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Central America and the Caribbean Regional Education Report

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Central America and the Caribbean Regional Education Report

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Acronyms List

GDP	Gross Domestic Product
ICT	Information and Communications Technology
IFs	International Futures
IHME	Institute for Health Metrics and Evaluation
ILO	International Labor Organization
ISCED	International Standard Classification of Education
LLECE	Latin American Laboratory for Assessment of the Quality of Education
MFP	Multifactor Productivity
MIDEH	Mejorando el Impacto al Desempeño Estudiantil de Honduras
PID	Proportional Integral Derivative
SDG	Sustainable Development Goal
SERCE	Second Regional Comparative and Explanatory Study
TFR	Total Fertility Rate
UAC	Unaccompanied Alien Children
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNODC	United Nations Office on Drugs and Crime
UNPD	United Nations Population Division
US	United States
USAID	United States Agency for International Development
WB	World Bank

Abstract

This report highlights the value of greater education investments in Central America and the Caribbean and assesses education's impacts on aspects of development, including GDP, GDP per capita, poverty, emigration, and violence, by conducting quantitative modeling using International Futures. It also explores benefits and costs of a scenario that pushes for achievement of SDG 4.1 - quality education for all children through secondary school by 2030. This SDG Achievement scenario generates various positive development impacts compared to the expected development trajectory. Impacts are examined for 2040 and 2060, but due to the time lag between education investments and their impacts, effects are greater in 2060. In Central America, the scenario boosts GDP by 5.3 percent, GDP per capita by 4.5 percent, reduces poverty by 12 percent, and lowers emigration and homicide by two percent in 2040. By 2060, it boosts GDP by 17.8 percent, GDP per capita by 14.3 percent, lowers poverty by 33.3 percent, reduces emigration by four percent, and homicide by five. In the Caribbean, it boosts GDP by 4.1 percent and GDP per capita by 3.7 percent, lowers poverty by 3.7 percent, and emigration by 1.4 percent in 2040. By 2060, it increases GDP by 13.1 percent, GDP per capita by 11.8 percent, lowers poverty by 20 percent, emigration by four percent, and homicide by 6.8 percent. Gains are observed across all countries, but underperformers, such as Haiti, Guatemala, and Honduras, start from a low base and experience some of the greatest gains.

Terms and Grouping

Box 1: A note on countries and groupings used in this report

The discussion of results in the regional section of the report includes different country groups throughout. To avoid confusion, Table 1 lists the group name and countries included in each. These group names are used consistently throughout the report.

Table 1: Regional groupings used in report.

Group name in report	Countries included
Central America and the Caribbean	Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Bahamas, Barbados, Cuba, Dominican Republic, Grenada, Haiti, Jamaica, Puerto Rico, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago
Central America	Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama
Caribbean[a]	Bahamas, Barbados, Cuba, Dominican Republic, Grenada, Haiti, Jamaica, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago

[a] Antigua and Barbuda, Dominica, and Saint Kitts and Nevis are not represented in IFs and thus not included in this report.

USAID has education programs in the following countries: El Salvador, Guatemala, Honduras, Nicaragua, the Dominican Republic, Haiti, and the Eastern Caribbean.[1]

This report also compares Central American and the Caribbean to other UN sub-regions, namely: UN North Africa, UN South America, UN Southeast Asia, and UN South Asia. These regional comparison groups were chosen based on average income levels (GDP per capita) and/or historical comparability based on income and/or geography. The detailed country groupings are as follows:

- **UN North Africa:** Algeria, Egypt, Libya, Morocco, Sudan, Tunisia
- **UN South America:** Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela
- **UN Southeast Asia:** Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste, Vietnam
- **UN South Asia:** Afghanistan, Bangladesh, Bhutan, India, Iran, Maldives, Nepal, Pakistan, Sri Lanka

[1] USAID has programs in the following countries in the Eastern Caribbean: Antigua and Barbuda, Dominica, Grenada, St Lucia, Saint Kitts and Nevis, St. Vincent and the Grenadines.

Table 2: Key terms used throughout this report.

Term	Definition
Sustainable Development Goals (SDGs)	This set of goals is defined on the United Nations (2018) website as "the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including those related to poverty, inequality, climate, environmental degradation, prosperity, and peace and justice."
Sustainable Development Goal 4.1	By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes
Current Path	A collection of interacting forecasts based on historical trend data. The Current Path generally demonstrates continuity with historical policy choices and environmental conditions, but generates a wide range of non-linear forecasts rather than a simple linear extrapolation of these trends.
Adult educational attainment	The average years of schooling for adults ages 15 and older
Education quality	The overall strength of the education system. This report uses test score estimates and projections to provide a standardized, comparable indicator of student achievement, which can be used to indicate the overall strength of the system.
International Futures (IFs)	A free and open-source quantitative tool used to understand dynamics within and across global systems, and to think systematically about potential trends, development goals, and targets. IFs forecasts — which are calculated using data and a mix of quantitative modeling approaches — offer a broad and transparent way to think about the tradeoffs in policymaking.
Highly skilled workers	Workers with college or technical training who possess specialized skills and knowledge
Brain Drain	The emigration of highly skilled workers in search of better opportunities abroad
Multifactor productivity (MFP)	An indicator of economic performance that represents the share of output (goods and services produced) that cannot be explained by labor and capital inputs

Table 3: Education indicator definitions

Variable	UNESCO Definition
Gross enrollment rate	Number of students enrolled in a given level of education, regardless of age, expressed as a percentage of the official school-age population corresponding to the same level of education. For the tertiary level, the population used is the 5-year age group starting from the official secondary school graduation age.
Net enrollment rate	Total number of students in the theoretical age group for a given level of education enrolled in that level, expressed as a percentage of the total population in that age group.
Graduation rate (gross)	Number of graduates regardless of age in a given level or program, expressed as a percentage of the population at the theoretical graduation age for that level or program.
Completion rate	Percentage of a cohort of children or young people aged 3-5 years above the intended age for the last grade of each level of education who have completed that grade.
Transition rate	Number of students admitted to the first grade of a higher level of education in a given year, expressed as a percentage of the number of students enrolled in the final grade of the lower level of education in the previous year.
Survival rate by grade	Percentage of a cohort of students enrolled in the first grade of a given level or cycle of education in a given school year who are expected to reach a given grade, regardless of repetition.
Repetition rate by grade	Number of repeaters in a given grade in a given school year, expressed as a percentage of enrolment in that grade the previous school year.
Gender parity	Purely a numerical concept. Reaching gender parity in education implies that the same proportion of boys and girls - relative to their respective age groups - would enter the education system and participate in its different cycles.
Literacy rate	Total number of literate persons in a given age group, expressed as a percentage of the total population in that age group. The adult literacy rate measures literacy among persons aged 15 years and above, and the youth literacy rate measures literacy among persons aged 15 to 24 years.
Government expenditure on education per student (as % of GDP per capita)	Average total (current, capital and transfers) general government expenditure per student in the given level of education, expressed as a percentage of GDP per capita.
Government expenditure on education (as % of GDP)	Total general (local, regional and central) government expenditure on education (current, capital, and transfers), expressed as a percentage of GDP. It includes expenditure funded by transfers from international sources to government.

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Executive Summary

Educational attainment and quality are projected to improve in Central America and the Caribbean along the expected development trajectory, but various challenges persist, and education outcomes are expected to lag behind those of many other regions. First, some regional peers, including South America and Southeast Asia, are expected to outperform Central America and the Caribbean across specific education indicators, such as education quality, as measured by test scores, and attainment, as measured by the effectiveness with which students are moved through the school system. Central America's test scores are also projected to lag behind North Africa and South Asia, while its attainment is projected to lag behind South Asia. Superior performance amongst these regional peers can be explained by faster growing economies or greater education spending.

Based on projections of current development trends, Central America and the Caribbean are forecast to fall short of achieving Sustainable Development Goal (SDG) 4.1 – full enrollment and graduation across primary and secondary school by the year 2030. This can be explained in part by underperformers in the region. Haiti, Guatemala, and Honduras continue to perform below Central American and Caribbean averages in educational attainment and quality. The Dominican Republic and Nicaragua also lag behind most neighboring countries in education performance. Insufficient education spending, especially in Central America, further explains the suboptimal forecast. The projected shortcomings in educational attainment and quality are problematic because education is essential to other areas of development, including decreased emigration rates and increased economic output. An additional push in education investments will be needed for Central America and the Caribbean to reach SDG 4.1.

This report highlights the value of greater investment (by governments as well as by external actors) in education in Central America and the Caribbean and assesses education's impacts on various aspects of development, such as emigration, GDP, GDP per capita, poverty, and violence. The benefits associated with these investments increase between the two time periods examined (2040 and 2060) because students need time to move through the education system, enter the workforce, and boost economic productivity. The report also explores the benefits and costs of a scenario in which Central America and the Caribbean achieve SDG 4.1 by 2030.

To evaluate the impacts of education investments in this part of the world, the Pardee Center draws upon its background in data assessment and scenario construction to forecast effects on various aspects of development. We use International Futures (IFs), a quantitative modeling tool, to develop scenarios that can be used to assess the impacts of education investments. The IFs platform uses data and a mix of different quantitative modeling approaches to provide an alternative way to think about tradeoffs in policymaking. Because education is modeled within IFS, as are the economy, violence and migration, we can shed light on the effects of education investments on these other outcomes. In the IFs model, education has direct (and indirect through other modules) effects on the economy (GDP and inequality) and labor. Education affects violence and migration indirectly through its impacts on the economy and labor. We believe that IFs provides a good way to help frame this work in the future, though we recognize that there is not a large literature documenting these relationships that affected the modeling choices made. In addition, the relationships, and findings, are affected by the quality of the data

available for use in modeling. As more information is available on these variables and relationships, the modeling can be updated.

We conduct two scenario analyses in this report. First, we use IFs to determine the current path of development in Central America and the Caribbean and compare this path to a situation in which investments in education stall. This demonstrates the impact of investments in education on development outcomes. Then, the current path of development is compared to the *SDG Achievement* scenario, which pushes for enrollment and graduation across primary and secondary school by the year 2030 and increases primary and secondary test scores to the average test scores in Central America and the Caribbean's top-performing countries (Cuba and Costa Rica) by 2040.

As part of its analysis, the report describes the geographic areas within Central America and the Caribbean that require the most attention. When separated, the Caribbean fairs better than Central America. However, both Central America and the Caribbean contain countries that may need extra consideration. Compared to average educational attainment in Central America, Guatemala and Honduras continue to underperform. Compared to average attainment in the Caribbean, Haiti underperforms. Average overall primary and secondary test scores in these countries (and the Dominican Republic) also register below the averages for Central America and the Caribbean. Notably, primary reading scores are below sub-regional averages (Central America or the Caribbean) for each of these countries except Honduras, and secondary reading scores are below the Caribbean average for all but the Dominican Republic. Furthermore, Nicaragua's attainment and test scores are only slightly above the Central American averages; the country may also require special consideration when examining broader performance.

Current Path Scenario

The Caribbean currently outperforms Central America in education attainment and quality. However, North Africa, South America, Southeast Asia, and South Asia – regional peers chosen based on average income levels GDP per capita and/or historical comparability based on income and/or geography - outperform Central America and the Caribbean in certain aspects of education. For example, Central American educational attainment lags behind all regional peers with the exception of North Africa (and is nearly the same as South Asia), while the Caribbean and South America outperform all regional peers. However, the Caribbean is outperformed by South America in overall primary test scores, while overall Central American scores lag behind regional peers with the exception of North Africa and South Asia. Poor performance in Central America reflects constraints that arise early in the education system. This is because primary students often fail to acquire the skills needed to succeed in secondary school. Constraints in the Caribbean occur later in the education system, typically at the secondary level.

Current underperformance can be explained in part by certain countries within each of the sub-regions, namely Haiti and the Dominican Republic in the Caribbean, and Guatemala, Honduras, and Nicaragua in Central America. These underperforming countries continue to lag behind neighboring countries in educational attainment and quality, and because they are populous, they hinder regional averages. Education spending also explains Central America and the Caribbean's performance compared to peers. While average spending in the Caribbean meets international standards, Haiti spends less than 2.5 percent of GDP on education, less than

any other country in Central America and the Caribbean. Also, Central America's average per pupil spending is low by international standards.

Using IFs, we were able to evaluate the current performance of Central America and the Caribbean, as well as expected development if trends continue. The Current Path – which captures the expected outcomes if current trends persist - projects that educational attainment in the Caribbean will improve from 8.3 years in 2017 to 9.3 in 2040. While this may appear to be a small increase, large gains can only occur for so many years before the rate of improvement begins to slow. This is why developed countries, with high average years of educational attainment, may expect to see little to no improvements in average years of education over the same time period.

Modest improvements are expected across other variables in the Caribbean. Average primary test scores are projected to increase from 37.6 to 40.4 and secondary test scores from 44 to 46.9 on a scale from zero to 100 (in which all countries have average scores between 20 and 60); GDP in the Caribbean is projected to increase from roughly $209 billion to $482 billion (roughly on par with Austria today). This means that the GDP is expected to grow at a faster rate than during the previous 30 years; between 1987 and 2017, the GDP in the Caribbean increased by roughly $100 billion, compared to more than $270 billion between 2017 and 2040. Between 2017 and 2040, GDP per capita is also projected to rise from $5.4 thousand to $18.1 thousand; poverty is expected to fall from 9.1 million to eight million.

In Central America, educational attainment is forecast to improve from seven years in 2017 to 8.5 years in 2040; average overall primary test scores are projected to increase from 32.5 to 37.2 and secondary test scores from 40.2 to 44.7. Central American GDP is forecast to increase from approximately $222 billion to $556 billion, while GDP per capita is projected to rise from $4.6 thousand to $13.7 thousand. Poverty is projected to fall from approximately 8.9 million to 6.8 million.

While these changes indicate improvements across the economy and education, education spending in both Central America and the Caribbean is projected to fall in comparison to regional peers. Additional spending is needed to outperform regional peers and reach SDG 4.1. This spending would also be helpful to other aspects of development, as demonstrated by additional analyses in this report that highlight the value of education in shaping economic outcomes, emigration rates, and homicide rates in 2040.

According to analysis in IFs on the value of education, education investments are projected to contribute significantly to development in Central America and the Caribbean. Without these investments, Central American GDP in 2040 is projected to be roughly six percent lower than expected along the Current Path. Caribbean GDP is also projected to be about six percent lower. Furthermore, the number of skilled Central American workers in 2040 is forecast to be 4.5 percent lower and the number of informal sector workers is projected to be 8.6 percent higher. Similar trends are observed in the Caribbean. The number of skilled Caribbeans in 2040 is 4.8 percent lower without investments in education and the number of informal sector workers is 14.4 percent higher. Furthermore, without these investments, there are forecast to be one million more Central Americans and 500,000 more Caribbeans living in poverty in 2040. Without education investments, the homicide rate is projected to be 3.6 percent higher in Central

America and 7.8 percent higher in the Caribbean. Emigration from Central America and the Caribbean is also higher in a world in which education stalls; Central American emigration is projected to be 2.2 percent higher and Caribbean emigration 1.4 percent higher.

Findings from this analysis on the value of education are backed by literature on education's extensive benefits. Education builds knowledge and helps students refine their skillsets, but it also affects and is affected by the economy, migration, and to a lesser extent, violence. Since 1990, Central America and the Caribbean's GDP growth rates have lagged behind the average GDP growth rates across upper-middle income economies and remain close to a full percent lower than the average for lower-middle income economies. However, improvements in education can help boost skills and output levels of the work force, leading to greater productivity and output. Emigration rates have also presented a challenge to development. Since 1960, the Caribbean and Central America have seen some of the highest rates of out migration of any global UN sub-regions, often due to societal violence and lack of economic opportunity. For example, in 2017, IFs estimates that approximately 125,000 people emigrated from Central America (0.26 percent of the total population), while 101,000 emigrated from the Caribbean (0.26 percent of the population). Many cross-country studies find little direct connection between education and migration, but a few studies, such as UNESCO (2012) and Williams (2015), find that education-based interventions can help limit youth violence. Education is also tied to violence. Its impact is not clear or direct at a cross-country macro level, but education can impact violence indirectly through inequality and the youth bulge. This is an important consideration for the analysis, as several countries in Central American and the Caribbean (including the aforementioned underperformer, Guatemala) rank amongst the highest in the world for homicide rates. According to IHME data, for every 100,000 people in 2017, the homicide rates are 32.8 in Honduras, 35.8 for Guatemala, and 54.8 for El Salvador.

