/				0.097			-0.041
				(0.096)			(0.127)
Fixed-line phone penetration 6/					-0.047**		-0.060*
					(0.018)		(0.033)
Mobile phone penetration 6/						-0.228	0.380
						(0.196)	(0.347)
Constant	0.782***	1.417***	0.589***	0.873***	0.669***	0.753***	0.973***
	(0.191)	(0.185)	(0.169)	(0.220)	(0.249)	(0.218)	(0.263)
Observations	68	47	59	68	60	59	41
R-squared	0.317	0.502	0.484	0.323	0.316	0.294	0.635

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Sources: Branko L. Milanovic, All the Ginis Dataset, World Bank; Barro and Lee (1994); IMF Financial Development Index; ITU; World Bank's Global Database of Intergenarational Mobility; World Bank WDI database; and IMF staff estimates.
Notes: 1/ 10-year average starting from first available observation closest to 1960. The gini coefficients are net gini for 30 countries, and gross gini for 38 countries among the available sample of 68 countries. 2/ Average of the first ten year of the birth of the cohort, or first available observation, depending on data availability. 3/ Total public expenditure on education in percent of GDP in 1970. Results are similar for other years (1960-1975 at 5-year intervals). 4/ Average years of schooling attainment in 1970. Results are robust for other years between 1975-1990. 5/ Value of the Financial Access sub-index of the IMF Financial Development Index in 2000. 6/ Average annual rate of change of fixed line penetration over 1970-1980 per 100 population. Average rate of change of mobile phone penetration per 100 population over 1990–2000.

B. Analysis of Inequality and Access to Education

The link between inequality and education is explored with the following equation:

$$Educ_{i,t} = b_0 + b_1 Gini_{i,k} + b_2 PCY_{i,k} + e_{i,},$$

Educational attainment ($Educ_i$) is measured at different points in time (average years of schooling in 1980 and 1990; learning-adjusted years of education in 2005, and in 2015) and k is a period that is sufficiently lagged with respect to the year educational attainment is measured. The Barro-Lee measure of educational attainment is used, and WB data on learning-adjusted years of education that captures more recent years. The regressions include per capita income (per-child education spending in the case of learning-adjusted years of education), and initial income inequality (in the decade of the cohort's birth).

Educational attainment is significantly associated with lagged income inequality (Online Annex Table 2.1.2). The size of the coefficient on inequality appears to have fallen over the years, though the samples differ. The estimates suggest that an increase in inequality by 9 points is associated with a decline in educational attainment by 0.9 years as measured in 1980; an increase of 10 points is associated with a reduction in educational attainment by 0.6 years in 1990. In learning adjusted terms, an increase in Gini of 11 points is associated with a decline in learning adjusted years of education of 0.4 years in 2015.

Online Annex Table 2.1.2. Inequality and Educational Attainment

Dependent variable:	Years of education		Learning-adjusted years of education	
	1980	1990	2005	2015
Gini 1/	-0.095***	-0.059***	-0.149***	-0.038**
	(0.020)	(0.014)	(0.040)	(0.015)
Real income per capita (log) 1/	1.175***	1.127***		
	(0.152)	(0.136)		
Education expenditure per child (log) 2/			0.692**	1.643***
			(0.311)	(0.015)
Constant	0.392	0.215	8.848**	-2.922**
	(1.745)	(1.473)	(3.617)	(1.375)
Observations	54	84	26	78
R-squared	0.670	0.623	0.709	0.860

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Sources: Branko L. Milanovic, All the Ginis Dataset, World Bank; Barro and Lee (1994); World Bank WDI database; World Bank Learning Adjusted Years of Schooling data;and IMF staff estimates.
Notes: 1/ Measured as the average over the decade prior to when educational attainment is measured. 2/ Measured in the year in which learning adjusted attainment is measured. Data on years of education from Barro-Lee (1994); on learning adjusted years of education from World Bank. Sample includes countries with both gross and net gini data.

Online Annex 2.2. Inequalities in COVID-19 Health Outcomes[1]

The main text of the *Fiscal Monitor* (section III.A) indicates that higher COVID-19 mortality is associated with lower healthcare access and with higher relative poverty, especially in urban areas. Income inequality and uneven access to basic services may thus have worsened COVID-19 health outcomes. This annex presents further details on the methodology and estimates to buttress these results, which need to be interpreted with caution given the small number of observations and possible concerns regarding omitted variables, the direction of causality, and varying quality of data about reported cases and deaths across countries.

The analysis relies on cross-country regressions and its main findings are in line with single-country studies. Growing evidence suggests that COVID-19 disproportionately affected disadvantaged groups, such as lower income households and minorities (Chen and Krieger 2020; Brown and Ravallion 2020; Chin and others 2020; Brandily and others 2020; Sá 2020). Other relevant factors include population age structure, comorbidities, gender, and 'smart' containment measures (Eichenbaum and others 2020; Kaplan and others 2020; Deb and others 2020; Fotiou and Lagerborg, forthcoming).

Data sources are as follows: COVID-19 deaths and cases per million population, share of population above age 65 and 70, number of hospital beds per thousand people, and GDP per capita in U.S. dollar PPP terms from Our World In Data COVID-19 dataset (as of October 2, 2020); COVID-19 tests per thousand population from Worldometer (as of November 15, 2020); containment and health index from the Oxford COVID-19 Government Response Tracker, where 'early' containment refers to the index level at 100 recorded cases whereas 'average' containment refers to the average index level over the period March 1 to September 30, 2020; and share of urban population and relative poverty, defined as the share of population living below 50 percent of the median income, from the World Bank.

Explaining Mortality Rates: The Role of Healthcare Access

Regressions show that better access to healthcare (measured by the number of hospital beds per thousand) is associated with lower mortality (Online Annex Table 2.2.1) conditional on the number of positive cases, testing, and controlling for demographics (column 6).[2] Turning to within-country income inequalities, deaths correlate positively with higher relative poverty (column 4), but this association becomes

Online Annex Table 2.2.1. Cross-Country Regression for COVID-19 Deaths

	COVID-19 deaths per million					
	(1)	(2)	(3)	(4)	(5)	(6)
Log GDP per capita	60.58***	36.55**	41.92***	56.75**	-2.4	25.04
Share of populaton aged 70+		7.89*	15.21***	12.25*	14.00***	14.19***
Hospital beds per thousand			-25.42***	-21.11**	-17.8***	-22.09***
Relative poverty				11.09***	1.88	0.84
COVID-19 cases per million					0.02***	0.02***
COVID-19 tests per thousand						-0.17***
Constant	-432.58***	-257.94**	-273.09**	-533.92***	-10.53	-213.96
Observations	175	171	155	124	124	117
R-squared	0.12	0.14	0.16	0.25	0.61	0.63

Source: IMF staff estimates.

[1] This Online Annex was prepared by Andresa Lagerborg of the Fiscal Affairs Department.