As discussed above, educational attainment and quality are projected to progress out to 2040 under the Current Path scenario, leading to improvements across these different facets of development. However, Central America and the Caribbean are forecast to underperform compared to some of their regional peers. In 2040, all regional peers are projected to have higher rates of primary survival and graduation at the lower and upper secondary and tertiary levels. Central America's overall test scores at the primary level are projected to lag behind all regional peers, while the Caribbean's are projected to lag behind South America and Southeast Asia. Central America and the Caribbean are also projected to fall short of SDG 4.1, quality education through the secondary level. Additional investments are needed to achieve SDG 4.1, outperform regional peers, and make greater strides in limiting emigration, improving economic outcomes, and alleviating poverty.

SDG Achievement scenario

The *SDG Achievement* scenario improves outcomes across the economy, such as the size of the informal sector, GDP and GDP per capita, and poverty rates. It also reduces emigration and has a small mitigating impact on violence. The magnitude of these effects increases fourfold for the GDP and poverty, and twofold for emigration and violence from 2040 to 2060, as more students move through the education system and enter the labor force.

The economic impacts of education investments demonstrate the importance of this time lag. When compared to the Current Path of development, the *SDG Achievement* scenario generates a

better-educated workforce, reducing the number of informal sector workers in Central America by five percent in 2040 and 14 percent in 2060. In the Caribbean, it reduces the number of informal sector workers by nearly nine percent in 2040 and nearly 22 percent in 2060. The *SDG Achievement* scenario also leads to a Central American GDP that is 5.3 percent higher than the Current Path and GDP per capita is 4.5 percent higher. Better-educated workers continue to enter the workforce after 2040, generating additional economic gains. In 2060, the Central American GDP is 17.8 percent higher than under the Current Path and GDP per capita is 14.3 percent higher. In the Caribbean, GDP is 4.1 percent higher and GDP per capita is 3.7 percent higher in 2040 than under the Current Path. In 2060, GDP is 13.1 percent higher and GDP per capita is 11.8 percent higher.

Improvements over the Current Path can also be observed in the poverty rate, emigration, and violence. Slight reductions in inequality combined with economic gains realized under the *SDG Achievement* scenario reduce the number of Central Americans living on less than $3.10/day by 12 percent in 2040 and 33.3 percent in 2060 (compared to the Current Path). In the Caribbean, poverty is reduced by 3.7 percent in 2040 and 20 percent in 2060. Increases in GDP and GDP per capita and slight reductions in the homicide rate help lower emigration. Under the *SDG Achievement* scenario, emigration from Central America is about two percent lower in 2040 and 4.9 percent lower in 2060. Caribbean emigration is 1.4 percent lower in 2040 and 4.1 percent lower in 2060. The *SDG Achievement* scenario also translates into slight reductions in violence when compared to the Current Path. In Central America, the small decrease in inequality, paired with a reduced youth population lowers the homicide rate by 2.3 percent in 2040 and 5.6 percent in 2060. In the Caribbean, it does not lower the homicide rate in 2040, but in 2060, the rate is 6.8 percent lower.

Conclusions

The findings in this report highlight the importance of education investments in Central America and the Caribbean. Education quality and attainment are projected to improve under the Current Path, but predictions suggest that some aspects of education in Central America and the Caribbean will continue to lag behind regions with comparable levels of average income. Furthermore, it is projected that SDG 4.1 – complete, free education through secondary school for boys and girls by 2030 – will not be reached by 2030 if current policies and trends continue. An additional push in education investments is needed to reach SDG 4.1. The benefits associated with these increased investments take time to materialize, but the investments would help Central America and the Caribbean improve education attainment and quality. As part of this push to increase investments, extra attention should be directed towards underperformers, such as Haiti, Guatemala, and Honduras, and to some extent the Dominican Republic and Nicaragua.

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Introduction

On the surface, education forecasts in Central America and the Caribbean appear promising. International Futures (IFs), the quantitative forecasting tool used in this report, projects that educational attainment (average years of schooling for adults 15+) in the Caribbean should improve from 8.3 years in 2017 to 9.3 in 2040 if historical patterns and policy choices continue. Educational attainment in Central America should improve from seven years in 2017 to 8.5 years. Projections indicate that we can also expect average regional test scores to rise. Average primary test scores (on a scale from zero to 100) in the Caribbean are forecast to improve from 37.6 to 40.4, while secondary test scores are projected to increase from 44 to 46.9. In Central America, average primary test scores are expected to improve from 32.5 to 37.2, and secondary test scores from 40.2 to 44.7.

These improvements seem to indicate that all of the investments and policy choices expected along the current development path will lead to favorable education outcomes. However, when test scores and educational attainment in the Caribbean and Central America are compared to regional peers (chosen based on average income levels (GDP per capita) and/or historical comparability based on income and/or geography), regional peers outperform in at least one education indicator. The Caribbean and South America outperform all regional peers in educational attainment; Central American attainment is similar to that of South Asia, but lags behind all other peers with the exception of North Africa. The Caribbean does not rank as high in primary test scores because it is outperformed by South America. Furthermore, Central America's average primary scores lag behind all regional peers with the exception of North Africa and South Asia. Looking forward, average regional test scores and attainment are projected to fall behind regional peers whose education spending is forecast to exceed that of both Central America and the Caribbean.

Expected performance is also concerning because Central America and the Caribbean are projected to fall short of the Sustainable Development Goal (SDG) 4.1 – full enrollment and graduation across primary and secondary school by the year 2030. This can be attributed in part to underperformers in Central America and the Caribbean that drag down regional averages, such as Guatemala, Honduras, and Haiti.[2] It can also be attributed to suboptimal per capita education spending in Central America. To reach SDG 4.1, and to attain test scores that are on par with sub-regional leaders, Cuba and Costa Rica, additional investments are needed.

Literature suggests that greater investments in education help improve various aspects of development, such as poverty reduction, emigration rates, and in some cases, violence. Education quality, as measured by student test scores, positively correlates with economic growth (Hanushek & Wößmann, 2007b), as does educational attainment (Barro & Lee, 1993). Other studies explore the benefits of education for emigration. In Central America, many individuals emigrate to flee violence (Bermeo, 2018), but Passel et al. (2017) find that migrants

[2] Nicaragua and the Dominican Republic also perform worse than many of their neighboring countries and may require additional consideration. The Dominican Republic performs below the Caribbean's average primary and secondary test scores. Nicaragua's attainment and test scores are only slightly above Central American averages.

also relocate for economic reasons. Improved educational attainment at home could help boost per capita income (Morgan & David, 1963), reducing the pressure for economic migration to countries with higher average wages.

The effects of education on violence are more complex. Some research indicates that education-based interventions can effectively curb violence among youth (UNESCO, 2012; Williams, 2015). This may be explained in part by a reduced economic incentive to participation in crime. Lochner (2004) frames education as a human capital investment that improves legitimate employment opportunities, thereby dissuading engagement in crime. If returns to education exceed the returns to crime, then improved education quality and quantity could lower crime rates.

Using IFs, we explore the impact of education investments on these development systems in the Caribbean and Central America to further highlight the value of education. This involves several steps. First, we created the Current Path, which represents the development trajectory characterized by a continuation of the "most likely" policies and development trends, from 2018 to 2060. The Current Path was used to show each of the projected improvements discussed above. Then, this Current Path was compared to a world in which education investments stall. By comparing these two situations, we can see the value of educational investments in shaping many aspects of development.

This comparison shows that education investments in Central America and the Caribbean are projected to have a significant impact on economic growth and poverty reduction, a moderate impact on emigration, a small impact on societal violence in 2040. Without education investments, Central American GDP in 2040 is forecast to be approximately six percent lower than expected along the Current Path. The number of skilled workers is forecast to be 4.5 percent lower and the number of informal sector workers is projected to be 8.6 percent higher. Furthermore, without these investments, there are forecast to be one million more Central Americans in poverty. The homicide rate is projected to be 3.6 percent higher and emigration is projected to be 2.2 percent higher.

Caribbean development outcomes are also affected by investments in education. In 2040, GDP is also projected to be about six percent lower without these investments. The number of skilled Caribbeans is 4.8 percent lower and the number of informal sector workers is 14.4 percent higher. Additionally, the number of impoverished individuals increases by 500,000. The homicide rate is forecast to be 7.8 percent higher, while emigration is projected to be 1.4 percent higher.

This comparison highlights education's clear impact on different facets of development. The benefits generated by education will enable Central America and the Caribbean to improve economic outcomes, migration, and labor. Nonetheless, progress across the education system, especially in Central America, is expected to improve at a slower pace than regional peers. Furthermore, Central America and the Caribbean are not expected to reach the SDG Target 4 of "inclusive and quality education for all" by 2030. In order to reach this target and catch up to and surpass regional peers across education indicators, an additional funding push is required.

This report utilizes an *SDG Achievement* scenario to simulate a situation in which Central America and the Caribbean push for SDG 4.1 by 2030, and reaps the benefits of this push out to 2060. This includes 100 percent attainment across primary and secondary school for all individuals by the year 2030 and an increase in countries' test scores to those of sub-regional leaders, Cuba and Costa Rica. As suggested in previous studies on the benefits of education, educational investments can lead to a number of improvements across development. In 2040, this scenario leads to a GDP in the Caribbean that is $20 billion greater than under the Current Path. Furthermore, in the year 2040, GDP per capita is $700 higher, 1,400 fewer people emigrate, and 300,000 fewer people live in poverty. In Central America, GDP is $30 billion higher than under the Current Path, GDP per capita is $620 higher, 2,000 fewer people emigrate, the homicide rate is reduced by 0.5 people by 100,000, and about 817,000 fewer people live in poverty. While the homicide rates under both scenarios in the Caribbean are comparable in 2040, Central America's homicide rate under the Current Path is 22 per 100,000 and about 21.5 per 100,000 under the *SDG Achievement* scenario. By 2060, more individuals will have moved through the education systems and the returns on the investment are projected to be even greater.

Cumulative effects also highlight the benefits of the *SDG Achievement* scenario. In the Caribbean, between 2017 and 2040, the *SDG Achievement* scenario adds a cumulative $126 billion to GDP, $4400 to GDP per capita. Between these years, 10,100 fewer people emigrate and 2.1 million fewer live in poverty. In Central America, the scenario adds a cumulative $183 billion to GDP and $4100 to GDP per capita. About 21,900 fewer people emigrate and 7.8 million fewer people live in poverty.

These findings suggest that Central America and the Caribbean would benefit greatly from additional education investments beyond that which comprise the Current Path. Some regional peers are projected to outperform Central America and the Caribbean across specific education indicators. By 2040, Central America and the Caribbean are projected to lag behind all regional peers in primary survival and graduation at the secondary and tertiary levels. Central America's overall primary test scores are forecast to lag behind all regional peers, while the Caribbean's are forecast to lag behind South America and Southeast Asia. At the secondary level, Central America is also forecast to underperform compared to all regional peers. The Caribbean is projected to lag behind South America, Southeast Asia, and South Asia. Also, Central America and the Caribbean are expected to fall short of achieving SDG 4.1 – full enrollment and graduation across primary and secondary school by the year 2030. These challenges can be partially attributed to countries that underperform in Central America and the Caribbean. Haiti, Guatemala, and Honduras continue to perform below sub-regional averages in educational attainment and quality, while the Dominican Republic and Nicaragua lag behind many neighboring countries. Insufficient education spending, especially in Central America, also explains the substandard performance. Additional education investments are needed to reach SDG 4.1 and catch up to all regional peers in education attainment and quality.

The report unfolds as follows: First, it briefly introduces the Current Path of development in Central America and the Caribbean, summarizing the current education situation and key challenges. Second, it outlines the Current Path projections, including educational attainment and completion, education quality (test scores), and the history and Current Path of key overarching issues in Central America and the Caribbean (including societal violence, economic

growth and labor dynamics, and migration). Next, it discusses the impact of the Current Path investment in education, as compared to a world in which education investments fail to impact growth. Then, it explores the *SDG achievement* scenario, its expected costs, and anticipated returns on investment. It concludes by highlighting the importance of additional education investments in both Central America and the Caribbean for various aspects of development.

Purpose and Methodology

This report uses International Futures analysis to explore regional development trends in Central America and the Caribbean focusing on the education system to 2040. It was produced for the USAID Latin America and Caribbean Regional Office in Washington D.C., with consulting support from Mathematica Policy Research.

The Frederick S. Pardee Center for International Futures

The Frederick S. Pardee Center for International Futures is based at the Josef Korbel School of International Studies at the University of Denver. The Pardee Center specializes in helping governments, international organizations, and private sector organizations think strategically about the future. The Pardee Center focuses on exploring past development trends, understanding the inter-relationships that drive development outcomes, and shaping policies that achieve development outcomes.[3]

As part of this mission, the Frederick S. Pardee Center hosts and develops the International Futures (IFs) integrated assessment platform.

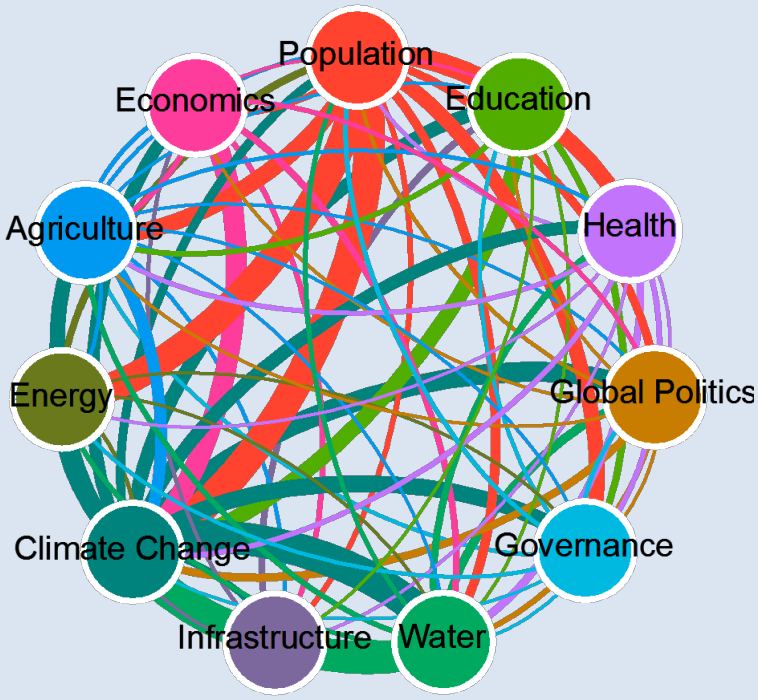
International Futures (IFs)

International Futures (IFs) is a free and open-source quantitative tool for thinking about long-term futures. The platform helps users to understand dynamics within and across global systems, and to think systematically about potential trends, development goals, and targets. IFs forecasts — which are calculated using data and a mix of quantitative modeling approaches — offer a broad and transparent way to think about the tradeoffs in policymaking.

IFs has three functions: historical data analysis (cross-sectional and longitudinal) of more than 4,000 series, Current Path analysis (how dynamic global systems seem to be developing), and alternative scenario development/analysis (exploring if-then statements about the future). To do this, IFs integrates relationships across 186 countries and 12 core systems, including: agriculture, demographics, economics, education, energy, environment, finance, governance, health, infrastructure, international politics, and technology. The sub-models for each system are dynamically connected, so IFs can simulate how changes in one system may lead to changes across all others.

[3] For more information on IFs, see: https://pardee.du.edu/.

Figure 1: Visual representation of IFs



Source: International Futures—https://pardee.du.edu/.

IFs modules added for this project

As part of this report, the Pardee Center added four separate models (or modules) to IFs in order to better represent some of the key issues facing Central America and the Caribbean now and into the future. Below are brief descriptions of each model addition to the broader IFs platform – for more information please see Appendix 1 and the 'reference report' (The Pardee Center, 2018), and for technical documentation please refer to the Pardee Center Wiki (https://pardee.du.edu/).

It is worth noting that the migration and violence models used in this report, which were developed by the Pardee Center in collaboration with USAID, are new and innovative. They allow us to be forward thinking and to understand the dynamics of these very complex issues using novel approaches. This is the first time USAID has worked on these types of models with the Pardee Center. The findings presented in this report should be used in conjunction with other research to better understand the dynamics of migration and violence, particularly how they interact with education.

Education quality

The new modelling efforts from the Pardee Center use test scores as the main indicator of learning quality. Test scores offer a standardized, comparable indicator of student achievement across time and country, which is a crucial requirement for cross-country based modeling. IFs test scores projections are initialized from test scores from the World Bank Global Achievement database (Angrist et al, 2013). This database measures test scores (on a

scale from 0 to 100) for 128 countries (from 1965 to 2010) at the primary and secondary level across three subjects - science, reading, and math. IFs uses the average overall score across all three subjects as the main indicator of education quality (by level).

Test score estimates and projections in IFs are driven by adult educational attainment (average years of education) and education spending per pupil.[4] This represents an 'intensive' approach to modeling education quality at the secondary and primary levels, which reflects the view that as individuals participate in higher levels of schooling, they tend to allocate more resources to higher quality schooling (Castelló-Climent & Hidalgo-Cabrillana, 2012:392). Adult educational attainment also provides an indication of the family and home environment, and serves as a proxy for level of teacher education and level of development (GDP per capita).

In IFs, average test scores directly impact levels of multifactor productivity (MFP), and thus have fairly direct impacts on the economy. These impacts on the economy then have an impact on violence and migration. For more information and/or details of the education attainment and quality models please see Appendix 1, the regional 'reference' report (The Pardee Center, 2018) and/or the Pardee Center Wiki.

The modeling on the relationship between education, the economy, violence and migration in the IFs platform is based on the economics literature. Assumptions about these relationships in the platform are based on relationships that have been well established. The literature does suggest that there could be additional mechanisms through which education might affect violence and crime, but because that literature is nascent and there is no consensus on how those alternative relationships function, we do not include them in the modeling at this point. The IFs modeling is continually updated as our collective understanding of the links between the various sectors included in the model improve.

Social violence

The data for the violence model is taken from the IHME (Institute for Health and Metric Evaluation), as well as the Government Risk index in IFs, which cuts across multiple dimensions of security. The model uses homicides across two main categories (political and interpersonal) and five sub categories (conflict and terror, police executions, and interpersonal homicides of men, women, and children) as the core indicators of social violence. While homicides are an imperfect proxy for social violence (which does not include other forms such as domestic abuse), homicide rates generally represent levels of overall violence and are a robust dataset.

The drivers of homicides across categories include the youth bulge (interpersonal), inequality (interpersonal), probability of civil conflict (conflict and terror), and corruption (police executions). The drivers of types of homicides are also interconnected and some

[4] Spending per pupil impacts take effect only at values above/below the expected level. For example, countries that spend more than a typical country at that level of development will get a boost in the score projection. The spending-induced score boosts are reduced in proportion to the level of corruption and prevalence of insecurity in the society.

types of homicide drive others: the total number of homicides is a driver of police executions and homicides against women drives suicide.

The model contains parameters for increasing both the total number of deaths in any category and increasing the total death rate. Further, in IFs, homicides directly impact multifactor productivity (MFP) via the IFs Security Index, which is comprised of the IFs homicide index and government risk index. Because social violence impacts more than homicide rates, the government risk index provides a broader security context that measures drivers of state fragility from a multidimensional perspective. More details on governance in the region can be found in the governance section of this report on page 49; this governance section provides broad justification for our representation of security. The violence model is also used to calculate the 'total number of deaths from intentional injuries' that is used in the health model, and thus has forward linkages to the IFs demographic model. For more information and/or details of the violence model please see Appendix 1, the regional 'reference' report (The Pardee Center, 2018), and/or the Pardee Center Wiki (https://pardee.du.edu/).

Labor market dynamics

IFs models labor supply and demand by skill level across six economic sectors (agriculture, energy, mining, manufacture, services, and ICT). Labor supply is predominantly driven by demographics that determine the population and participation rate of working-aged individuals. Educational attainment determines the skill level of the workforce. Labor demand is largely driven by technological progress and potential economic output.

Supply and demand are equilibrated via wages, which can result in short- or medium-term fluctuations in unemployment. The model also forecasts the share of non-agricultural labor employed informally, driven primarily by level of development, educational attainment, and business regulation. For more information and/or details of the labor model please see Appendix 1, the regional 'reference' report (The Pardee Center, 2018), and/or the Pardee Center Wiki (https://pardee.du.edu/).

Bilateral migration

In this report, IFs forecasts the annual flow of migrants from Central America and the Caribbean who are projected to relocate to the United States. While it is impossible to know the exact number of migrants in the US at a given time, these data do adjust for undocumented workers. However, they do not capture those who move seasonally or who traverse the border multiple times in a given year, or who are caught and returned by border patrol.

All demographic models in the report rely on understandings of stocks and flows, and models of migration are no different. Stocks are measures that persist across time, while flows add or remove from stocks. Abel (2016) uses the stock of foreign-born population living in each country on a bilateral basis (provided by the United Nations Population Division) to estimate the flows of people moving from one country to another (not those

moving temporarily). While the stock measure captures the number migrants residing in the US, flows are changing and capture movements of migrants over a specified period.

Bilateral migration flows are forecast using a "gravity model,"[5] which incorporates push-pull factors, such as distance (between two countries), size of the population (of the origin and destination countries), the size of migrant communities living in the destination country (as a percent of the destination country's population), the ratio of the household income per capita (between two countries), the GDP per capita of the origin country, security (which includes the levels of homicide in origin country among other components), and risk of government instability in origin country. The resulting bilateral migration flow pattern is then adjusted through an iterative process until the sum of all inward flows to a country is equal to the country-level forecast value of inward migration. Migrant populations (stocks) increase with migrant inflows and decrease with outflows and deaths. For more information and/or details of the labor model please see Appendix 1, the regional 'reference' report (The Pardee Center, 2018), and/or the Pardee Center Wiki (https://pardee.du.edu/).

Scenarios

The IFs Current Path is a collection of integrated forecasts that, while dynamic, represent a continuation of current policy choices and environmental conditions. Although the Current Path generally demonstrates continuity with historical patterns, it generates a wide range of non-linear forecasts rather than just a simple linear extrapolation of historical trends. The Current Path assumes no major paradigm shifts, seismic policy changes or impactful low-probability events. Given that the Current Path represents a data-driven path of development that is most likely across issue areas, it can be a valuable starting point to carry out scenario analysis and construct alternative scenarios.

In this report we compare the Current Path with two alternative scenarios. The main comparison scenario models full Sustainable Development Goal (SDG) achievement by increasing enrollment and graduation rates across Central America and the Caribbean to achieve full primary and lower secondary levels and bringing quality test scores to the level of current regional leaders, Cuba and Costa Rica. The second scenario was used to measure the impact of current education spending regionally and was constructed by keeping levels of educational attainment at current levels across time, thus simulating a world in which all other development systems improved, but education did not.

[5] In physics, gravity is defined by distance and mass. In gravity models of trade or migration, physical distance is one variable and mass is measured by the size of populations or GDP.

The Current Path Projections: Central America and the Caribbean education systems in global and regional context

Key takeaways:

- Across the key education indicators in this report – educational attainment and test scores – the Caribbean outperforms Central America. However, both Central America and the Caribbean underperform compared to some of their regional peers. Primary test scores in Central America and the Caribbean lag behind South America (Central America also lags behind Southeast Asia); Secondary test scores in Central America rank last among all regional peers while the Caribbean's are highest. Both sub-regions have higher levels of educational attainment than North Africa, while the average attainment level in the Caribbean exceeds both Central America and South Asia.

- Underperformance can be explained in part by certain countries within each of the sub-regions, namely Haiti in the Caribbean (and to a lesser extent the Dominican Republic), and Guatemala and Honduras in Central America. For example, in Central America, Guatemala registers the lowest or secondary lowest enrollment and graduation rates and makes up over 35 percent of the total population.

- Countries that struggle to move students through primary school have relatively lower primary test scores – Haiti, Guatemala, Honduras, and Nicaragua have the lowest primary test scores in Central America and the Caribbean. When primary education fails to equip students with essential skills, students encounter greater obstacles at the secondary level, leading to higher dropout and repetition rates.

- Education spending explains Central America and the Caribbean's performance compared to peers. While average spending in the Caribbean meets international standards, Haiti spends less than 2.5 percent of GDP on education (and less than any other country in Central America and the Caribbean). Also, Central America's per pupil spending is low by international standards.

- By 2040, the Caribbean and Central America's education spending is projected to fall in comparison to regional peers, in part due to faster economic growth amongst regional peers. Average regional test scores and attainment are forecast to improve, but additional spending is needed to outperform regional peers and reach SDG 4.1. Underperformers will continue to lag behind in 2040. For example, primary survival rates are forecast to exceed 90 percent for all countries except Guatemala, Nicaragua, and Haiti. Lower secondary enrollment rates are expected to exceed 75 percent for all countries except Haiti.

- By 2040, average upper secondary graduation rates are expected to be below 66 percent in both Central America and the Caribbean, which is nearly seven-percentage points lower than the expected rates in the next lowest region (North Africa).

- The Caribbean and Central America are projected to fall behind the other regions in part due to poor economic growth: Central America is projected to average 3.7 percent growth and the Caribbean is forecast to average 3.8 percent growth by 2040.

Educational attainment (average years of education) and quality (average test scores) measure the effectiveness of an education system. These elements impact productivity and human well-being in different ways, and they are intrinsically interconnected. The following section explores these elements and outcomes, their links to other development outcomes, and their links to each other. It also outlines an important driver of education quality: education spending (per pupil, per pupil as a share of GDP, and total as a share of GDP).

This section begins with the analysis of education spending in Central America and the Caribbean. Then it explores past trends and future estimates based on the IFs model in educational quantity, specifically adult educational attainment and the education system outcomes (enrollment, graduation, etc.), and outlines education quality (test scores across levels) in Central America and the Caribbean. Both the education quantity and quality sections explore the current state and Current Path of education outcomes at both regional and sub-regional levels and provide a global comparative perspective.[6] This includes an overview of some of the countries within Central America and the Caribbean that perform below regional averages in education indicators, such Guatemala, Honduras, and Haiti. Other countries that perform around or slightly below regional averages are Nicaragua and Dominican Republic, both of which may require additional attention. Finally, it briefly explores the current state and Current Path across key challenge areas (the economy, labor, migration, societal violence) in Central America and describes how each interact with education at a macro level.

Education Spending

There are three key measures used to assess education spending: total per pupil spending on education by level (as a portion of GDP), total per pupil spending by level (in absolute terms), and total spending on education (as a percent of GDP). Broadly speaking, total spending on education (as a percent of GDP) serves as the cross-country indicator of commitment and capacity to improve an education system.

According to spending targets established at the UNESCO Global Education for All Muscat Agreement (2014a), Central America's 2017 expenditure (four percent of GDP) fell at the lower bound of the acceptable range (four to six percent), while the Caribbean spends toward the upper bound (5.6 percent). However, total education spending (as a percent of GDP) does not account for other factors that affect education systems, such as skewed allocation of funds across education levels (some governments devote greater funds to primary than secondary or vice versa) and demographic pressures.

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[6] Throughout this report, Central America and the Caribbean are compared to the South Asia, Southeast Asia, South America, and North Africa UN sub-regions. The Caribbean most closely compares to South America and Southeast Asia across education indicators and average levels of income (GDP per capita), while Central America more closely compares to North Africa and South Asia across broad education indicators and GDP per capita (see Box 1 for details).

Table 4: Education spending indicators, Central America and the Caribbean, 2017

	Total Education Spending (% GDP)	Spending on education per student (% of GDP capita)			
	Total	Primary	Lower Secondary	Upper Secondary	Tertiary
Central America	**4.0**	**14.7**	**14.3**	**21.6**	**27.5**
Belize	5.4	16.2	24.7	16.5	36.5
Costa Rica	6.6	27.2	28.6	25.0	35.9
El Salvador	2.8	11.9	11.9	9.0	13.6
Guatemala	2.4	10.3	6.8	6.4	19.6
Honduras	6.6	19.2	29.2	54.9	38.2
Nicaragua	3.2	11.6	4.9	6.7	69.2
Panama	2.6	6.7	4.9	32.4	18.8
Caribbean	**5.6**	**25.9**	**27.7**	**28.0**	**34.6**
Bahamas	3.8	17.8	21.1	23.2	45.1
Barbados	5.4	22.7	28.1	27.9	41.0
Cuba	7.3	48.9	50.0	53.8	40.3
Dominican Republic	3.6	14.4	15.1	15.1	10.4
Grenada	6.5	9.8	9.3	13.1	54.8
Haiti	2.1	9.2	7.5	11.2	114.4
Jamaica	4.7	21.1	27.8	27.7	36.1
St Lucia	3.7	17.1	30.7	31.6	17.6
St Vincent and the Grenadines	4.0	17.4	16.5	21.3	56.9
Trinidad and Tobago	3.0	14.9	19.3	9.1	66.3

Source: Data from UNESCO Institute of Statistics (2017); estimated from IFs 7.38.

Education spending per pupil helps illustrate the impact of demographic pressures that impact education systems. Central America spends significantly less per pupil than the global average (when controlling for income level). The sub-region has the youngest population (median age of 25) of its regional peer groups and is younger than the global average (median age of 30.7 years). This generates a significantly higher ratio of children and dependents to adults, which means that Central America must spend more (as a percent of GDP) than UNESCO's recommended standard to provide quality education for its young people.

Educational outcomes in the Caribbean are better than those in Central America. However, there are still several challenges that exist. One issue is students' failure to acquire the basic cognitive skills needed to excel at the secondary level (World Bank, n.d.). Poor attendance, particularly in remote communities, leads to inadequate performance.

Inequality exacerbates this challenge of student performance. Poor students are less likely to make it through the education pipeline; their schools receive fewer resources, reducing the quality of education. Furthermore, teachers and students' families cannot afford resources that

might compensate for shortcomings at school. This challenge worsens at the secondary and tertiary levels when fewer educational resources are available. These inequities limit achievement while contributing to crime and juvenile delinquency.

Within Central America and the Caribbean, several countries stand out for their low spending as a percent of GDP. For example, Guatemala and Haiti are the only countries that spend less than 2.5 percent of GDP on education. Low spending in these countries contributes to worse education outcomes at the country-level and can lower regional averages.

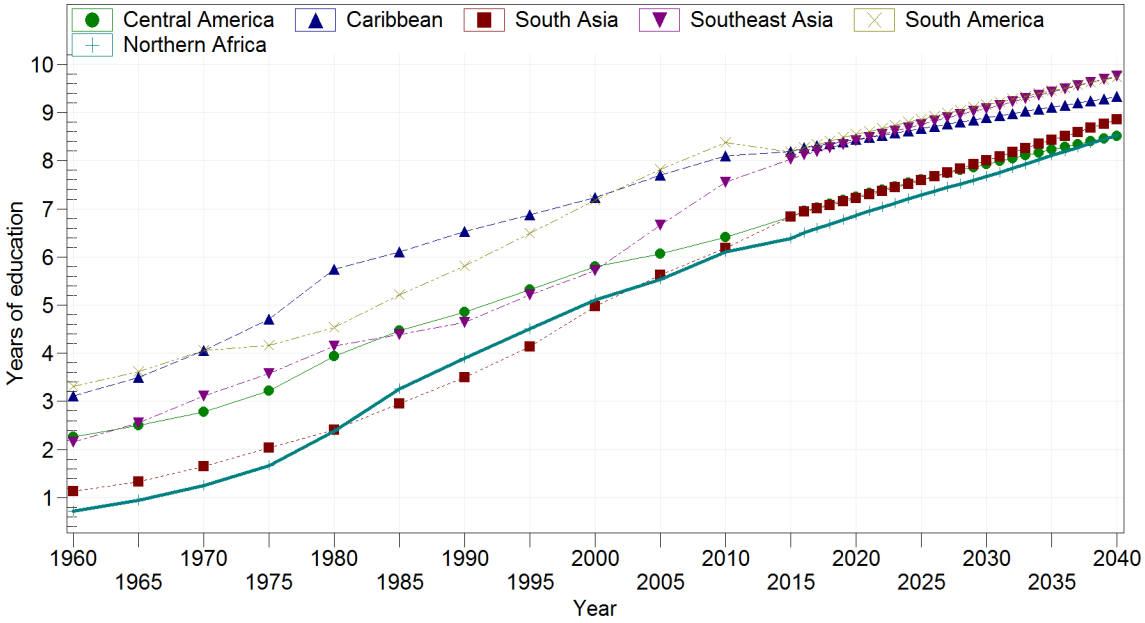
Educational attainment

Average adult educational attainment is a measure of the 'stock' of education in a society. It is driven by demographics (age and size of population) and by enrollment, transition, and graduation rates at the primary, secondary, and tertiary levels. It is a crucial indicator of education because it measures how effectively the system moves students through school, or rather, the "output" of the education system.

The level of average adult education changes slowly in a society, reflecting the complexity of dramatically improving educational outcomes over time. To significantly increase the overall 'stock' of education in the adult population, countries must sustain education system investments over long periods of time. Students who enter primary school today do not affect average adult educational attainment for at least 10 years and most adults today are unlikely to significantly increase their education levels.

Figure 2 shows that educational attainment improves over time for the Caribbean and Central America, as well as its regional comparison groups. The most rapid five-year increase in average adult attainment of any of these regions (Caribbean between 1975 and 1980) equated to only one additional year of average education, which is less than three additional months of education on average per year. Further, as countries and regions increase average adult attainment, progress inevitably slows as countries move toward the upper limits of plausible investments in human capital.