[2] Results are robust to using alternative indicators for demographics (share of population above 65 and above 80 years and the median age) and healthcare access (physicians per 1000 inhabitants), using data from the World Bank. Controlling for pre-existing health conditions is not found to be significant in our analysis.

insignificant controlling for the number of cases per capita (columns 5 and 6). In other words, income inequality appears to explain mortality to the extent it explains higher infection rates. Testing is also associated with lower mortality, controlling for the number of cases (column 6).

Explaining Infection Rates: The Role of Income Inequality

Regressions reveal that the incidence of COVID-19 relates to within-country inequalities (Online Annex Table 2.2.2).[3] Infection rates are positively associated with relative poverty and the share of urban population (columns 3-4). The interaction term of relative poverty and the share of urban population is also significant, suggesting that the urban poor were disproportionately affected (columns 5-6). Results are robust to controlling for containment policies (column 6), where endogeneity is the reason for the strong relationship between average containment and infection rates, while early containment measures are associated with lower deaths per capita (see also Fotiou and Lagerborg, forthcoming). Combining both aforementioned analyses to explain COVID-19 deaths, without conditioning on the number of cases and tests, but instead by controlling for relevant determinants of cases per capita, reveals that results remain robust (not reported here). Higher death rates are associated with (i) lower healthcare access and (ii) higher relative poverty, especially in urban areas, controlling for other relevant factors.

Online Annex Table 2.2.2. Cross-Country Regression for COVID-19 Cases

	COVID-19 cases per million					
	(1)	(2)	(3)	(4)	(5)	(6)
Log GDP per capita	2,744.69***	1,906.03***	1,706.53***	678.07	925.44	618.79
Tests per thousand		6.42***	3.64	2.95	3.25	4.52**
Relative poverty			360.56***	306.52***	342.58***	240.71***
Share of urban population				83.71**	88.93***	101.84
Relative poverty × Share of Share of urban population					20.59***	20.48***
Average containment policy						136.72***
Early containment policy						-44.03**
Constant	-20,100.68***	-13,283.67***	-11,157.25**	-1,496.79	-4,005.92	-6,861.95
Observations	175	163	128	129	130	117
R-squared	0.20	0.22	0.24	0.28	0.40	0.51

Source: IMF staff estimates.
Note: Share of urban population and the relative poverty are mean-centered.

[3] Results are robust to using alternative measures of relative poverty, including the income share held by low versus high deciles (data from the World Bank), as well as the Gini coefficient (data from the International Income Gini Coefficient Database).

Online Annex 2.3. Inequalities In COVID-19 Education Outcomes[1]

The main text of the *Fiscal Monitor* (section III.C) presents estimates of educational losses from school closures during COVID-19. This annex presents details on the methodology and summarizes additional studies by other researchers. Specifically, the annex provides a global assessment of educational losses by country as well as socioeconomic characteristics, such as income quintiles, rural-urban location, and gender, using two different approaches. The first estimates learning losses using data on school closure days and building on recent findings on the effectiveness of remote learning. The second focuses on the demand for education in the period ahead, using multi-year local projection methods, based on data for school enrollment drops by country, education level, and gender.

(i) Reduced Learning: Effect of School Closures during COVID-19

Studies of the impact of school closures reveal major learning losses—larger among students from less educated or poorer families. Evidence for *The Netherlands* suggests that students made little or no progress studying from home, with average learning losses equivalent to a fifth of a school year for primary school students, about the same period that schools remained closed (Engzell and others 2020).[2] *The Netherlands* may represent a best-case scenario with a relatively short lockdown and high technological preparedness. Learning losses were larger (that is, abilities slid further behind) among students with low-education parents, magnifying learning inequalities.[3] Studies for other countries also find learning losses disproportionately affecting students in low-education and low-income households.[4]

Uneven remote learning outcomes stem from factors such as unequal access to remote learning resources, school support, parental teaching both in terms of time and skills, and private tutoring. Parental support likely matters for remote learning during school closures in both financial and non-financial terms (Di Pietro and others 2020; Fuchs-Schündeln and others 2020; Oreopoulos and others 2006). Lower income students had a stronger reduction in learning time in *England* (Andrew and others, 2020), a deeper drop in online coursework in the US (Chetty and others 2020), and were less likely to engage in any educational activities during school closures according to cross-country phone surveys conducted by the World Bank.[5] In line with these findings, educational losses are estimated based on the share of days that schools were closed ($\%\ Closure\ days_c$) and the heterogeneous ability of students to compensate this via remote learning ($Comp^{Q}_{c,g,r}$), where c, g, r, and Q respectively denote the country, gender, rural-urban location, and income quintile. The loss per student ($Loss^{Q}_{c,g,r}$) is thus:

$$Loss^{Q}_{c,g,r} = (\%\ Closure\ days_c) * (1 - Comp^{Q}_{c,g,r}) \qquad (1)$$

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[1] This Online Annex was prepared by Andresa Lagerborg of the Fiscal Affairs Department.

[2] The authors use over 350,000 observations and a difference-in-difference approach to compare learning progress (based on national exams before and after lockdown) to the same period in three previous years. They assess standardized tests for students aged 7–11 (grades 4–7).

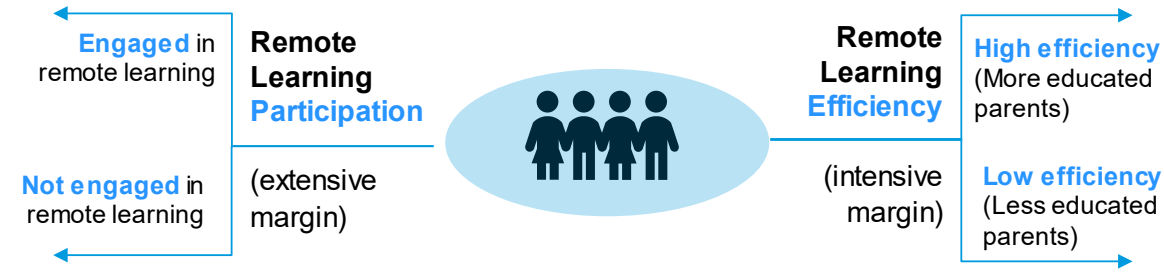
[3] By contrast they find little evidence of losses differing by gender, school grade, subject, or prior performance.

[4] Maldonaldo and de Witte (2020) focus on *Belgium* and document substantial learning losses in mathematics and Dutch for sixth grade students in Flanders, with losses increasing in the share of students with a low-education level mother and in the share of students receiving financial support. Dorn and others (2020) document a "COVID slide" for the *United States*, based on primary school standardized test scores for the Fall of 2020, suggesting stark differences across student age, race, and income level, whereby the disadvantaged students have slipped backward since the onset of the pandemic.

[5] Children were substantially less likely to engage in any educational activities at all during school closures in lower income countries, with a slightly stronger effect in rural areas while no difference is detected across genders (Online Annex Table 2.3.1).