Figure 2: Average years of education (15+), selected regions, 1960 to 2040



Source: Data from Barro & Lee, 2015; Current Path forecast from IFs 7.38.

Table 5 shows average adult educational attainment for countries in Central America and the Caribbean. These forecasts show notable improvement, though problems persist with several countries highlighted throughout this report. Today, average adult attainment in Guatemala is over a year lower than the next lowest country in Central America (Honduras) and Haiti's average adult attainment is about three years lower than the next lowest country in the Caribbean (the Dominican Republic). Both Guatemala and Haiti are projected to remain well below their respective regional averages.

The table also reveals that gender disparity in educational attainment is projected to decline, reflecting trends observed in data. In 1990, Caribbean males had, on average, 0.6 more years of education than females and Central American males had 0.5 more years of education than females. In 2017, males have roughly 0.4 more years of education than females in the Caribbean and in Central America. Along the Current Path, female average education years are projected to surpass the average for males in the mid-2020s in Central America, while the Caribbean is forecast to reach gender parity by 2040.

Table 5: Selected education indicators, Central America and the Caribbean, 2017 and 2040

	Average Attainment (15+)		Sex difference in Education years (Male - Female)	
	2017	**2040**	**2017**	**2040**
Central America	**7.0**	**8.5**	**0.4**	**-0.2**
Belize	10.6	10.9	-0.1	-0.5
Costa Rica	8.5	10.0	-0.3	-0.7
El Salvador	7.6	9.5	0.3	0.2

	Average Attainment (15+)		Sex difference in Education years (Male - Female)	
	2017	2040	2017	2040
Guatemala	5.7	7.4	0.5	0.2
Honduras	6.9	8.5	-0.3	-0.4
Nicaragua	7.1	8.6	-0.4	-0.3
Panama	9.7	10.5	-0.4	-0.7
Caribbean	**8.3**	**9.3**	**0.4**	**0.0**
Bahamas	11.8	12.4	-0.7	-1.0
Barbados	9.5	10.8	-0.7	-1.0
Cuba	10.2	10.9	0.2	-0.4
Dominican Republic	8.3	9.7	-0.7	-1.1
Grenada	10.3	12.3	0.1	-0.2
Haiti	5.5	7.1	1.9	1.4
Jamaica	9.5	10.3	-0.2	-0.3
St Lucia	10.9	11.9	-0.7	-0.6
St Vincent and the Grenadines	11.7	12.3	-1.0	-1.1
Trinidad and Tobago	10.6	11.3	0.0	-0.3

Source: Data initialized from Barro and Lee, 2015; Current Path forecast from IFs 7.38.

Table 6 shows adult completion rates (percent of population aged 15+) at each level of formal education. In Central America in 2017, 66.5 percent of those older than 15 had completed primary education, 26.9 percent had completed secondary, and 5.7 percent had completed tertiary. IFs projects that by 2040, 81.2 will have completed primary, 39.5 will have completed secondary, and 11.9 percent will have completed tertiary. Rates are also projected to improve in the Caribbean, although from a higher starting point for all levels. Primary completion is projected to increase from 77.2 to 82.2 percent, secondary completion from 40.4 to 46.5 percent, and tertiary completion from 7.5 to 12.7 percent.

Despite these improvements, Central America's secondary and tertiary completion rates lag behind other regions and are projected to continue to lag to 2040 (see Table 6). A low completion rate at the tertiary level can be explained by the fact that approximately a quarter of adults have completed the secondary schooling needed to advance to the tertiary level. It can also be explained by the emigration of highly educated workers. When highly educated individuals emigrate, it lowers the stock of human capital and alters labor opportunities in the domestic economy (World Bank, 2012). Lack of economic opportunity and inadequate wages can drive those with tertiary attainment to relocate to wealthier countries. Violence also encourages emigration of Central America and the Caribbean's most talented and skilled workers.

Table 6: Completion rates (percent of population 15 and older) by level, selected regions, 2017 and 2040

	Primary		Secondary		Tertiary	
	2017	**2040**	**2017**	**2040**	**2017**	**2040**
Central America	66.5	81.2	26.9	39.5	5.7	11.9
Caribbean	72.2	82.2	40.4	46.5	7.5	12.7
South America	88.2	93.5	46.6	59.5	8.9	17.2
Southeast Asia	83.3	91.3	39.7	55.0	6.9	16.7
North Africa	65.4	81.6	33.2	47.9	7.7	13.4
South Asia	70.4	83.9	35.6	46.7	6.6	19.1

Source: Data initialized from UNESCO Institute for Statistics, 2017; Current Path forecast from IFs 7.38.

Table 7 provides an overview of completion rates by country in Central America and the Caribbean. In both Central America and the Caribbean, a few countries stand out for their low completion rates. At the primary level in Central America, the countries with the lowest completion rates in 2017 were Guatemala (with the lowest rates), followed by El Salvador, and Nicaragua. At the secondary level, Guatemala had the lowest completion rates, followed by Honduras and Nicaragua. At the tertiary level, Guatemala also has the lowest completion rates, followed by El Salvador, and Honduras and Belize (which tie for third lowest tertiary completion rates). Completion rates are projected to improve across levels between 2017 and 2040, but these countries are forecast to maintain the lowest rates.

In the Caribbean, average completion rates exceed those of Central America. However, completion rates in Haiti remain low, especially at the primary level. In 2017, Haiti's primary completion rate was 37.2 percent; the next lowest country was the Dominican Republic with 78.4 percent. At the secondary level, Haiti has the lowest completion rate, followed by Barbados, and the Dominican Republic. However, it should be noted that with a completion rate of 38.7 percent, the rate for the Dominican Republic still remains well above the average secondary completion rate for Central America (26.9). At the tertiary level, Haiti maintains the lowest completion rate, followed by the Dominican Republic and Barbados. By 2040, it is projected that Haiti will remain an outlier, with the lowest completion rates at every level.

Table 7: Completion rates (percent of population 15 and older) by level, countries in Central America and the Caribbean, 2017 and 2040

	Primary		Secondary		Tertiary	
	2017	**2040**	**2017**	**2040**	**2017**	**2040**
Central America	**66.5**	**81.2**	**26.9**	**39.5**	**5.7**	**11.9**
Belize	100.0	99.8	44.2	50.5	2.4	8.5
Costa Rica	80.2	89.2	39.1	51.0	18.3	32.9
El Salvador	61.4	79.6	33.9	48.9	1.4	7.7
Guatemala	58.6	76.0	14.7	30.2	0.9	5.4
Honduras	69.3	84.1	22.8	36.8	2.4	9.6
Nicaragua	64.1	79.5	32.6	44.0	11.8	17.0
Panama	84.6	91.8	50.3	55.9	15.7	21.8

	Primary		Secondary		Tertiary	
	2017	2040	2017	2040	2017	2040
Caribbean	**72.2**	**82.2**	**40.4**	**46.5**	**7.5**	**12.7**
Bahamas	91.9	95.3	54.8	68.1	11.4	14.2
Barbados	95.1	97.6	30.0	53.2	5.0	17.8
Cuba	90.9	94.8	54.8	59.9	17.8	25.3
Dominican Republic	78.4	88.3	38.7	50.6	3.0	12.7
Grenada	85.3	92.7	48.3	67.8	15.6	36.3
Haiti	37.2	61.9	18.1	23.4	0.4	2.1
Jamaica	89.2	92.8	54.1	65.0	8.8	13.7
St Lucia	83.8	88.9	47.4	64.7	9.3	15.0
St Vincent and the Grenadines	82.5	90.3	45.1	57.6	8.1	10.4
Trinidad and Tobago	96.5	98.2	78.2	82.6	7.9	12.8

Outcomes by level (the education pipeline)

Average adult attainment and completion are a good summary measure of educational attainment, but they do not clarify where developmental challenges may exist within particular education levels. The IFs education model assesses and forecasts movement through the education system by accounting for student enrollment, transition and graduation by level. Students must enroll and complete levels in succession, which means student movement through the system is necessarily constrained or enabled by the enrollment and graduation rates in the level prior.

Assessing specific 'bottlenecks' in the education system requires an analysis of the education 'pipeline'. For example, if only 50 percent of total school-age children who can enroll in primary school in a given year do so, then by default no more than 50 percent of those children can graduate and advance to secondary school. The value of this pipeline model (especially as it connects to the demographic model) lies in its ability to account for student flows and accurately reflect future education system developments. It can also be used to identify potential 'bottlenecks' and other constraints in the system from primary enrollment through tertiary graduation.

The first stage in the education pipeline is primary school. Central America has the second highest gross primary enrollment rate amongst regional comparison groups, just behind South America; Central America also has the second highest net primary enrollment rate (92 percent). The Caribbean also has high gross primary enrollment, however its primary net enrollment rate (76.4 percent) is the lowest of any region analyzed in this report. The Caribbean average is reduced by Haiti – net primary enrollment rates stood at 43 percent in 2017 – all other countries in the region are above 80 percent.

Regionally, bottlenecks in the education pipeline begin to show at the end of primary school. Primary survival rates – which indicate the portion of students who begin first grade that are expected to reach the final grade of primary school – in both Central America and the Caribbean are nine percentage points lower than the next lowest regional peer. This 'bottleneck' at the end

of primary school limits the number of students who can finish primary school and enroll in secondary school.

As such, gross lower secondary enrollment rates in Central America and the Caribbean are lower than nearly all regional peers (Central America is higher than South Asia). Further, lower secondary graduation rates in both regions are also suboptimal. Central America has one of the lowest secondary graduation rates of regional peer groups, ahead of only South Asia. Caribbean lower secondary graduation rates are about 11 percentage points higher than Central America, but are a full 10 percentage points lower than South America.

Poor enrollment and graduation rates in lower secondary school translate to poor upper secondary school outcomes. In 2017, upper secondary enrollment rates in Central America were above North Africa and South Asia, while the Caribbean registered similar upper secondary enrollment as Southeast Asia. However, less than half of upper secondary students in Central America and the Caribbean graduate, placing both regions behind regional comparison groups (with the exception of South Asia). Graduation rates are also low at the tertiary level. Central America has the lowest tertiary graduation rate of all regional comparison groups, while North Africa has the second lowest and the Caribbean has the third lowest.

Table 8: Regional education pipeline indicators (reported as percentages), selected regions, 2017

	Primary Enrollment	Primary Survival Rate	Lower Secondary Enrollment	Lower Secondary Graduation	Upper Secondary Enrollment	Upper Secondary Graduation	Tertiary Enrollment	Tertiary Graduation
Central America	108.4	81.6	87.1	63.4	64.6	45.2	27.3	14.8
Caribbean	105.0	81.3	82.5	75.0	70.2	49.4	28.8	18.0
South America	108.6	93.4	106.6	85.1	87.5	69.2	55.3	22.8
Southeast Asia	107.0	90.7	95.1	83.6	71.1	62.5	29.1	20.5
North Africa	102.4	90.9	97.4	71.4	63.0	59.9	32.3	17.1
South Asia	107.9	91.4	86.2	60.3	60.7	38.9	26.4	23.3

Source: Data initialized from UNESCO Institute for Statistics; IFs v 7.38.

Note: Enrollment can exceed 100 percent.

Looking forward, each of the assessed regions is projected to improve across all levels of the education pipeline. However, the Caribbean and Central America fall further behind regional peer groups. In fact, Central America and the Caribbean are projected to rank last or second to last among regional peers in every pipeline indicator highlighted in Table 9. By 2040, Caribbean primary survival rates are expected to remain under 90 percent, while all other regions are expected to be above 93 percent. Furthermore, upper secondary graduation rates are expected to be below 66 percent in both Central America and the Caribbean, which is roughly seven percentage points lower than the expected rates in the next lowest region (North Africa).

The Caribbean and Central America fall behind the other regions partially due to poor economic growth projections: Central America is forecast to average 3.7 percent growth and the Caribbean is forecast to average 3.8 percent growth in 2040. Only South America is forecast to average lower rates of growth in 2040, at 2.3 percent growth. Further, education spending (as a percent of GDP) is forecast to decline in both regions, while per pupil spending (as a percent of GDP per capita) is forecast to grow only slightly in Central America and decline in the Caribbean. Spending (total and per pupil) is forecast to increase fairly steadily in every other comparison region (except South America).

Table 9: Regional education pipeline indicators (reported as percentages), selected regions, 2040

	Primary Enrollment	Primary Survival Rate	Lower Secondary Enrollment	Lower Secondary Graduation	Upper Secondary Enrollment	Upper Secondary Graduation	Tertiary Enrollment	Tertiary Graduation
Central America	104.3	93.1	87.2	77.1	73.6	64.6	38.2	23.6
Caribbean	106.6	89.8	88.9	80.4	72.6	65.6	38.2	24.4
South America	100.9	99.1	95.5	91.4	86.8	80.9	61.3	32.3
Southeast Asia	101.4	98.7	97.1	95.4	87.0	82.2	46.7	34.0
North Africa	100.4	97.0	90.6	81.9	76.0	72.8	40.1	25.1
South Asia	101.7	97.3	93.6	87.8	81.9	77.0	54.8	40.8

Source: Data initialized from UNESCO Institute for Statistics; Current Path forecast from IFs v 7.38.

A significant portion of these pessimistic regional forecasts is traced to two large and underperforming countries across Central America and the Caribbean – Guatemala and Haiti. Because Haiti and Guatemala are populous, poor education outcomes drag the regional average down. They are the only countries in Central America and the Caribbean that spend less than 2.5 percent of GDP on education. Further, Table 10 shows that Haiti is the only country in the Caribbean with primary survival rates below 90 percent. Also, Haiti, Honduras, and Guatemala are the only three countries in Central America and the Caribbean to have an upper secondary graduation rate below 40 percent.

In Central America, Honduras and Guatemala continue to perform poorly across several other pipeline indicators, while Nicaragua also lags behind many of the Central American averages. For example, Guatemala registers the lowest or secondary lowest rates across all indicators and makes up over 35 percent of the total population in Central America. Nicaragua registers by far the lowest primary survival rate and Honduras registers the lowest upper secondary graduation rate.

All countries in Central American and the Caribbean are expected to improve across all education pipeline indicators by the year 2040 (see Table 11). As countries continue to grow and develop, education systems are also expected to improve. However, Haiti and Guatemala – the two populous underperformers – are expected to continue to lag well behind peers and, subsequently, continue to pull down averages for Central America and the Caribbean. Primary survival rates are projected to exceed 90 percent for all countries except Guatemala, Nicaragua, and Haiti. Lower secondary enrollment rates are expected to exceed 75 percent for all countries in Central America and the Caribbean except Haiti.

Table 10: Education pipeline indicators (reported as percentages), selected countries, 2017

	Primary Enrollment	Primary Survival	Lower Secondary Enrollment	Lower Secondary Graduation	Upper Secondary Enrollment	Upper Secondary Graduation	Tertiary Enrollment	Tertiary Graduation
Central America	**108.4**	**81.6**	**87.1**	**63.4**	**64.6**	**45.2**	**27.3**	**14.8**
Belize	110.6	99.5	92.4	61.9	60.5	43.3	23.7	8.0
Costa Rica	108.3	98.1	131.3	92.5	109.4	51.3	54.0	45.3
El Salvador	109.7	86.9	98.9	75.6	61.2	64.0	29.2	12.6
Guatemala	103.5	76.7	74.0	53.8	55.5	39.6	22.1	5.2
Honduras	110.6	90.1	76.4	59.5	66.2	39.0	22.3	10.9
Nicaragua	120.4	56.4	86.1	54.4	59.1	46.5	18.1	17.7
Panama	102.9	91.2	95.2	71.4	59.1	43.7	38.8	26.4
Caribbean	**105.0**	**81.3**	**82.5**	**75.0**	**70.2**	**49.4**	**28.8**	**18.0**
Bahamas	107.4	94.7	97.7	92.4	87.2	82.4	16.7	10.1
Barbados	94.3	95.7	105.4	98.3	110.7	77.8	65.0	30.5
Cuba	98.0	95.2	100.1	97.8	99.0	57.4	36.3	33.9
Dominican Republic	104.1	90.8	87.5	76.2	74.1	48.4	50.3	20.2
Grenada	104.9	92.2	99.5	97.1	97.7	85.1	89.5	56.9
Haiti	115.5	50.3	54.1	43.9	30.5	28.0	1.6	1.0
Jamaica	97.5	98.1	88.2	83.9	77.0	73.9	27.7	14.5
St Lucia	100.5	96.8	89.4	88.4	83.3	84.9	17.2	14.3
St Vincent and the Grenadines	104.2	93.0	118.9	82.8	86.2	68.2	7.8	1.9
Trinidad and Tobago	105.3	93.9	96.9	92.6	84.7	85.6	12.0	10.4

Source: Data initialized from UNESCO Institute of Statistics; IFs v 7.38.

Table 11: Education pipeline indicators, selected countries, 2040

	Primary Enrollment	Primary Survival	Lower Secondary Enrollment	Lower Secondary Graduation	Upper Secondary Enrollment	Upper Secondary Graduation	Tertiary Enrollment	Tertiary Graduation
Central America	**104.3**	**93.1**	**87.2**	**77.1**	**73.6**	**64.6**	**38.2**	**23.6**
Belize	100.1	100.0	88.4	76.8	70.0	65.7	36.9	18.4
Costa Rica	100.0	100.0	99.4	99.0	94.6	83.5	72.8	63.1
El Salvador	104.5	96.1	90.4	82.1	73.4	70.9	36.3	19.7
Guatemala	105.7	88.3	79.3	68.1	64.3	56.3	30.2	13.4
Honduras	101.2	99.5	87.3	76.1	75.2	62.3	37.0	21.4
Nicaragua	111.4	84.8	91.5	72.8	76.2	64.3	32.5	25.4
Panama	100.3	100.0	98.8	94.6	85.5	78.6	49.4	33.3
Caribbean	**106.6**	**89.8**	**88.9**	**80.4**	**72.6**	**65.6**	**38.2**	**24.4**
Bahamas	101.8	100.0	101.1	98.4	91.1	88.1	36.4	21.2
Barbados	100.9	100.0	100.4	102.1	96.0	85.4	68.4	37.7
Cuba	100.1	100.0	99.7	100.3	90.8	81.6	47.8	40.6
Dominican Republic	101.6	99.6	99.1	92.9	85.9	78.7	59.1	30.4
Grenada	100.1	100.0	99.8	99.8	97.3	98.1	97.1	71.3
Haiti	118.5	68.6	67.5	47.4	39.4	32.8	10.8	5.7
Jamaica	100.8	100.0	95.3	92.0	85.0	82.2	39.5	22.8
St Lucia	100.2	100.0	98.8	96.7	94.5	93.3	34.7	26.0
St Vincent and the Grenadines	100.1	100.0	97.9	92.2	90.1	79.2	27.5	17.5
Trinidad and Tobago	100.3	100.0	99.3	98.5	93.8	92.9	30.6	25.2

Source: Data initialized from UNESCO Institute of Statistics, 2017; Current Path forecast from IFs 7.38.

Both Central America and the Caribbean have reached or nearly reached gender parity at each level of enrollment, and at many levels there are more females students enrolled than males. The disparity is the greatest at the tertiary level. Across the Current Path forecast, the gap is projected to widen in favor of females; by 2040, we estimate that 1.32 females in Central America could be enrolled in tertiary education for every male. In the Caribbean, 1.41 females could be enrolled for every male.

A few countries deviate from the 2017 and 2040 averages for gender parity. At the primary level, all countries were close to achieving gender parity in 2017. The Dominican Republic remained the furthest from gender parity, with a ratio of 0.91. At the secondary level, most countries had more females enrolled in school than males. However, Haiti stands out in the Caribbean, with a secondary gender parity ratio of 0.9. At the tertiary level, all countries have gender parity ratios that favor females except for Haiti (0.40). In fact, two countries in the Caribbean have gender parity ratios about 2.0, the Bahamas (2.48) and Barbados (2.23).

Table 12: Education gender parity by level, selected regions, 2017 and 2040

	Primary Gender Parity ratio (Gross)		**Secondary Gender Parity ratio (Gross)**		**Tertiary Gender Parity ratio (Gross)**	
	2017	**2040**	**2017**	**2040**	**2017**	**2040**
Central America	**0.97**	**0.98**	**1.04**	**1.03**	**1.25**	**1.32**
Belize	0.97	1.00	1.02	1.04	1.60	1.46
Costa Rica	1.00	1.00	1.04	1.03	1.31	1.47
El Salvador	0.96	0.97	1.01	1.04	1.11	1.21
Guatemala	0.97	1.00	0.94	0.99	1.17	1.26
Honduras	0.98	0.98	1.18	1.06	1.35	1.31
Nicaragua	0.98	0.91	1.13	1.03	1.12	1.20
Panama	0.97	1.00	1.07	1.06	1.49	1.45
Caribbean	**0.95**	**0.98**	**1.04**	**1.05**	**1.60**	**1.41**
Bahamas	1.02	0.99	1.05	1.04	2.48	2.04
Barbados	1.02	1.01	1.02	1.01	2.23	1.95
Cuba	0.95	1.00	1.04	1.05	1.42	1.37
Dominican Republic	0.91	0.98	1.10	1.10	1.82	1.64
Grenada	0.97	1.00	0.99	1.03	1.12	1.13
Haiti	0.98	0.97	0.90	0.99	0.40	0.75
Jamaica	1.00	1.00	1.08	1.11	1.68	1.32
St Lucia	0.95	1.00	0.99	1.02	1.90	1.49
St Vincent and the Grenadines	0.98	1.00	0.97	1.07	1.99	1.46
Trinidad and Tobago	0.97	0.99	1.03	1.02	1.29	1.33

Source: Data initialized from UNESCO Institute of Statistics, 2017; Current Path forecast from IFs 7.38.

Education quality (test scores)

Average educational attainment constitutes an essential indicator of a well-functioning education system, but the quality of those education years is an equally important indicator of the state of an education system. It is also important for its impacts on productivity, economic growth, and the accumulation of human capital (Hanushek & Woessmann, 2016; Hanushek & Wößmann, 2007a).

In Central America and the Caribbean, education quality remains a key concern (Bruns & Luque, 2015; Gropello, 2005; Maso, 2016; UNESCO, 2014b). In Guatemala, El Salvador, and Nicaragua, civil wars in the latter part of the 20th century damaged education systems that were already burdened by insufficient resources, inadequate curriculums, and suboptimal teacher training (Marques & Bannon, 2003). During this period, school buildings and infrastructure were destroyed, rural communities were displaced, and education funds were redirected toward conflicts.

Poor education quality causes students to move through the system with insufficient knowledge and skills. This leads to grade repetition, poor learning outcomes, and school abandonment (Gropello, 2005). According to an UNESCO regional report (2012) on Latin America and the Caribbean (including South America), students in this region account for 17 percent of primary education repeaters across the globe. Of the countries examined, Cuba had among the lowest rates of primary repetition. The Dominican Republic (seven percent), Guatemala (13 percent), and Nicaragua (11 percent) had the highest percentages of repeat students in Central America and the Caribbean. However, the average percent of repeaters fell from 12 percent in 2000 to eight percent in 2010, reflecting the success of interventions developed to lower repetition.

Measuring education quality is inherently challenging, subjective, and tied to the nature of education itself (Mortimore & Stone, 1991). However, it is generally accepted that its key components include health and nutrition of students, safe, protective, and inclusive learning environments, relevant content and materials, appropriate student-centered teaching approaches, and suitable methods to evaluate knowledge, outcomes, and skills (UNICEF, 2000:3).

Measuring and modeling education quality

The education model in IFs uses average test scores at the primary and secondary level as the main indicators of education quality. IFs test score estimates are initialized from the World Bank Global Achievement database (Angrist et al, 2013). This database measures cognitive achievement for 128 countries around the world from 1965 to 2010 at the primary and secondary level and across three subjects – science, reading, and math – on a scale from zero to 100.[7]

[7] The data are constructed from regional and global achievement tests, such as the Programme for International Student Assessment (PIRLS), Trends in International Mathematics and Science Study (TIMSS), and the regional tests, like SACMEQ, the Programme d'Analyse des Systemes Educatifs de la Confemen (PASEC), and the Laboratorio Latinoamericano de Evaluacion de la Calidad de la Educacion (LLECE), among others. Where data is unavailable, IFs estimates test

IFs calculates and forecasts the overall score averaged across the three subjects for primary and secondary.

Test score forecasts by level are driven by adult educational attainment (average years of education) and education spending per pupil (relative to income).[8] Adult educational attainment provides an indication of the family and home environment, and serves as a proxy for teacher education and overall level of development (GDP per capita). Education spending per pupil (relative to GDP per capita) provides a proxy for overall education system resources such as school infrastructure and teacher pay.

Test scores and bottlenecks: and intra-regional comparison

The scale for all test scores in Central American and the Caribbean ranges from zero to 100 for all subjects. Generally speaking, the test scores narrative largely follows the educational enrollment and graduation stories outlined in the 'pipeline' section, especially at the primary level. In fact, primary test scores play an essential role in Central America and the Caribbean's bottlenecks. Countries that experience issues moving students through primary school have relatively lower primary test scores – Haiti, Guatemala, Honduras, and Nicaragua have the lowest primary test scores in Central America and the Caribbean.

When primary education fails to equip students with key skills and abilities, students are likely to struggle at the secondary level, leading to greater dropout and repetition rates. This issue can be seen in countries that are able to move students through the primary school, but that struggle to equip them with skills necessary to transition to secondary school. For example, Honduras registers relatively high primary survival rates, but low primary test scores likely contribute significantly to relatively low secondary enrollment and graduation rates.

Looking forward, every country in Central America and the Caribbean is projected to improve overall scores by 2040, but some countries are expected to experience greater gains than others. Current and expected overall educational attainment and education spending (relative to GDP and GDP per capita) drive the varying rates of growth in test scores across countries.

For example, the countries that are expected to improve most rapidly between now and 2040 – Costa Rica, Honduras, and Barbados – have and are expected to maintain the highest levels of education spending (total and per pupil) and the largest gap between overall attainment and primary test scores. Meanwhile, countries that start from a relatively low base, such as Guatemala and Haiti, are also expected to see the most rapid gains in primary test scores.

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scores by level and subject based on levels of average adult educational attainment and spending per pupil (relative to income).

[8] Spending per pupil (relative to income) is calculated as the percent of average per capita income spent on each student in each level. The impacts of this driver take effect only at values above/below expected level and are further adjusted for level of corruption and security/violence

Table 13: Primary test scores by subject, Central America, the Caribbean, and South America, 2017 and 2040

	Math		Reading		Science		Overall Scores	
	2017	2040	2017	2040	2017	2040	2017	2040
Central America	**31.1**	**35.9**	**32.8**	**37.4**	**33.8**	**38.3**	**32.5**	**37.2**
Belize	42.5	43.7	40.7	42.0	45.5	46.7	42.9	44.1
Costa Rica	34.3	40.3	36.1	42.1	39.0	45.0	36.5	42.5
El Salvador	31.4	37.6	34.3	40.6	36.3	42.6	34.0	40.3
Guatemala	32.2	36.1	29.0	32.9	29.1	33.0	30.1	34.0
Honduras	26.4	32.7	34.2	40.5	33.3	39.6	31.3	37.6
Nicaragua	32.3	37.0	32.3	37.0	33.7	38.4	32.8	37.5
Panama	30.6	33.5	38.8	41.7	42.7	45.6	37.4	40.3
Caribbean	**33.1**	**35.9**	**41.7**	**44.3**	**38.0**	**41.0**	**37.6**	**40.4**
Bahamas	46.7	47.8	43.7	44.8	49.4	50.5	46.6	47.7
Barbados	38.9	44.3	38.4	43.8	42.1	47.5	39.8	45.2
Cuba	41.9	44.2	56.6	58.8	43.2	45.5	47.3	49.5
Dominican Republic	27.2	31.4	39.8	44.0	37.7	41.8	34.9	39.1
Grenada	41.7	48.3	40.5	47.2	44.8	51.4	42.3	49.0
Haiti	25.9	30.5	29.6	34.2	29.9	34.5	28.5	33.0
Jamaica	38.8	41.5	38.3	41.1	42.0	44.8	39.7	42.5
St Lucia	43.1	46.9	41.3	45.0	46.1	49.8	43.5	47.2
St Vincent and the Grenadines	46.6	48.8	43.6	45.8	49.3	51.6	46.5	48.7
Trinidad and Tobago	42.3	44.7	36.7	39.1	45.3	47.7	41.4	43.8
South America	**32.9**	**37.1**	**43.4**	**47.4**	**38.2**	**42.3**	**38.2**	**42.3**
Argentina	31.9	38.9	34.4	41.4	42.5	49.5	36.3	43.3
Bolivia	43.0	51.2	38.4	46.6	38.8	47.0	40.0	48.2
Brazil	30.5	34.0	47.7	51.2	35.9	39.4	38.0	41.5
Chile	34.8	38.5	47.7	51.4	44.3	47.9	42.3	45.9
Colombia	34.1	38.6	39.1	43.6	39.1	43.7	37.4	42.0
Ecuador	32.5	39.1	35.8	42.4	38.4	45.0	35.6	42.2
Guyana	34.0	35.6	35.0	36.6	37.5	39.1	35.5	37.1
Paraguay	33.3	36.7	42.5	45.9	37.9	41.3	37.9	41.3
Peru	31.4	36.9	38.0	43.5	41.5	47.0	37.0	42.5
Suriname	44.3	44.0	42.0	41.7	47.2	46.9	44.5	44.2
Uruguay	34.9	39.3	36.3	40.7	39.2	43.6	36.8	41.2
Venezuela	45.1	44.3	44.1	43.4	39.0	38.2	42.7	42.0

Source: Data initialized from World Bank Global Achievement Database, 2013; Current Path forecast from IFs 7.38.

When average overall primary scores from Central America are compared to South America, we see that South America fares better, on average, than Central America. However, average overall scores for South America are only slightly better than Caribbean scores. In fact, a few Caribbean countries, including the Bahamas, Barbados, Cuba, St. Lucia, and St. Vincent and the Grenadines, tend to outperform the South American 2017 averages in each subject. Their performance suggests that some parts of the Caribbean may be performing better than others. Notably, Haiti stands in sharp contrast to these high-performing Caribbean countries and all neighboring South American countries.

Primary test scores of countries in Central America and the Caribbean can be broken down further by gender. For most countries throughout Central America and the Caribbean, males and females achieve similar scores, with females scoring slightly higher than males. However, there are two countries in which females' average reading scores exceed males' by more than two percentage points: Belize and Trinidad and Tobago. In countries that underperform, such as Guatemala, Honduras, and Haiti, male and female test scores are nearly identical across all subjects.

Table 14: Primary test scores in Central America and the Caribbean, by gender, by subject, 2017

	Math		Reading		Science		Overall	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Central America	**31.1**	**31.1**	**32.6**	**33.0**	**33.6**	**33.9**	**32.4**	**32.7**
Belize	42.5	42.5	39.1	42.4	45.1	45.8	42.2	43.6
Costa Rica	34.3	34.3	35.9	36.4	38.7	39.2	36.3	36.6
El Salvador	31.4	31.4	34.3	34.3	36.3	36.3	34.0	34.0
Guatemala	32.2	32.2	29.0	29.0	28.9	29.4	30.0	30.2
Honduras	26.4	26.4	33.9	34.4	33.3	33.3	31.2	31.4
Nicaragua	32.3	32.3	31.9	32.7	33.4	34.0	32.5	33.0
Panama	30.5	30.7	38.2	39.4	42.4	43.0	37.0	37.7
Caribbean	**33.0**	**33.2**	**41.3**	**42.2**	**37.7**	**38.3**	**37.3**	**37.9**
Bahamas	46.7	46.7	43.0	44.3	49.1	49.7	46.3	46.9
Barbados	38.9	38.9	37.9	38.9	41.8	42.4	39.6	40.1
Cuba	41.7	42.2	55.9	57.3	42.9	43.6	46.8	47.7
Dominican Republic	27.2	27.3	39.4	40.3	37.5	37.9	34.7	35.1
Grenada	41.7	41.7	40.1	41.0	44.4	45.1	42.1	42.6
Haiti	25.9	25.9	29.6	29.6	29.6	30.3	28.4	28.6
Jamaica	38.8	38.8	38.0	38.6	41.7	42.3	39.5	39.9
St Lucia	43.1	43.1	40.9	41.7	45.8	46.4	43.3	43.8
St Vincent and the Grenadines	46.6	46.6	43.2	44.0	49.0	49.7	46.3	46.8
Trinidad and Tobago	42.3	42.3	35.5	37.9	45.0	45.6	41.0	41.9

Source: Data initialized from World Bank Global Achievement Database, 2013.

By 2040, average primary scores are forecast to rise amongst countries in Central America and the Caribbean, but the pattern of slightly higher scores amongst females is projected to persist. The same countries in which female reading scores exceeded male reading scores in 2017 are also projected to diverge in 2040. In Belize, for example, average female reading scores are forecast to be 43.6, compared to 40.3 for males. In Trinidad and Tobago, IFs forecasts that the average female reading score will be 40.4 compared to 37.8 for males.