Two scenarios are considered for estimating the share of school closure days: (i) closure for all schools is mandatory, and (ii) closure for some schools is recommended or required. The data is from the Oxford COVID-19 Government Response Tracker (OxCGRT). The heterogeneous ability to mitigate losses from school closures is captured by: (a) the efficiency of remote learning (relative to in-person learning) across students according to their parents' education, and (b) the share of children engaged in remote learning (Online Annex Figure 2.3.1). This analysis applies a comparative statics approach by considering one source of heterogeneity at a time.

Online Annex Figure 2.3.1. Heterogeneity in Compensating Learning Losses



Sources: IMF staff.

Using equation (1) and the results from *The Netherlands* study (Engzell and others 2020), the ability to compensate ($Comp^{Q}_{c,g,r}$) for the loss of learning during school closure is calculated separately for children from low- and high-educated families. For example, *The Netherlands* study suggests that during school closure, which lasted for 22 percent of the academic year, children with low-educated (lower secondary school education and below) parents experienced learning losses of 27 percent. Using equation (1) this implies the ability to compensate of -23 percent. Using a similar approach, the ability to compensate for children with more educated parents was +13 percent and the average for all students was +10 percent. Using these estimates, the average efficiency of remote learning ($1 - Comp^{Q}_{c,r}$) can be estimated as:

$$(1 - Comp^{Q}_{c,r}) = (\%UppSec^{Q}_{c,r}) * (1 - 13\%) + (1 - \%UppSec^{Q}_{c,r}) * (1 + 23\%)$$

where data on upper secondary school completion rates by country, rural-urban location, and income quintile ($\%UppSec^{Q}_{c,r}$) are from the World Inequality Database in Education (WIDE).[6] To the extent that *The Netherlands* represents a best-case scenario for remote learning effectiveness, these estimates can be considered a lower bound of learning losses.

Children in advanced economies, especially in high income quintiles, have a higher remote learning efficiency than children in developing countries, especially in low-income quintiles, enabling them to better mitigate learning losses. Longer required school closures in developing countries exacerbate these differences.[7] Learning losses for the more disadvantaged students could exceed 50 percent in emerging market economies and 40 percent in low-income countries, compared to less than 20 percent in advanced economies (Online Annex Figure 2.3.2). Also considering partial closure requirements and

[6] For countries without available data, including most advanced economies, estimates are obtained as predicted values from regressions of upper secondary school completion rates by country, quintile, and rural-urban location on widely available country-level data for: secondary school completion rates, GDP per capita, and measures of inequality including the Gini coefficient and share of population living below 50 percent of median income, censored between 0 and 100 percent.

[7] As of end-December 2020, the average duration of broad-based mandatory school closures was 40 percent of an academic year in emerging market economies and low-income developing countries, twice the duration in advanced economies, where partial and recommended closures have been more prevalent.

recommendations, learning losses could have averaged close to 80 percent of a school year for children in lower income groups across the world.

Another source of heterogeneity relates to children's participation in remote learning. Children who do not engage in any remote learning activities during school closures may forget part of what they learned previously. Evidence on the so-called 'summer slide' suggests 25-30 percent of learning achieved over the school year is typically lost during the summer holiday period (Alexander and others 2016), or 4 percent per week. Exploring the heterogeneity in remote learning participation during school closures, children engaged in remote learning are assumed to have the same remote learning efficiency as the average observed for *The Netherlands* (10 percent), whereas children not engaged in remote learning activities experience learning depreciation of 4 percent per week. Learning losses are estimated as:

$$Loss^{Q,R}_{c,g,r} = \%\ Rem^{Q}_{c,g,r} * \%\ Closure\ days_c * (1-10\%) + (1-\%\ Rem^{Q}_{c,g,r}) * (1-4\%)^{52*\%\ Closure\ days_c}$$

Data on the share of children that engaged in any learning activities during school closures ($\%\ Rem^{Q}_{c,g,r}$) by income quintile, gender, and rural-urban location for 30 countries come from the World Bank's COVID-19 High-Frequency Phone Surveys. For the other countries, estimates are obtained as predicted values from regressions of the share of children engaged in remote learning activities on socio-economic characteristics such as GDP per capita and dummy variables for gender and urban-rural locations (Online Annex Table 2.3.1), censored at 100 percent. Assuming the share of children in remote learning correlates with income quintiles, estimates are further obtained by quintiles.

Online Annex Table 2.3.1. Socio-Economic Determinants of Learning During COVID-19 School Closures

	% of HHs with children engaged in any learning/education activities since school closures						
		By educational activity					
	All	Completed Teacher's Assignment	Teacher/ Tutor Meeting	Mobile Learning Apps	Educational TV Programs	Educational Radio Programs	Other
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
% attending school pre-COVID	-0.175	-0.259	-0.171	0.03	-0.642***	-0.126	-0.752**
	-0.142	-0.187	-0.158	-0.136	-0.154	-0.086	-0.342
Log GDP per capita	19.966***	37.946***	26.456***	26.408***	15.898***	-1.250	6.451**
	(2.271)	(3.147)	(2.564)	(2.149)	(2.571)	(1.449)	(3.205)
Female	-0.039	2.195	-1.092	-0.345	0.154	-2.068	0.331
	(3.749)	(5.034)	(4.185)	(3.592)	(4.117)	(2.369)	(5.354)
Rural	-8.431**	-3.469	-11.520***	-8.665**	-10.295**	-1.178	-1.069
	(3.753)	(5.044)	(4.194)	(3.600)	(4.125)	(2.372)	(5.360)
Constant	-89.739***	-256.501***	-170.805***	-196.467***	-49.871**	33.853**	27.817
	(22.355)	(30.369)	(24.802)	(20.710)	(24.895)	(14.014)	(37.832)
Observations	124	107	110	113	107	98	97
R-squared	0.427	0.609	0.574	0.649	0.494	0.257	0.348
Controls							
Interview wave	Yes	Yes	Yes	Yes	Yes	Yes	Yes

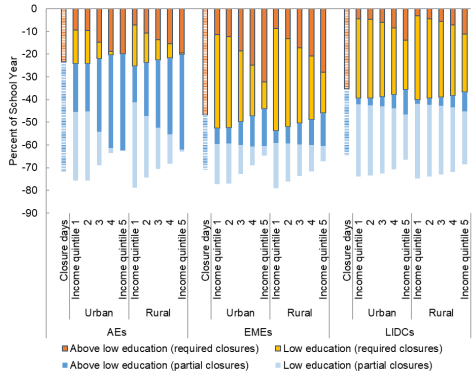
Sources: World Bank's COVID-19 High-Frequency Phone Survey; and IMF staff calculations.

One month of school closures could cause education losses of 8 percent of the school year in advanced economies and higher income quintiles in developing countries and 18 percent for the lowest quintile in low-income countries, where most children are not engaged in any remote learning. Longer durations of broad-based mandatory school closures magnify these differences, with learning losses exceeding 40 percent in developing countries, double those in advanced economies (Online Annex Figure 2.3.2).