Table 15: Primary test scores in Central America and the Caribbean, by gender, by subject, 2040

	Math		Reading		Science		Overall	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Central America	**35.9**	**36.0**	**37.0**	**37.8**	**38.1**	**38.5**	**37.0**	**37.4**
Belize	43.7	43.7	40.3	43.6	46.3	47.1	43.4	44.8
Costa Rica	40.2	40.4	41.6	42.7	44.7	45.2	42.2	42.8
El Salvador	37.6	37.7	40.3	40.8	42.4	42.7	40.1	40.4
Guatemala	36.0	36.1	32.6	33.1	32.7	33.2	33.8	34.1
Honduras	32.7	32.7	40.0	41.0	39.5	39.8	37.4	37.8
Nicaragua	37.0	37.1	36.5	37.6	38.1	38.7	37.2	37.8
Panama	33.3	33.7	41.0	42.5	45.3	45.9	39.9	40.7
Caribbean	**35.7**	**36.0**	**43.7**	**44.8**	**40.7**	**41.3**	**40.1**	**40.7**
Bahamas	47.8	47.9	44.1	45.5	50.2	50.8	47.4	48.1
Barbados	44.3	44.3	43.2	44.5	47.2	47.8	44.9	45.5
Cuba	43.9	44.4	58.0	59.7	45.1	45.8	49.0	50.0
Dominican Republic	31.3	31.5	43.3	44.7	41.6	42.0	38.7	39.4
Grenada	48.2	48.4	46.4	47.9	51.1	51.7	48.6	49.4
Haiti	30.4	30.5	34.1	34.3	34.2	34.9	32.9	33.2
Jamaica	41.5	41.6	40.6	41.5	44.4	45.1	42.2	42.7
St Lucia	46.8	46.9	44.4	45.6	49.5	50.1	46.9	47.6
St Vincent and the Grenadines	48.8	48.9	45.2	46.4	51.2	51.9	48.4	49.1
Trinidad and Tobago	44.6	44.7	37.8	40.4	47.4	47.9	43.3	44.3

Source: Data initialized from World Bank Global Achievement Database, 2013; Current Path forecast from IFs 7.38.

Many of the countries that perform well at the primary level continue to do so at the secondary level. In Central America, Belize and Costa Rica have the highest overall secondary test scores. In the Caribbean, the Bahamas, St. Vincent and the Grenadines, and Cuba have the highest scores. Meanwhile, Honduras, Haiti, the Dominican Republic, and Guatemala register some of the lowest test scores at the secondary level.

As with primary test scores, secondary test scores are expected to improve, largely due to current levels and increases in overall educational attainment and per pupil spending. Honduras,

the Dominican Republic, and Panama are all expected to improve secondary scores the most rapidly, as all are significantly lower than would be expected based on spending and overall attainment. By 2040, all countries in Central America and the Caribbean are expected to reach over 40 in overall secondary test scores, though Guatemala and Haiti are expected to remain well behind regional peers.

Table 16: Secondary test scores by level, Central America and the Caribbean, 2017 and 2040

	Math		Reading		Science		Overall Scores	
	2017	**2040**	**2017**	**2040**	**2017**	**2040**	**2017**	**2040**
Central America	**41.6**	**46.1**	**40.4**	**44.7**	**38.7**	**43.1**	**40.2**	**44.7**
Belize	53.4	54.6	48.9	50.1	46.6	47.8	49.6	50.8
Costa Rica	47.4	52.2	44.9	49.8	42.7	47.5	45.0	49.8
El Salvador	41.2	46.7	43.5	49.0	39.0	44.5	41.2	46.7
Guatemala	41.9	44.9	39.0	42.0	36.8	39.7	39.2	42.2
Honduras	38.3	45.2	37.1	44.0	39.4	46.3	38.3	45.2
Nicaragua	41.4	45.5	41.8	45.9	39.5	43.7	40.9	45.0
Panama	41.0	46.3	40.3	45.5	38.2	43.4	39.8	45.1
Caribbean	**45.4**	**48.1**	**44.3**	**47.5**	**42.5**	**45.2**	**44.0**	**46.9**
Bahamas	56.9	58.0	51.3	52.4	49.0	50.1	52.4	53.5
Barbados	50.4	55.4	46.9	51.9	44.6	49.6	47.3	52.3
Cuba	55.7	58.4	47.6	50.2	53.3	56.0	52.2	54.9
Dominican Republic	37.8	43.3	44.4	49.9	35.5	41.0	39.2	44.8
Grenada	52.7	58.6	48.7	54.6	46.4	52.3	49.3	55.1
Haiti	39.4	42.2	39.4	42.2	37.2	40.0	38.7	41.5
Jamaica	50.3	52.6	46.8	49.1	44.5	46.8	47.2	49.5
St Lucia	54.0	58.0	49.4	53.4	47.1	51.1	50.2	54.2
St Vincent and the Grenadines	56.8	58.9	51.3	53.3	49.0	51.1	52.4	54.4
Trinidad and Tobago	48.5	52.4	44.4	48.3	41.0	44.9	44.7	48.6

Source: Data initialized from World Bank Global Achievement Database, 2013; Current Path forecast from IFs 7.38.

Test scores: an inter-regional comparison

The scale for test scores ranges from zero to 100, but all countries across the globe register average scores between 20 and 60 across all levels and subjects. Globally, Montenegro has the highest estimated average scores (across all three subjects) at the primary level (55) and Singapore has the highest at the secondary level (59), while Burkina Faso has the lowest scores in primary (22) and Niger has the lowest in secondary (32).

Average primary scores in the Caribbean were slightly above the global average in 2017, but slightly below South America. Average primary scores in Central America were higher than

North Africa and Southern Asia but below Southeast Asia. At the secondary level, the Caribbean continues to outperform Central America and the rest of its regional peers. The Caribbean has the highest average scores of all regions while Central America has the lowest.

Average scores across both levels are projected to improve for both Central America and the Caribbean. However, both regions are projected to fall behind some of their regional peers (see Table 17 and 18). The Caribbean is forecast to improve scores across both levels by about three points, but both South America and Southeast Asia are projected to improve by four points or more across levels. Likewise, improvements in Central America are forecast to be overshadowed by South Asia; Central America is forecast to improve test scores by about four and half points across both levels, but South Asia is forecast to improve by five points or more.

Table 17: Primary test scores by subject, selected regions, 2017 and 2040

	Math		Reading		Science		Overall	
	2017	**2040**	**2017**	**2040**	**2017**	**2040**	**2017**	**2040**
Central America	31.1	35.9	32.8	37.4	33.8	38.3	32.5	37.2
Caribbean	33.1	35.9	41.7	44.3	38.0	41.0	37.6	40.4
North Africa	31.4	36.7	32.3	37.8	33.0	38.6	32.2	37.7
South America	32.9	37.1	43.4	47.4	38.2	42.3	38.2	42.3
Southeast Asia	35.7	40.9	35.9	41.4	37.4	42.5	36.4	41.6
South Asia	29.5	36.1	32.0	38.5	33.3	39.9	31.6	38.2

Table 18: Secondary test scores by subject, select regions, 2017 and 2040

	Math		Reading		Science		Overall	
	2017	**2040**	**2017**	**2040**	**2017**	**2040**	**2017**	**2040**
Central America	41.6	46.1	40.4	44.7	38.7	43.1	40.2	44.7
Caribbean	45.4	48.1	44.3	47.5	42.5	45.2	44.0	46.9
North Africa	44.6	48.5	41.1	45.2	40.6	44.6	42.1	46.1
South America	43.5	48.2	43.3	48.0	41.0	45.6	42.6	47.2
Southeast Asia	45.8	50.7	44.1	49.0	41.0	45.8	43.7	48.5
South Asia	43.0	48.3	41.4	46.8	40.1	45.5	41.5	46.8

Source: Data initialized from World Bank Global Achievement Database, 2013; Current Path forecast from IFs 7.38.

This slow growth (relative to peers) can be explained in part by changes in the core drivers of education quality: education spending and educational attainment. Central America currently spends more (total and per pupil relative to GDP/GDP per capita) on education than North Africa and South Asia. However, North Africa and South Asia are forecast to significantly increase spending (as a portion of GDP and GDP per capita) over the next 22 years, while Central American spending (as a portion of GDP and GDP per capita) is forecast to fall. This is driven by overall faster economic growth in North Africa and South Asia than in Central America.

While the Caribbean currently spends more on education than most regional peer groups (both total and per pupil relative to GDP/GDP per capita), regional peer groups are expected to catch up and surpass spending levels over the forecast horizon, driven by higher projected levels of economic growth. This additional spending drives growth in education quality that will converge towards (already relatively high) scores in the Caribbean.

History and 'Current Path' of key overarching issues in Central America and the Caribbean

Key takeaways:

- Education is valuable for its ability to build knowledge and skills, but it also impacts and is influenced by violence, economic growth and opportunity, migration, and governance.

- Violence: Countries in Central America and Caribbean rank amongst the highest in the world for homicide rates. Education does not have a clear, direct impact on violence at a cross-country macro level, but may impact violence indirectly through inequality and the youth bulge.

    - IFs forecasts that all Central American and the Caribbean countries will reduce homicide rates by 2040, but many countries will maintain high rates compared to other countries around the world.

- Economic outcomes: Overall educational attainment and quality contribute to the skill level of the labor force and the output potential of an economy. Improvements in education can boost skills and output levels of the work force.

    - Since 1990, Central America and the Caribbean's GDP growth rates have lagged behind the average GDP growth rate across upper-middle income economies and remain close to a full percent lower than the average for lower-middle income economies. Annual GDP growth is projected to average 3.7 percent in Central America and 3.8 percent annually across the Caribbean in 2040.

    - Central American and Caribbean labor forces are projected to increase by an average of 1.3 and 0.50 percent per year, respectively, from 2017 until 2040. This is largely driven by shifting demographic dynamics and Current Path population growth. Also, IFs projects that the service sector and, to a lesser extent, manufacturing sector, will see the most significant workforce growth over the next 23 years. However, the exact education policies needed to encourage this growth and reduce informal labor will differ by country.

- Governance: Across both government effectiveness and transparency, Central America is generally in the middle to low end of regional peers while the Caribbean consistently scores on the higher end of effectiveness. Within Central America, Guatemala, Honduras, Nicaragua, and Belize are among the least transparent, both in Central America and the Caribbean, and in the world. In 2017, Nicaragua, Honduras, Guatemala, and Belize's were the 138th, 135th, 126th, and 119th most transparent countries out of the

186 measured in IFs. In the Caribbean, Haiti is the major outlier and is one of the ten most corrupt countries in the world.

- Migration: Societal violence and lack of economic opportunity in the Caribbean and Central America have driven migrants to the United States. UNESCO (2012) and Williams (2015) find that education-based interventions can limit youth violence, but many cross-country studies find little direct connection between education and migration.

    - In IFs, the primary way through which education can lower migration and violence is greater economic output and reduced inequality (a core driver of poverty and violence). Raising the stock and quality of education in Central America and the Caribbean would help encourage students to remain in school and increase economic potential, discouraging migration to other countries.

- In some cases, education's impact on different facets of development is unclear, highlighting the need for comprehensive development strategies that address all factors that shape progress in development.

The previous sections outlined the Current Path forecasts for the education system in the Caribbean and Central America. However, education systems do not operate in a vacuum. Education outcomes interact and are driven by factors such as violence, economic growth and opportunity, and governance in both direct and indirect ways. The following section briefly outlines additional issue areas that impact educational outcomes in Central America and the Caribbean.

Societal violence

High levels of societal violence were endemic to the Caribbean and Central America for large parts of the latter half of the 20th century. For example, 200,000 civilians died in Guatemala's 30-year civil war (1966-1996). Conflict between the El Salvadoran military and leftist guerrilla groups (1980 -1992) left over 75,000 dead. The Nicaraguan revolution and subsequent Contra War in the 1980s also took tens of thousands of lives. These long-term conflicts left Central America awash with arms and weapons. Additionally, the military-led governments that ruled in many of these countries left little opportunity for democratic institutions to mature.

Post-conflict countries today still have some of the highest homicide rates in the world. The U.S. policy of deporting undocumented immigrants back to the Northern Triangle, which accelerated after 1996, led to an expansion of another form of violence that contributed to the high homicide rates: gang violence. Upon return to their home countries, MS-13 and 18th Street gangs have transferred a "Los Angeles" style gang culture to Central America (Seelke, 2016a). The gang culture is especially pervasive in the Northern Triangle, but Costa Rica, Nicaragua, and Panama have also reported a growing MS-13 and 18th Street gang presence (Gurney, 2014; LaSusa, 2016).

Since 2005, El Salvador has maintained one of the highest homicide rates in the world, while Guatemala and Honduras currently rank sixth and eighth, respectively (see Table 20).[9] The highest concentration of homicides lies in the Northern Triangle, but other Caribbean and Central America countries also endure societal violence and homicides. Jamaica ranks 11th in the world in homicides, while Belize, the Bahamas, and St. Vincent and the Grenadines rank 12th, 13th, and 14th, respectively. In 2040, IFs forecasts that all countries in Central America and the Caribbean will reduce homicide rates out to 2040, but many countries will fail to improve relative to global peers. In fact, Guatemala, Belize, and Honduras are expected to move up the global rankings.

Table 19: Total homicide rates and global ranking, Central American and the Caribbean, selected years

	2005		2017		2040	
	Homicide rate	**Global ranking**	**Homicide rate**	**Global ranking**	**Homicide rate**	**Global ranking**
Central America	**30.9**	**N/A**	**29.7**	**N/A**	**22**	**N/A**
Belize	19.2	16	21.8	12	19.1	8
Costa Rica	6.9	53	7.7	48	5.4	56
El Salvador	58.3	1	54.8	1	34.2	1
Guatemala	39.6	4	35.8	6	28.0	5
Honduras	30	7	32.8	8	24.4	7
Nicaragua	11.2	34	10.1	39	7.4	43
Panama	12.1	31	15.7	24	13.0	20
Caribbean	**10**	**N/A**	**10.4**	**N/A**	**7.9**	**N/A**
Bahamas	19.1	19	21.0	13	14.7	17
Barbados	10.8	35	10.1	38	9.6	34
Cuba	5.6	67	5.4	71	4.0	78
Dominican Republic	12.4	30	13.4	31	10.1	31
Grenada	6.4	60	6.8	57	4.5	70
Haiti	7.2	52	7.2	53	6.0	52
Jamaica	21.9	10	24.1	11	16.0	15
St. Lucia	16.4	22	16.7	22	10.5	29
St. Vincent and the Grenadines	17.2	21	20.8	14	16.1	14
Trinidad & Tobago	21.6	11	20.7	15	17.1	11

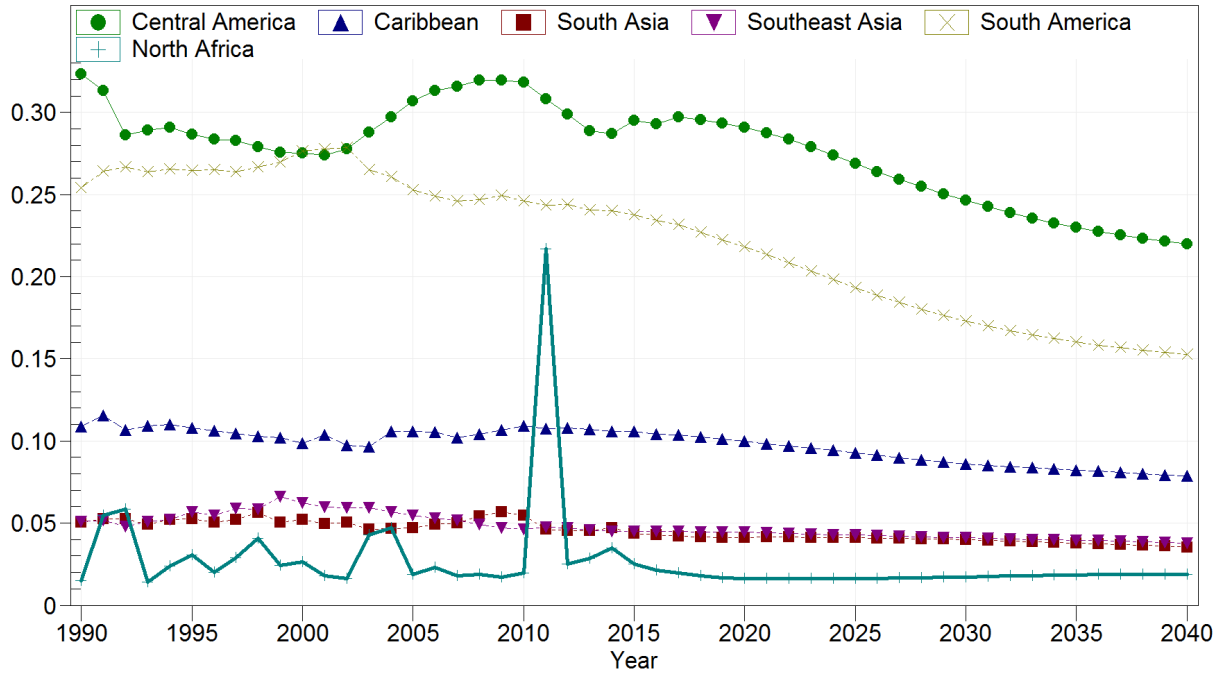
Source: Data from IHME; Current Path forecast from IFs 7.38. Note: Homicide rate is the number of individuals per 100,000.

N/A = Not available.

[9] No data were available for Haiti for the years included in the table. In 2011 and 2012, Haiti's homicide rate was nine per 100,000 and 10 per 100,000 respectively. It ranked 33rd and 34th globally.

Central America has one of the highest regional homicide rates in the world. Of regional peers, only South America experiences total homicide rates comparable to those of Central America. While IFs projects that homicide rates will slowly decline out to 2040, societal violence in Central America and the Caribbean is forecast to persist. Figure 3 below shows the forecast of total homicide rates for selected regions out to 2040.

Figure 3: Total homicide rates, selected regions, 1990 to 2040



Source: Data from IHME; Current Path forecast from IFs 7.38.

The persistence of social violence is linked to its drivers in IFs: high and enduring inequality and a youthful population (especially in Central America). This is because inequality exacerbates societal tensions and youth are more likely to engage in violence than older adults. These drivers are slow moving and difficult to influence at a national level, which means that high levels of societal violence are expected to persist through the forecast horizon.

At a cross-country macro level, there is no clear, direct impact between education and violence. However, there are "hard links" in the IFs model, or connections in which one variable affects another through separate links in the model. Here, violence and education can impact each other indirectly through the drivers listed above (inequality and the youth bulge). Also, education can influence violence (and migration) through its links to the economy, such as GDP and labor. Furthermore, changing patterns of educational attainment and quality can impact violence by affecting the demographic structure or the distribution of income (inequality). Increased female education leads to lower fertility rates, which can in turn reduce the youthfulness of a population by accelerating ageing. Further, education improvements impact the distribution of skilled and unskilled labor, and therefore play a role in changing patterns of income distribution, and reducing inequality.

That said, education, demographics, and inequality are large, slow moving phenomena, which means it would take large changes in one or all to significantly affect levels of violence. Furthermore, impacts of education on demographics and inequality depend heavily on the current conditions – in a country that already has a low or rapidly falling birth rate, education interventions will not have a dramatic impact on demographics. Educated females typically have fewer children (Cochrane, 1979), so education interventions in areas with low total fertility rates may be less impactful.

There is also no clear, direct link between homicides and education at a cross-country national level. However, homicide rates and violence can significantly impact economic growth and opportunity, thereby affecting the education system. The economic costs of high and persistent social violence are far-reaching and pernicious, with direct impacts on healthcare, law enforcement, lost wages, and labor (World Bank, 2011). A study by the Inter-American Development Bank estimates the direct costs of crime in Latin America and the Caribbean (17 countries) from 2010-2014; the cost of homicide is estimated to be 0.4 percent of GDP in 2010 and 0.32 percent in 2014 (Jaitman et al., 2017). This study also finds homicides constituted the largest contributor to the costs of crime in Latin America and the Caribbean (17 countries) in 2014.

Economic growth and labor dynamics

Sub-par economic growth and lack of opportunity in the Caribbean and Central America are deeper drivers of education, migration, and violence. Since 1990, Central America's average annual GDP growth rate (4.2 percent) and the Caribbean (2.2 percent) have lagged behind the average GDP growth rate across upper-middle income economies (4.4 percent) and remain close to a full percent lower than the average for lower-middle income economies (4.8 percent).[10] Annual GDP growth is projected to average 3.7 percent in Central America and 3.8 percent annually across the Caribbean out to 2040.

Labor market demand and supply patterns reflect the composition of the economy and, in Central America in particular, labor has largely been absorbed into agriculture and low-skilled service sectors. Many of these jobs are in the informal sector.[11] IFs estimates that in 2017 close to 59 percent (8.7 million people) of the non-agricultural labor force works in the informal sector in Central America and 44.8 percent (6.3 million people) works informally in the Caribbean.

The Central American and Caribbean labor forces are projected to increase by an average of 1.3 and 0.50 percent per year, respectively, out to 2040. This is largely driven by shifting

[10] The majority of countries in these sub-regions are middle-income countries, allowing for comparison to direct peers.

[11] The informal economy is a broad term for enterprises and/or employment relationships that are not legally regulated, incorporated, or protected (Chen, 2007). The informal sector does not offer benefits or social protection to workers, and it costs governments in the shape of lost tax revenue. The informal sector is demonstratively less productive than the formal sector, but in developing countries a large portion of the population depends on informal activity for their livelihoods (Porta & Shleifer, 2014).

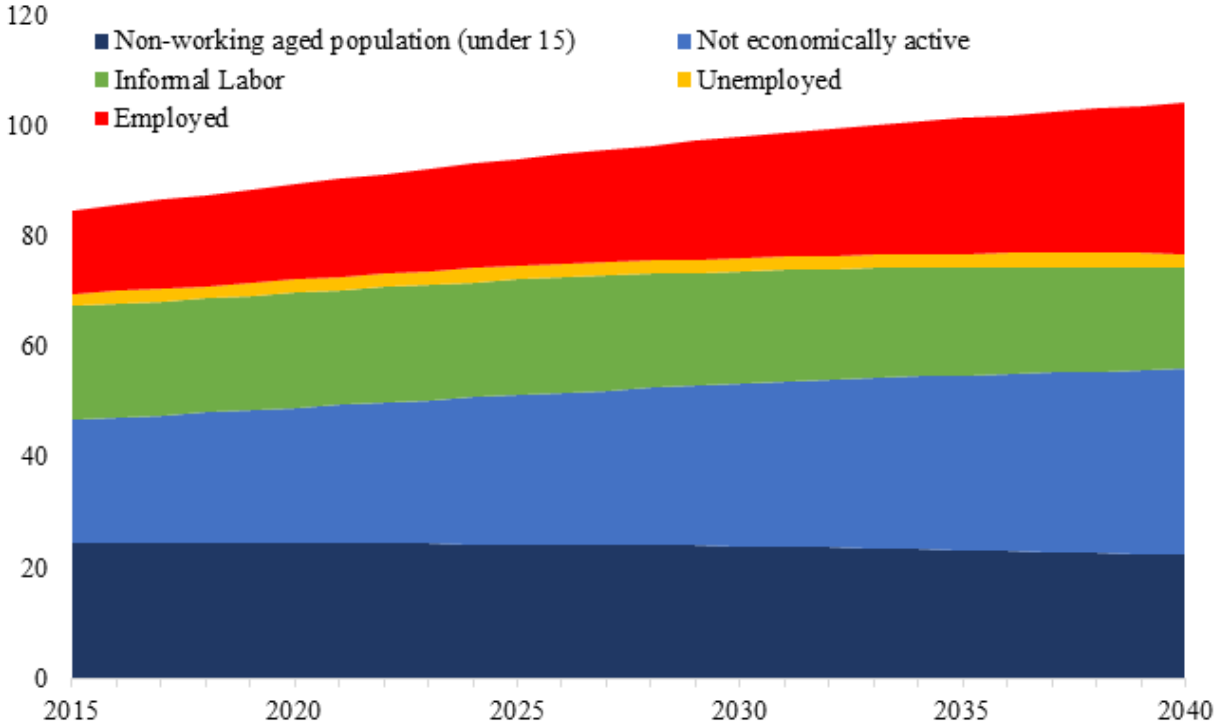
demographic dynamics and Current Path population growth. Central America is one of the youngest regions in the world, but is in the midst of a transition to an older and more balanced population. Central America and the Caribbean both have a large youth bulge (as measure of the relative size of the population 15 to 24), but it is expected to decline as population ageing generates what is referred to as a demographic dividend.[12]

IFs projects that the service sector and, to a lesser extent, manufacturing sector, will see the most significant workforce growth over the next 21 years. The larger question is how additional labor will be absorbed into the workforce. As mentioned above, the Central American economy is projected to grow out to 2040, but whether that growth results in increases in formal employment and opportunities is unclear. In the Caribbean formal sector, for example, unemployment rates (population aged 15+) have averaged between seven and eight percent annually since 2000 according to data from the ILO.

Figure 4 shows the current and forecast labor status of Central America and the Caribbean's population (as a whole). Of its 86 million people, 47 million (54 percent) are not currently economically active. 24.5 million of those individuals are under the age of 15 and 23 million are of working age but not actively seeking employment. The labor force constitutes 45 percent of the total population in Central America and the Caribbean (39 million people). Of the 39 million individuals currently in the labor force, over 20 million (50 percent) work in the informal sector, 2.3 million are considered officially unemployed (six percent), and the remaining 16 million are employed in the formal sector (42 percent).

[12] The demographic dividend occurs when the ratio of working aged individuals to dependents (under 15 and over 65) increases significantly over a period of time. It is driven by improvements in life expectancy and reductions in the fertility rate, which subsequently shift population dynamics. The demographic dividend has long been associated with robust economic growth that comes from having a smaller dependent population that creates an important opportunity for economic growth and frees up resources for productive investments (Lee & Mason, 2006; Population Reference Bureau, 2012).

Figure 4: Labor status of population, Central America and the Caribbean, 2015 to 2040



Source: Data from International Labor Organization (ILO); Current Path forecast from IFs 7.38.

Along the forecast horizon, IFs projects that the informal share of the workforce will decline as the population in Central America and the Caribbean becomes more educated and economic output becomes more sophisticated. By 2040, the labor force is expected to reach 48 million (46 percent of total population), of which 18 million (37 percent) are expected to still be in the informal sector, 2.5 million (five percent) are expected to unemployed, and 27 million (56 percent) are expected to be formally employed.

Overall educational attainment and quality are direct drivers of the skill level of the labor force and, thereby, the output potential of an economy. Improvements in education can boost the skills and output levels of the work force, thereby improving overall productivity and output. However, the supply of skilled labor must also be met with demand for high skilled jobs. The demand for labor (by sector and skill) is informed largely by historical patterns and tends to shift towards higher value-add sectors that require more skilled labor. While there are no direct links from education to labor demand, enhanced productivity from improved attainment or quality can in the long run accelerate a country's progress towards an economic structure more dependent on higher skilled labor.[13]

[13] Unemployment in IFs can be driven up or down in response to short- and medium-run fluctuations in supply and demand (across six sectors and two skill levels). Unemployment interacts with changing wages by sector as well, producing dynamic behavior that then impacts household consumption. In the long-run, unemployment rates experience pressure to converge to historical country average unemployment rates. So, while unemployment can be driven up or

The exact education policies needed to encourage growth and reduce informal labor will differ by country. In the Northern Triangle and Nicaragua, significant investments in education over the long-term could give low-wage workers the skills and know-how to move into higher-value added activities. In Costa Rica and Panama, where the existing human capital base is higher, the challenge will be to disseminate its comparative advantage in high-tech sectors across the economy into other knowledge sectors and increase the pool of labor with specialized skills and access to technology. Alongside improvements in education and job training, the effective provision of a social safety net to both support and retrain workers displaced by the automation will become increasingly important.

Governance

The processes undertaken by governments to protect their citizens (security), provide basic services (capacity) and foster social and economic integration (inclusion) are crucial factors in the development of any country or region. In Central America and, to a lesser extent, the Caribbean, high levels of corruption, societal violence and the influence and operation of organized crime undermine and influence overall national and regional security, inclusion, and capacity in different ways.

IFs conceptualizes governance across three dimensions: security, capacity and inclusion. The three measures can be conceptualized as a governance triangle: each area is a distinct and necessary pillar of governance, but each is also intrinsically linked to the other two areas. These dimensions are based on historical development of governance via the three primary transitions conceptualized in modernization theory. Traditionally, these transitions have occurred in order (security to capacity to inclusion), but they are all heavily inter-connected and do not necessarily occur sequentially. See Appendix 1 for additional details.

Measuring governance can be challenging and drawing out the precise interplay between governance and other key issues like social violence, economic growth, and education requires an in-depth assessment of country-specific issues. However, we can use global governance indicators to assess and compare regional and country-level governance to identify gaps and issues. Moreover, we can assess the role governance can have in improving education systems. The following will briefly outline regional security and inclusion issues then explore regional government capacity issues and their link to education outcomes.

First, insecurity (via societal violence) is a key barrier to overall development in Central America and the Caribbean and policies to reduce societal violence have, in general, been ineffective (Seelke, 2016b). As outlined in a previous section, high rates of homicide and societal violence have persisted over time. The persistence of this type of insecurity can undermine governments' monopoly on the use of force and the rule of law, thereby weakening the effectiveness of institutions. While the nature of the societal violence is unique to each country context, the literature has consistently highlighted several common threads in Central America and the Caribbean: gangs and organized crime, narcotics trafficking, weak governance

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down based on changing supply-demand factors interacting with wages, there is a long-term pressure towards historical average values.

and systemic corruption, and weak rule of law (International Crisis Group, 2017; Renwick, 2016; Rivera, 2016; Shifter, 2012).

Persistent insecurity and societal violence not only have detrimental effects on economic growth and human well-being, they can have detrimental effects on the capacity of government institutions and undermine democratic stability and inclusion over time. Currently, both Central America and the Caribbean have high levels of institutionalized democracy, but countries with high levels of violence have seen threats to democracy and political inclusion in recent years. While an analysis of strength of democratic institutions (and the inclusion of a governance pillar in general) is out of the scope of this report,[14] the repercussions of political violence of a democratic backslide in any of the countries in Central America and the Caribbean would have significant effects.

In IFs, the third pillar of the governance triangle, government capacity, has the most proximate and sustained impact on education outcomes and key drivers of economic and human under development (Hughes, 2014). Poor government capacity and effectiveness in Central America and the Caribbean limit governments' ability provide public goods, support human and economic development, and promote social cohesion (Casas-Zamora, 2001). Lack of government capacity in Central America specifically exacerbates economic inequality – a key driver of homicides – and undermines the effectiveness of the education system.

The ability for governments to collect revenue is a first key indicator of total government capacity. Overall government revenue in Central America stands at 18 percent of GDP and at 22 percent of GDP in the Caribbean. The Caribbean has the highest government revenues of regional peer groups while Central America falls in the bottom three. As noted in the Current Path of education section above, this relatively low government revenue translates into low spending on education in Central America. However, the amount of resources a government can allocate is only part of the government capacity story - governments must not only be able to collect revenue, but also allocate it efficiently and effectively.

Two key cross-country measures of governments' ability to efficiently and productively allocate funds and provide services are levels of transparency and government effectiveness. IFs measures and forecasts government effectiveness (on a scale of zero to five – with five being most effective) using data from the Worldwide Governance Indicators project at the World Bank (2016) and measure and forecasts transparency (on a scale of one to 10 – with 10 being most

[14] IFs uses and projects two key measures of political inclusion: the state of institutionalized democratic governance (Polity Index) and gender empowerment (GEM). The Polity Index, which measures patterns of authority (from autocracy to democracy), suggests that Central America is the most democratic of any of its regional peers, while the Caribbean is one of the least democratic region. It should be noted that the Caribbean average is pulled down significantly by Cuba, which has one of the lowest Polity scores in the world (166 out of 186). Both sub-regions rank on the high end of regional peer groups on gender empowerment. That said, there is significant variation across the region. In northern Central America, violence and corruption are threats to democratic stability.

transparent) using data from Transparency International's Corruption Perceptions Index.[15][16] The most transparent country in the world is New Zealand (9.7) and the most corrupt is Somalia (one); the most effective government in the world is Singapore (4.7) and the least is Somalia (0.7).

Across both government effectiveness and transparency, Central America is generally in the middle to low end of regional peers while the Caribbean consistently scores on the higher end of effectiveness. Of regional peers, the Caribbean transparency is highest while Central America sits in the middle, scoring below South America (3.5) and Southeastern Asia (3.5), but higher than North Africa (2.9) and South Asia (3). Meanwhile, the Caribbean's government effectiveness score ranks just below Southeast Asia (2.7), but both are well ahead of other regional peers. Central America scores above both North Africa (1.8) and South Asia (2.1) but below South America (2.3).

Within Central America, Guatemala, Honduras, Nicaragua, and Belize are among the least transparent, not only in Central America and the Caribbean, but also in the world. In 2017, Nicaragua, Honduras, Guatemala, and Belize's scores left them as the 138th, 135th, 126th, and 119th most transparent countries out of the 186 measured in IFs. In the Caribbean, Haiti is again the major outlier and is one of the most corrupt countries in the world.