Considering both mandatory and recommended school closures, losses could reach 65 percent on average for most children, and close to 90 percent for the lowest quintile in low-income countries. [8]

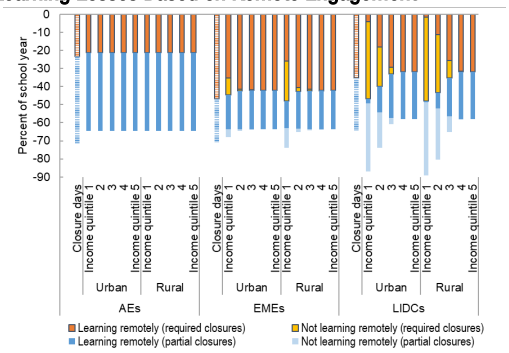
Online Annex Figure 2.3.2. Children's Learning Losses Based on Parents' Education and Remote Learning Participation

1. Learning Losses Based on Parent's Education



Sources: Engzell and others (2020); OxCGRT; UESCO; WDI; WIDE; and IMF staff calculations.
Note: AEs = Advanced Economies; EMs = Emerging Market Economies; LIDCs = Low-income Developing Countries.

2. Learning Losses Based on Remote Engagement



Sources: Engzell and others (2020); OxCGRT; UESCO; WDI; World Bank's COVID-19 High-Frequency Survey; and IMF staff calcuations.
Note: AEs = Advanced Economies; EMs = Emerging Market Economies; LIDCs = Low-income Developing Countries.

(ii) Reduced School Enrollment: Income Effect of COVID-19

In addition to the supply-side reduction in education caused by school closures, the COVID-19 shock is expected to reduce demand for education, especially for low-income countries and households whose income is reduced by the pandemic. The impact of past economic contractions (*Contraction*) on school enrollment rates (*Enroll*) by school level (s), gender (g), country income grouping (i), and year forecast horizon (h) is estimated using panel local projection methods (Jordà 2005) as:

$$Enroll^{s}_{c,g,t+h-1} - Enroll^{s}_{c,t-1} = \alpha_c + \beta_h * Contraction_{c,t} + \varepsilon_{t,h} \qquad h = 1,2,\dots$$

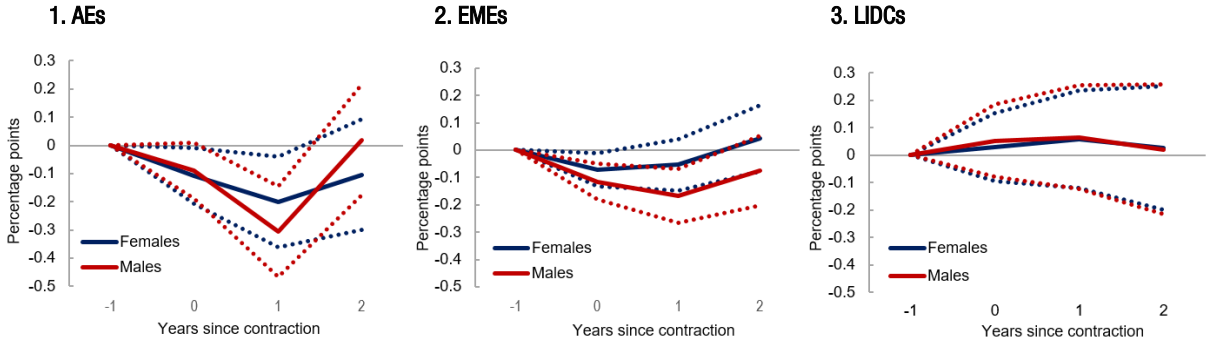
where country fixed effects allow for country-specific (linear) trends in enrollment rates over time (t). The coefficient of interest β_h represents the impact of contractions on enrollment rates at different time horizons. Economic contractions are defined as a recession dummy for years with negative GDP growth (using data from the IMF WEO) multiplied by GDP growth rate to account for the severity of the recession. Contractions are interacted with an indicator variable for country income groups to allow the effect to differ across groups. Data on net enrollment rates and share of school-age children out of school by country, school level, and gender are obtained from the World Bank.

Impulse response functions show that the peak impact on school enrollment would occur in the year following the contraction (Online Annex Figure 2.3.3). Primary school enrollment rates could fall by 0.2-0.3 percent in low-income countries, 0.1-0.2 percent in emerging market economies, and insignificantly in advanced economies.[9] Secondary school enrollment rates also fall by close to 0.3 percent in low-income countries, while results are insignificant for the other country groups.

[8] Measured as a share of lifetime schooling, disparities widen substantially, with learning exceeding 2 percent of lifetime learning for children in advanced economies compared to over 10 percent for children in the lowest income quintile in developing countries, particularly for females and rural areas.

[9] Results are consistent considering the share of primary school-age children out of school, whereas no significant effect is detected for lower secondary school-age children.

Online Annex Figure 2.3.3. Impact of 1 Percent of GDP Contraction on Primary School Enrollment Rates



Sources: World Bank Open Data; and IMF staff calculations.
Note: Solid lines denote point estimates; dotted lines denote 90 percent confidence interval.
AEs = advanced economies; EMs = emerging market economies; LIDCs = low-income developing countries.

Based on these estimates and taking into account the magnitude of countries' economic contraction in 2020, enrollment rates could fall, on average, by around 1 percentage point for primary school-age children in developing countries and for secondary school-age children in low-income countries in 2021. Children who drop out of education are expected to see much larger learning losses than those implied only by school closure days. In addition to losing human capital during the closures, they continue losing human capital in their aftermath, with enrollment effects persisting in future years.[10]

[10] While the peak drop in school enrollment rates tends to occur the year after the recession hits, enrollment effects are likely to be persistent, whereby many children who drop out of school are likely never to return. As this analysis does not track individual students over time, the share of permanent enrollment drops cannot be estimated.

Online Annex 2.4. The Effect of Public Education Spending on School Attendance and Efficiency of Public Education Spending[1]

The main text of the *Fiscal Monitor* (sections IV.A and IV.B) presents estimates of the empirical association between education spending and school enrollment gaps between rich and poor households. It also reports estimates of education spending inefficiencies. This annex presents methodological details.

A. Estimating The Effect of Government Education Spending On Gaps In School Attendance Rates Across Households From Different Income Levels

The data are from UNESCO and the World Bank and cover 38 emerging market and low-income developing countries, including 15 countries from Latin America and 16 from Sub-Saharan Africa, over 2000-2018. Separate panel regressions are estimated using attendance rates for different schooling levels (primary and secondary), considering households in the bottom and top quintiles of the income distribution, as well as gaps in attendance rates between these income groups. In addition to (one year lagged) government education spending as a share of GDP, country fixed effects are included.

Higher government education spending is associated with a smaller attendance rate gap between higher- and lower-income households (Online Annex Table 2.4.1). The dependent variables are the school attendance rates for children from households in the bottom quintile of each country's income distribution (columns 1 and 4), attendance rates for those in the top quintile (columns 2 and 5), and the difference in attendance rates between the top and bottom income quintiles (columns 3 and 6). Government spending in primary and secondary education is associated with higher attendance rates for both lower- and higher-income households but has a stronger effect on the former and thus reduces the gap in attendance rates across household income levels.

Online Annex Table 2.4.1. Effect of Government Education Spending on Attendance Rates

	Primary education			Secondary education		
	School attendance rate for households in bottom quintile	School attendance rate for households in top quintile	Difference in attendance rate between households in top and bottom quintile	School attendance rate for households in bottom quintile	School attendance rate for households in top quintile	Difference in attendance rate between households in top and bottom quintile
	(1)	(2)	(3)	(4)	(5)	(6)
Government education spen	5.061***	2.279**	-2.782***	5.831***	2.506***	-3.325***
	(1.638)	(1.064)	(0.969)	(1.023)	(0.622)	(0.903)
Observations	198	198	198	190	190	190

Source: IMF Staff estimates.
Note: This table reports panel regressions using annual data for a sample of 38 countries over the period 2000-2018, including country fixed effects. Attendance rate is defined as the total number of students of the official age group for a given level of education who are attending school at any level of education, as a percentage of the corresponding population. Robust standard errors are in parentheses. ***, **, * mean statistically significant at the one, five, and ten percent levels respectively.

B. Estimating The Efficiency of Public Education Spending

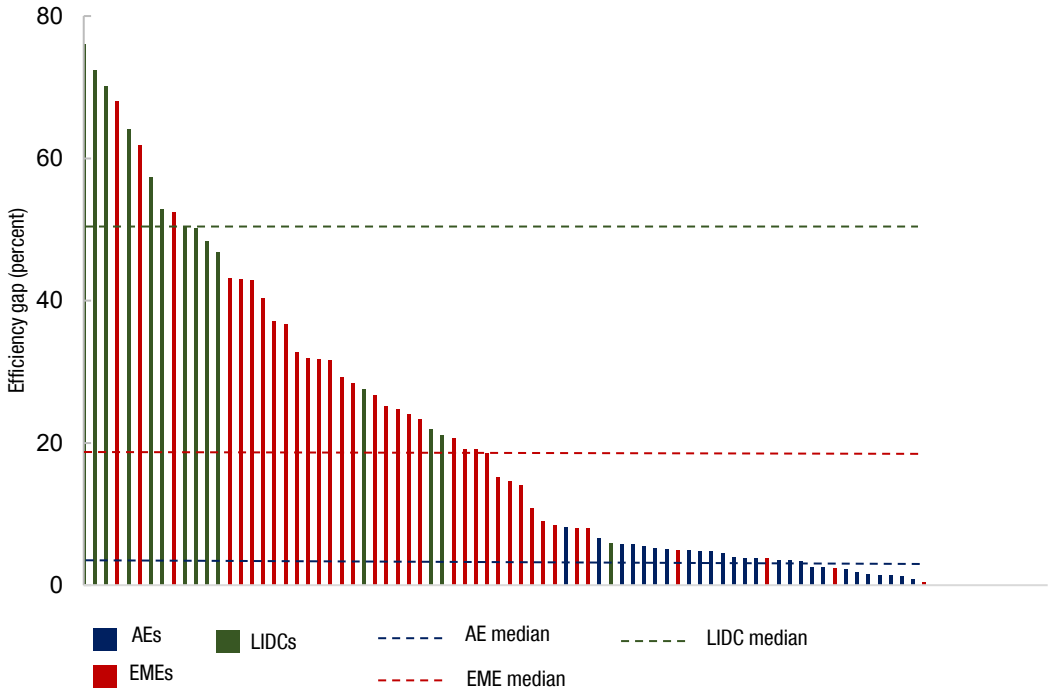
Past studies provide measures of efficiency based on the difference between observed output levels and the maximum that could have been obtained given the inputs utilized (Gupta and Verhoeven 2001; Herrera and Pang 2005; Grigoli 2014). This maximum is the efficient frontier. To estimate the efficiency of public education spending in different countries, first estimates of the unobservable efficient frontier

[1] This Online Annex was prepared by Fernanda Brollo of the Fiscal Affairs Department.

are obtained using Data Envelopment Analysis (DEA), a non-parametric approach that does not assume any specific form for the relationship between inputs and outputs (Charnes and others 1978). Calculations are based on inefficiency scores that show the increase in output that a country could achieve, keeping inputs constant, if it reached the efficient frontier. These scores range from 0 to 1, with higher scores for countries further away from the frontier (i.e., more inefficient countries).

To construct efficiency estimates, two measures of education output are considered: harmonized test scores from Patrinos and Angrist (2018), and net secondary education enrolment rates, from the World Bank. Input is government spending on secondary education as a share of GDP, from the World Bank. Efficiency estimates are constructed for every five years starting in 2000. The inefficiency scores for the latest available date are reported for the 87 countries in our sample (Online Annex Figure 2.4.1).

Online Annex Figure 2.4.1. Government Education Spending Inefficiency



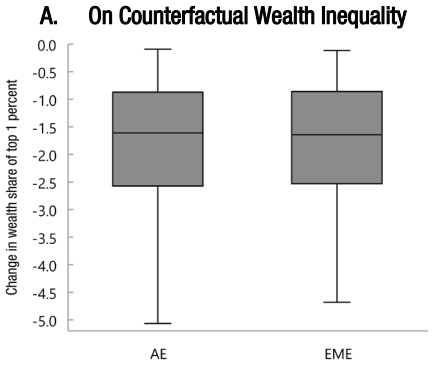
Sources: World Bank; Patrinos and Angrist (2018); and IMF staff estimates.
Note: AEs = Advanced Economies; EMEs = Emerging Market Economies; LIDCs = Low-income Developing Countries.

Online Annex 2.5. Estimating the Potential Mechanical Impact of a Recurrent Wealth Tax on Inequality and Tax Revenue[1]

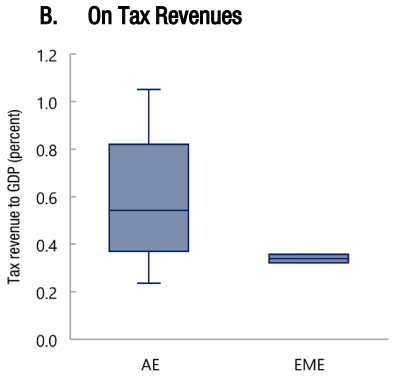
The main text of the *Fiscal Monitor* (section IV.A) presents estimates of the effect on wealth inequality and on revenue from the introduction of a hypothetical recurrent wealth tax. This annex provides details underlying these estimates.

Using data on top wealth shares and country total net wealth in U.S. dollars in 21 advanced and 3 emerging market economies from the Credit Suisse Global Wealth Databook (2019), and medium-term GDP growth forecasts from the IMF October 2020 World Economic Outlook, the mechanical effect from the introduction of a recurrent 1 percent wealth tax on counterfactual wealth inequality is estimated.[2] As in Saez and Zucman (2019), the assumption is made that the expected return on wealth for the top wealth holders is the same as the economy-wide return.[3] Advanced economies in the sample have marginally greater initial wealth inequality than emerging market economies (average country top 1 percent wealth share at 18.5 percent versus 18.2 percent, respectively),[4] but also lower projected returns on wealth (3 percent versus nearly 5 percent), which would translate into less accelerated growth of wealth concentration over the projection horizon.[5]

Online Annex Figure 2.5.1. Effect of Introduction of a 1 percent Recurrent Wealth Tax on the Top 1 percent of Wealth Distribution.



Sources: Credit Suisse Wealth 2019 Databook; IMF World Economic Outlook Database; and IMF staff calculations.
Note: Reduction in the share of wealth owned by the top 1 percent of individuals over 20 years of a recurring 1 percent tax on wealth for those individuals, assuming no behavioral responses. Data available for 21 advanced economies and 3 emerging economies.



Sources: Credit Suisse Wealth 2019 Databook; IMF World Economic Outlook Database; and IMF staff calculations.
Note: Average tax revenue ratio to GDP under a recurring wealth tax of 1 percent on the top 1 percent of individuals over 2020-2039. Data available for 21 advanced economies and 3 emerging economies.

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[1] This Online Annex was prepared by Maria Coelho of the Fiscal Affairs Department.

[2] Advanced economies: *Austria*, *Belgium*, *Canada*, *Denmark*, *Spain*, *Estonia*, *Finland*, *France*, *Greece*, *Ireland*, *Italy*, *Japan*, *Luxembourg*, *Latvia*, *The Netherlands*, *Norway*, *Portugal*, *Slovak Republic*, *Slovenia*, *Sweden*, and *the United States*; and emerging market economies: *Hungary*, *India*, *Poland*.

[3] This is a conservative assumption, because extreme net worth individuals are likely to have opportunities to earn higher economic returns than the average individual (e.g. Fagereng and others 2020). Higher returns on wealth at the top would translate into even higher wealth inequality over time, for any given initial distribution of wealth. Thus, the estimated reduction in top wealth shares represents an upper bound on such potential for any given tax rate. Other factors such as behavioral responses and volatility of economic returns over time could further dampen the potential effect of this policy on inequality reduction.

[4] The wealth share of the top 10 percent is 52.6 in advanced versus 45.8 percent in emerging economies, respectively.

[5] The higher projected returns in emerging economies reflects the fact that the proxy used for projected returns in this exercise is average nominal GDP growth in the available projection horizon, and emerging economies on average display higher rates of economic growth than the sluggish growth observed and forecast for advanced economies in the medium-term.

Absent individual avoidance or evasion behavioral responses (a strong simplifying assumption), countries would reduce the top 1 percent wealth share by 1-2½ percentage points, depending on the country (Online Annex Figure 2.5.1, panel A). The tax revenue to GDP potential (Online Annex Figure 2.5.1, panel B), of 0.4-0.6 percent of GDP on average, is in line with actual collections of comparable taxes in countries that currently have them.[6] International cooperation on information sharing and compliance enforcement, such as automatic exchange of information, would be critical for revenue collections to be near such potential estimates.

[6] Only four OECD countries (*France*, *Norway*, *Spain,* and *Switzerland*) currently levy wealth tax on a recurrent basis bringing in 0.2-1.0 percent of GDP in tax revenues annually (OECD, 2018).

Online Annex 2.6. Public Perceptions and Distributive Policies[1]

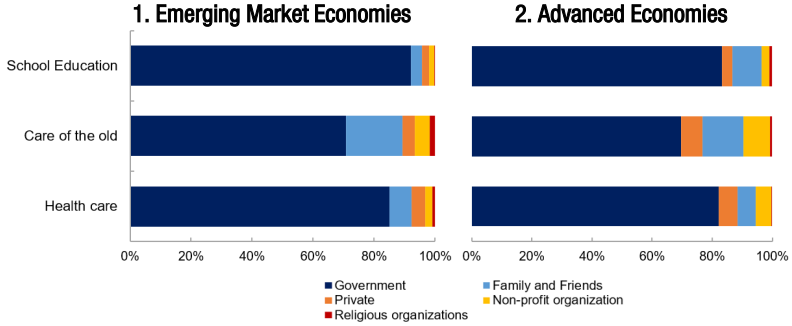
The main text of the *Fiscal Monitor* (Section V) reports results on preferences for distributive policy inferred from cross-country surveys and discusses the need for caution in interpreting them. This annex provides details behind those results.

A. Support For Government Spending Size, Spending Mix And Progressive Taxation

The 2016 Role of Government (ROG) survey from the International Social Survey Program (ISSP)[2] is used to study preferences for distributive spending including education, health, old age pension and unemployment benefits, as well as for progressive taxation. The survey covers 35 economies from different geographic regions and at different income levels with the total of more than 40,000 individual-level observations. Samples are designed to be representative of all adult population.

Several questions gauge support for government spending. First, respondents are asked whether they would like to see more or less spending in eight areas, with a warning that if they say, "much more", it might require a tax increase to pay for it. Education, health, and pensions are the top spending priorities for the respondents. A higher share of respondents from emerging than advanced economies would prefer increases in almost every spending category, with the largest differences for pensions and unemployment benefits. Consistent with these preferences, most respondents believe that the government should reduce income inequalities, and that it is the government that should provide health care and education and take care of the old (Online Annex Figure 2.6.1). However, less than half of the respondents think the government is successful in caring for the sick or for the old. Most respondents think that the tax burden on the low and middle income is too high and that the government should cut spending, albeit the latter is less pronounced for the young (Online Annex Tables 2.6.1 and 2.6.2).

Online Annex Figure 2.6.1. Preferences for Providing Basic services



Source: ISSP ROG 2016
Note: Respondents answer a question about who should primarily provide each of these services

The ISSP also allows for documenting preferences for progressive taxation. The survey asks in the same manner the extent to which the tax burden of the rich and of the poor is too high. If a respondent

Online Annex Table 2.6.1. Preferences for Spending Cuts

	Strongly in favor	In favor	Total
Advanced	***28%***	***35%***	***62%***
Female	27%	34%	62%
Young (<= 25 years old)	22%	32%	53%
Emerging	***36%***	***39%***	***75%***
Female	36%	39%	76%
Young (<= 25 years old)	32%	39%	72%

Sources: ISSP (2016); and IMF staff calculations.

[1] This Online Annex was prepared by Chuling Chen and Jean-Marc Fournier, both from the Fiscal Affairs Department.

[2] The ISSP ROG is a unique high-quality cross-country database for comparative research on political attitudes (Edlund and Lindh 2019). It has been fielded five times (1985, 1990, 1996, 2006 and 2016) covering topics on civil rights, government intervention in the economy, government spending, and government responsibilities and performance. The 2016 ISSP ROG module was fielded in 23 advanced and 12 emerging market economies: *Australia*, *Belgium*, *Chile*, *Croatia*, *Czech Republic*, *Denmark*, *Finland*, *France*, *Georgia*, *Germany*, *Hungary*, *Iceland*, *India*, *Israel*, *Japan*, *Korea*, *Latvia*, *Lithuania*, *New Zealand*, *Norway*, *Philippines*, *Russia*, *Slovak Republic*, *Slovenia*, *South Africa*, *Spain*, *Suriname*, *Sweden*, *Switzerland*, *Taiwan Province of China*, *Thailand*, *Turkey*, *the United Kingdom*, *the United States*, and *Venezuela*.

believes that taxes on the rich are too low and they are too high for the poor, this could be interpreted as preference for more progressive taxation. On this basis, in most economies a higher share of respondents supports more progressive taxation. The view is held across income levels, for both advanced and emerging economies, and at high or low trust of civil servants (Online Annex Figure 2.6.2).

A regression analysis with country fixed effects explores how public preferences for spending size, spending reallocation including toward education, health, and pension, and progressive taxation (Online Annex Table 2.6.3) relate to individual characteristics, perceptions of government capacity, and trust in civil servants.[3] Views on the size of spending are captured by preferences toward cuts in spending, or toward spending more (measured when a respondent wants additional spending in at least one area without cuts in the others). Demand for spending reallocation is an individual-level standard deviation across answers to questions about spending more in eight areas. This is complemented by another measure, which is support for shifting resources toward specific sectors: difference between the demand for a particular sector and the average demand for spending across all sectors.

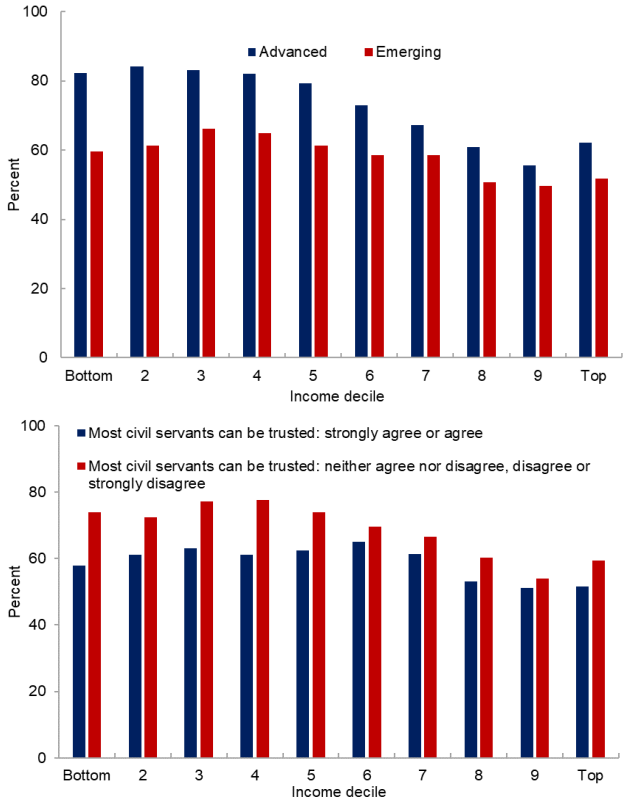
Higher income respondents are less supportive of larger government or progressive taxation (Online Annex Table 2.6.3). The young and families with children support education spending more, whereas female respondents support general spending increases more. Distrust in civil servants is associated with support for more spending cuts, spending relocation toward basic services such as education and health, and more progressive taxation (Online Annex Figure 2.6.3). Moreover, regressions (not reported here) show that higher mistrust is associated with stronger opposition to taxing the poor, suggesting that the lower the trust the higher the demand for more progressivity rather than overall taxation.

Online Annex Table 2.6.2. Views on Tax Levels Across the Income Distribution

	Taxes are too high for the			Taxes are too low for the		
	high income	middle income	low income	high income	middle income	low income
Advanced	19%	50%	71%	53%	4%	3%
Emerging	32%	51%	64%	36%	10%	13%

Sources: ISSP (2016); and IMF staff calculations.
Note: Share of respondents answering "much too high" or "too high" for taxes are too high, "much too low" or "too low" for taxes are too low. Respondents can also answer about right.

Online Annex Figure 2.6.2. Support For Progressive Taxation By Income Decile



Sources: ISSP (2016); and staff calculations.
Note: Support for progressive taxation is the share of respondents whose answer to the question on the tax burden on the high income is too high is below the answer to the question on the tax burden on the low income.

[3] The analysis regards qualitative variables with ordered modalities such as "much more", "more", "about right", "less" and "much less" as quantitative variables, following the advice of Norman (2010) among others.

This may be viewed as a corrective measure against inequalities arising due to perceived corruption (Domonkos 2016; Di Tella, Dubra, and Lagomarsino 2019). Additional regressions show that perception of corruption is associated with demand for spending in education, health and pensions, which people consider beneficial and may be less prone to corruption (IMF 2019).

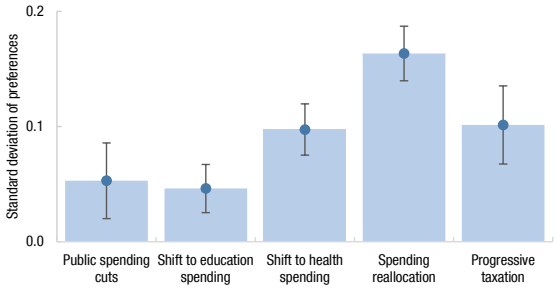
Online Annex Table 2.6.3. Panel Regressions for Preferences on Spending and Taxes

	Spending cuts	Spending more	Reallocation	Shift to education	Shift to health	Shift to pensions	Progressive taxation		High income taxes
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<=25 years old	-0.047**	-0.001	-0.114	0.052***	-0.042***	-0.107***	-0.211***	-0.130**	-0.135***
>= 55 years old	0.015	0.025**	-0.305***	-0.053***	-0.022**	0.096***	0.142**	0.140***	0.126***
Female	0.014	0.032***	-0.402***	-0.013	0.021**	0.029***	-0.023	0.024	-0.026
Married	0.068***	0.004	-0.135*	0.022	-0.009	-0.018	0.019	0.029	0.020
Children	-0.034	-0.013	0.021	0.073***	0.010	-0.034***	-0.077**	-0.086**	-0.027
Secondary education	0.058*	-0.008	0.288*	0.023	0.022	-0.025	0.039	0.077*	0.038
Tertiary education	-0.031	-0.002	0.352*	0.121***	-0.011	-0.181***	-0.134**	-0.086	0.010
Unemployed	-0.024	0.005	-0.019	-0.077***	-0.039**	-0.027*	0.049	0.051	0.053**
Divorced	0.067***	-0.004	0.132	0.010	-0.004	0.037**	0.086*	0.052	0.046*
Income quintile	0.017***	-0.008**	0.027	0.017***	-0.007	-0.019***	-0.078***		-0.045***
Perceived income decile								-0.084***	
Trust in civil servants	-0.053***	0.039***	-0.668***	-0.028***	-0.058***	-0.057***	-0.145***	-0.134***	-0.080***
Government makes people pay taxes							-0.050**	-0.039**	-0.087***
Constant	2.748***	0.346***	6.844***	0.360***	0.574***	0.522***	1.855***	1.943***	3.815***
Observations	32,557	33,718	30,530	30,530	30,530	30,530	29,170	34,102	29,635
R-squared	0.006	0.011	0.030	0.019	0.012	0.038	0.029	0.032	0.024
Number of country	35	35	35	35	35	35	35	34	35

Sources: ISSP (2016); and IMF staff estimates.
Note: Spending more means spending more in at least one of eight spending sectors and no cut in others. Reallocation is the individual-level standard deviation across answers to questions about spending more in eight areas. Shift to sectors refers to the difference between spending more for this sector and average demand for spending more. Income quintile is the quintile within the distribution of self-declared income among respondents. Perceived income decile is self-declared income decile. Progressive taxation is the difference between perception that the tax burden is too low for the high income and the tax burden is too low for the low income. High income tax is the perception that the tax burden is too low for the high income. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1.

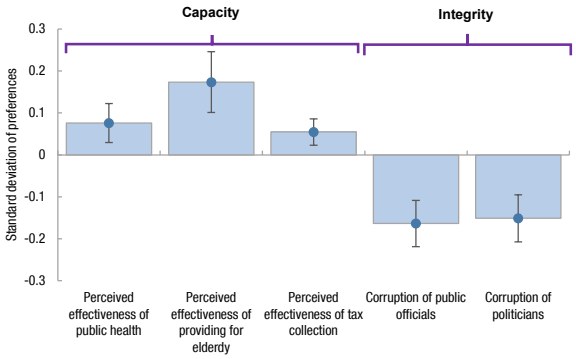
Indeed, trust in government can depend on respondents' view of the government's capacity and integrity to deliver basic services (Online Annex Table 2.6.4, Online Annex Figure 2.6.4). Capacity is measured with perceived success in taking care of the old and the sick, or in collecting taxes. Integrity is measured with perceived corruption of government officials and of politicians.

Online Annex Figure 2.6.3. Effect of Distrust in Government on Demand for Spending Cuts, Reallocation and Progressive Taxation



Sources: ISSP (2016); and IMF staff estimates.
Note: Columns show estimated effect of one-standard deviation decline in trust. Individual-level data covering 23 advanced and 12 emerging economies in 2016. Whiskers show 95 percent confidence intervals.

Online Annex Figure 2.6.4. Trust in Government, Government Capacity and Government Integrity



Sources: ISSP (2016); and IMF staff estimates.
Note: The figure presents coefficient estimates of OLS regressions of trust in civil servants on capacity and integrity variables with additional controls. Individual-level data covering 14 advanced and 9 emerging economies in 2016. Whiskers show the 95 percent confidence interval.

Similar regression results were obtained using the ISSP ROG 2006 data (not reported here), which covered 33 countries and had consistent questions on spending preferences, tax burdens, trust, and perceptions of corruption and government effectiveness in taking care of the old and sick.

B. Support For Government Provision of Public Services

To further explore the association between preference for distribution and trust in government, the World Value Survey (WVS) provides a complementary angle, with different survey questions and a broader country coverage. The minimum sample size per country is 1,200 and samples are designed to be representative of all adult population. Preference for distribution is measured with questions on outcomes provided by the government, rather than on spending. Respondents are asked to rank their preferences on a scale from 1 to 10 whether "People should take more responsibility to provide for themselves" (coded as 1) or "The government should take more responsibility to ensure that everyone is provided for" (coded as 10). Trust in the government is captured by a confidence question that ranges from zero (none at all) to 3 (a great deal). WVS trust data are correlated with experimentally measured trust (Johnson and Mislin 2012) and alternative surveys (Gonzales and Smith 2017). The analysis covers 30 advanced, 52 emerging, and 20 low income developing economies from 1989 to 2019.

The linear regression analysis relating preference for distribution to socio-economic status, education, income, trust, beliefs and values is similar to Alesina and Giuliano (2011). Country and year fixed effects are included. Preference for distribution is negatively associated with trust in government, perceived income and health status, and positively associated with being unemployed or female (Online Annex Table 2.6.5). The negative association between trust in government likely reflects an association between distrust and dissatisfaction with services that are provided. People with low trust in government thus want it to provide more services. This may reflect demand for greater spending efficiency, because the analysis above with the ISSP data suggests that those who distrust the government want it to spend less. The analysis also shows that people who are more likely to benefit from public services—like the unemployed, those who believe their income is low, or those in poor health—want more distribution.

Online Annex Table 2.6.4 Panel Regressions for Trust

	Trust in civil servants	
VARIABLES	(1)	(2)
<=25 years old	-0.002	-0.044
>= 55 years old	0.086***	0.069**
Female	0.009	-0.001
Married	0.054*	0.033
Children	-0.026	-0.016
Secondary education	-0.031	-0.032
Tertiary education	0.017	-0.031
Unemployed	-0.025	-0.033
Divorced	0.027	0.036
Income quintile	0.022*	
Perceived income decile		0.054***
Successful in caring the sick	0.084***	0.077***
Successful in caring the old	0.172***	0.176***
Government makes people pay taxes	0.062***	0.075***
Corruption of government officials	-0.176***	-0.163***
Corruption of politicians	-0.157***	-0.153***
Constant	1.805***	1.537***
Observations	16,339	18,492
R-squared	0.164	0.166
Number of country	23	22

Sources: ISSP (2016); and IMF staff estimates.
Note: Income quintile is the quintile within the distribution of self-declared income among respondents. Perceived income decile is self-declared income decile. Robust standard errors in parentheses.
***p<0.01, **p<0.05, *p<0.1.

Online Annex Table 2.6.5 Panel Regressions for Preference for Redistribution

	Preference for redistribution	Preference for equality
VARIABLES	(1)	(2)
age under 25	-0.095***	0.014
age between 45 and 65	-0.033**	0.040***
age above 65	-0.053***	0.047**
female	0.112***	0.092***
married	-0.069***	-0.069***
divorced	-0.122***	-0.062**
separated	-0.078*	-0.058
unemployed	0.122***	0.053***
high school	-0.136***	-0.233***
college	-0.151***	-0.329***
Perceived income	-0.120***	-0.120***
Perceived health status	-0.118***	-0.093***
trust in the government	-0.091***	-0.035***
Constant	7.818***	6.562***
Observations	297,170	295,484
R-squared	0.091	0.100

Sources: World Values Survey; and IMF staff calculations.
Note. Gov.: government. Civil serv.: Civil service. The political scale ranges from 1 (left) to 10 (right). Extreme political view: absolute difference between political scale and 5.5. Country, year fixed effects and the constant are included. Robust standard errors in parentheses.
***p<0.01, **p<0.05, *p<0.1.

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