The story is much the same when it comes to government effectiveness. Guatemala, Honduras, and Nicaragua, and Belize are in the bottom 30 percent of countries in IFs with respect to their effectiveness scores in 2017. Haiti is in the bottom three in the world in terms of government effectiveness and the next lowest country is the Dominican Republic at 110th in the world.

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[15] The World Bank's Government Effectiveness measure is meant to capture aspects of effectiveness like the quality of public services, the civil service, the policy formulation process, and the government's commitment to these policies. IFs adjusts the original World Bank Government effectiveness measure from a -2.5 to 2.5 scale to a 5 point scale.

[16] IFs uses the Corruption Perceptions Index (CPI) from Transparency International (TI) to initialize and forecast quantitative measures of governance corruption. IFs uses the CPI because it contains information on perceived corruption from over 180 countries derived from multiple sources and institutions. In 2012, TI simplified the CPI computation to allow for analysis across time. The index is normalized and scored in IFs from 1 (least transparent) to 10 (most transparent).

Table 20: Government capacity indicators, Central American and the Caribbean, 2017 and 2040

	Transparency Index (Scale: 0 - 10)				Government Effectiveness Index (Scale: 0 - 5)			
	2017		2040		2017		2040	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Central America	**3.2**	**N/A**	**4.4**	**N/A**	**2.2**	**N/A**	**2.7**	**N/A**
Belize	2.9	119	3.6	124	1.8	135	2.3	142
Costa Rica	4.9	50	6.5	55	2.9	51	3.4	52
El Salvador	3.5	87	4.3	99	2.5	81	2.9	85
Guatemala	2.7	126	3.6	123	1.8	136	2.4	135
Honduras	2.7	135	3.6	121	1.8	145	2.3	137
Nicaragua	2.6	138	3.5	132	1.7	146	2.3	146
Panama	3.5	86	6.0	62	2.8	60	3.4	53
Caribbean	**4.9**	**N/A**	**5.9**	**N/A**	**2.5**	**N/A**	**3.0**	**N/A**
Bahamas	7.3	23	8.2	35	3.2	44	3.6	45
Barbados	7.8	19	7.8	39	3.7	24	3.8	39
Cuba	4.2	62	5.2	74	2.5	85	2.8	93
Dominican Republic	5.3	45	7.0	52	2.1	110	2.9	88
Grenada	3.6	78	5.6	66	2.4	88	3.1	71
Haiti	1.8	177	2.4	179	0.5	184	1.2	183
Jamaica	3.4	92	4.2	105	2.7	69	3.0	79
St Lucia	6.9	29	7.3	46	2.5	80	3.0	81
St Vincent and the Grenadines	5.8	39	6.3	57	2.6	71	3.1	74
Trinidad and Tobago	3.0	114	5.1	78	2.7	67	3.3	57

Source: Data initialized from World Bank and Transparency International data, forecast from IFs 7.38.

N/A = Not available.

Looking forward, transparency and government effectiveness across many countries in Central America and the Caribbean are projected to improve at a slower rate than other countries. In 2040, 11 of the 17 countries assessed here have a lower global transparency rank and nine of the 17 have a lower government effectiveness rank than today. Further, the countries that do not fall in the rankings barely improve or just maintain their position globally. For example, Guatemala is projected to see its global transparency position improve by only three spots from 126th in 2017 to 123rd in 2040.

Slow improvements in government effectiveness and transparency are driven by relatively modest growth projections, Central America and the Caribbean's youthful population, and risk of conflict and institutional deterioration from persistent social violence. In the Northern Triangle, where governance issues are most acute, improvements in transparency and effectiveness are undermined by the prevalence of organized crime, drug cartels, and gang activity (Rivera, 2016; UNODC, 2012). These slow improvements in government capacity - via government revenues, effectiveness and corruption - drive slow improvements in education outcomes.

Education systems exist within systems governance and national government capacity is a crucial element of a well-functioning education system. As outlined in the Current Path of education section in the report, spending on education across Central America and the Caribbean is generally low and lack of resources for students and teachers is a key barrier to education progress. Part of this funding gap stems from corruption; a multitude of high ranking government officials and leaders across Central America have colluded with organized crime organizations (Asmann, 2018; Goldstein & Weiser, 2017). Taking bribes and colluding with organized crime undermines government revenue processes, syphoning money away from government programs.

Further, weakened government institutions and lack of capacity in government agencies limit the effectiveness of the funds that are allocated to education and other government programs. Corruption breeds inefficiency and Central America and the Caribbean, and the Northern Triangle specifically, needs civil service reform and better government management to ensure that education systems receive the support and funding they need to succeed.

The compounding and reinforcing pressures stemming from pervasive social violence and poor governance pose significant barriers to overall development in Central America and the Caribbean. Lack of government capacity undermines basic service delivery and the effectiveness of education systems. Moreover, the influence of organized crime undercuts economic growth and undermines the security of the state.

The possible spillover effects of societal violence and insecurity in Northern Triangle countries could have an adverse effect on Central America and the Caribbean as whole. Recent political violence in Nicaragua has led to an influx of Nicaraguan refugees in neighboring Costa Rica. While Costa Rica has accommodated the influx thus far, rising anti-immigrant sentiment has led to protests in the capital city (Kahn, 2018).

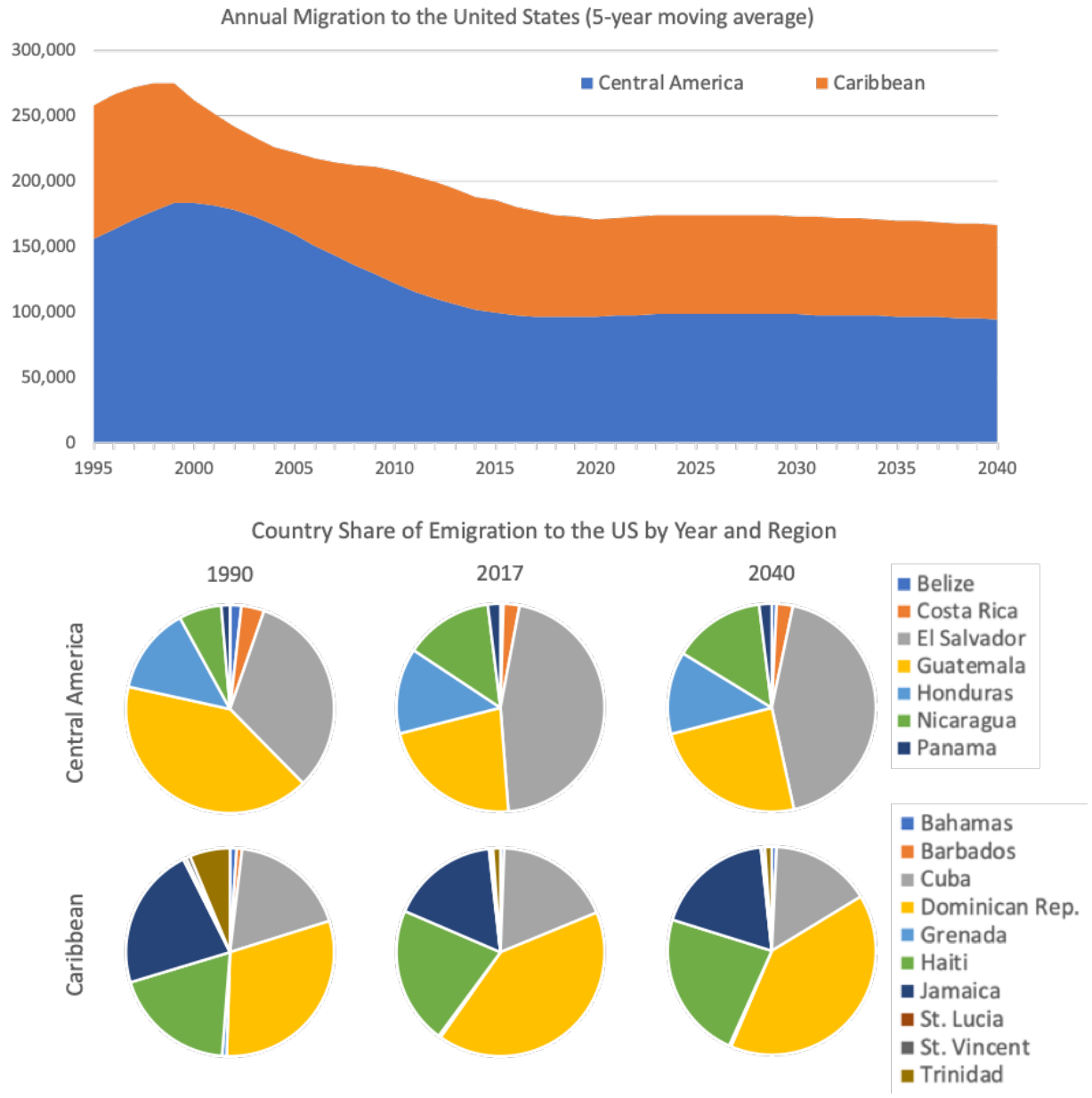
Migration

The outward flow of individuals accounts for much of the relocation and movement in Central America and the Caribbean. However, net migration from both Central America and the Caribbean peaked around the mid 20th century; since those peaks, net migration as a share of the population has declined in both regions. In 2017, IFs estimates that approximately 125,000 people emigrated from Central America (0.26 percent of the total population), while 101,000 emigrated from the Caribbean (0.26 percent of the population). By 2040, the number of emigrants is projected to remain fairly constant (126,000 in Central America; 101,000 in the Caribbean), but the portion of the population that elects to migrate will fall to 0.23 percent in the Caribbean and 0.21 in Central America. IFs projects that the vast majority of migrants will continue to relocate to the United States in search of safety and economic opportunity.

Figure 5 shows that emigration from Central America and the Caribbean to the United States has fallen since 1995 and will continue to do so (although at a slower pace) until 2040. The figure also uses pie charts to show that the countries that send the most emigrants change over time. For example, in 1990, Guatemala sent the largest number of emigrants of any country in Central America, but in 2017, was surpassed by the second largest sender of migrants, El Salvador. El Salvador will remain the largest sender in Central America out to 2040.

Despite declines in migrants as a share of the population, the topic remains politically charged and a focus of the current US Administration. For example, in November of 2018, a caravan filled with undocumented Central Americans entered the US, prompting President Trump to describe the incident as an "invasion" of "bad people" (Trump, 2018). The President has also championed for the construction of a wall to curb the influx of migrants. Debate over this wall has led to tensions between Democrats in the Senate and the President, contributing to the longest government shutdown in US history (Bryan, 2019).

Figure 5: Annual Emigration from Central America and the Caribbean to the United States, 1990, 2017, 2040



Source: Yearly data estimated from Abel (2017) et al. and UNDESA, 2017; Current Path forecasts and estimates from IFs 7.38.

Lack of economic opportunity and persistence of societal violence are the factors that continue to drive migrants from Central America and the Caribbean to the United States. Individuals often have multiple overlapping reasons for migration, but the most powerful and cited reasons for migration are economic opportunity and fear of violence. Some studies find that migrants from Central America and the Caribbean are just as likely to cite economic reasons for their decision to migrate as violence (Passel et al., 2017). Pew Research Center (2017) finds that migrants from the Northern Triangle commonly cite high homicide rates, gang activity, and violence at home as key motivators.

Clemens (2017) examines this link by assessing the relationship between homicides and apprehension of child migrants from Central America and Mexico. In his review of the literature, he addresses a large wave of unauthorized Unaccompanied Alien Children (UACs) in the US and the uptick in violent crime in Central America and Mexico, which has been linked to forced displacement. In his quantitative analysis, he finds that one additional homicide per year in the region over a six-year period (2011-2016) led to an additional 3.7 apprehensions of UACs in the United States. The impact of short-term increases in homicide is approximately equivalent to that of economic factors in the region, such as poverty and average income.

Studies indicate that education-based interventions effectively curb violence among youth in certain instances (UNESCO, 2012; Williams, 2015). However, the majority of cross-country studies that examine the relationship between education and migration find little direct connection. In IFs, the main channel through which education can reduce migration and violence is increased economic output and reduced inequality (a core driver of poverty and violence). Increasing the stock and quality of education in Central America and the Caribbean would raise economic potential and could incentivize children to stay in school and adults with education to remain in their home countries.

Some of those with advanced degrees seek employment in the US, where opportunities are more plentiful. This phenomenon is referred to as 'brain drain' – the exodus of high-skilled labor. Significant brain drain also reduces the stock of human capital and changes labor opportunities in the domestic economy. It may also reduce incentives to invest in education in Central America because children are likely to leave or drop out in search of greater security or economic opportunity abroad (World Bank, 2012).

The impact of Current Path investment in education in Central America and the Caribbean

Key takeaways:

- Investments in education generate gains across the economy and the labor force while alleviating poverty and contributing to reductions in violence and emigration.

- Without education investments, IFs forecasts that in 2040 Central American and Caribbean GDP would both be roughly six percent lower than expected under the Current Path of development

- Education investments are also forecast to boost the number of skilled workers in 2040, while also alleviating poverty. Without education investments, the number of skilled Central American workers is forecast to be 4.5 percent lower and the number of skilled Caribbeans is forecast to be 4.8 percent lower. The size of the informal labor force is projected to be 8.6 percent higher in Central America and 14.4 percent higher in the Caribbean. Furthermore, without education investments, there are projected to be one million additional Central Americans and half a million additional Caribbeans living in poverty in 2040.

- Education investments also affect homicide rates. In 2040, the Central American homicide would be 3.6 percent higher and the Caribbean homicide rate 7.8 percent higher. This can be explained in part by the fact that failure to attend school can increase gang participation and gang violence.

- Education investments also reduce the emigration rate from Central America and the Caribbean. Increased economic output improves economic opportunities and reduces violence, discouraging relocation. Without education investments, emigration from Central America is forecast to be 2.2 percent higher in 2040 and Caribbean emigration is projected to be 1.4 percent higher.

Theory and evidence suggest that education contributes to overall development and in numerous ways and different contexts. But, what is the value of education in society? How do continued improvements in education impact (directly or indirectly) overall development and key issue areas in Central America and the Caribbean? To demonstrate the value of education Central America and the Caribbean moving into the future, we simulated a world in which improvements in educational attainment and quality stall[17] to show the benefits of education investments along the Current Path of development.

The overall economic value of continued progress in education is immense. As the stock and quality of education in Central America and the Caribbean improves, those who enter the labor force possess skills that help increase overall economic productivity in the economy. We estimate that continued gains in educational attainment and quality will produce an additional $217 billion in GDP in Central America and $184 billion in the Caribbean between 2017 to 2040 compared to a world in which education progress ceases. Without investments in education, Central America and the Caribbean's GDP would both be about six percent lower in 2040.

Improved education outcomes also impact participation in the informal labor market and increase the number of skilled workers – workers with college or technical training who possess specialized skills and knowledge. Education investments add approximately 330,000 skilled workers to the Caribbean and 340,000 skilled workers to Central America in the year 2040.

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[17] In the stalled education world, average educational attainment remains the same out to the 2030's in both Central America and the Caribbean, before declining slightly out to 2060. Average attainment begins to fall in each region as older educated individuals begin to die, but younger individuals lack the education necessary to increase the overall stock of education in society.

There are projected to be approximately 780,000 fewer informal workers in the Caribbean and 865,000 fewer informal workers in Central America in 2040. This means that a world without investments in education, informal labor in Central America would be 8.6 percent higher and informal labor in the Caribbean would be 14.4 percent higher.

Current Path improvements in education also alleviate inequality. They do this by boosting educational attainment and quality for underserved groups who may otherwise lack access to schooling. Improved education, paired with economic and labor force gains, help pull one million Central Americans and 500,000 people in the Caribbean out of poverty over the next 22 years. Furthermore, the additional reductions in inequality and the reduction of the youth bulge (due to improvements in female education) reduce societal violence along the Current Path. In a world without education investments, the homicide rate would be 3.6 higher in Central America and 7.8 percent higher in the Caribbean in 2040. Failure to attend school can lead to increased likelihood of gang participation, and thus increased gang violence. Children who drop out of school or fail to engage at school are at the greatest risk of joining gangs due to the sense of belonging, discipline, and structure that gangs provide.

Lastly, education reduces emigration from Central America and the Caribbean. Increased economic output improves economic opportunities and reduces violence, discouraging relocation to other regions. Emigration in Central America is forecast to be 2.2 percent higher (3,000 additional people) in a world in which education investments stall, while emigration from the Caribbean is forecast to be 1.4 percent higher (1,000 additional people). Between 2017 and 2040, education investments increase the number of people who elect to stay in the Caribbean by 11,000 and increase the number of people who chose to stay in Central America by 24,000.

Gains generated by education systems are slow moving, and children must move through levels of education sequentially to get to the next step and eventually the workforce; the gains from Current Path improvements in education are even more pronounced in the extreme long-run. This is because children must move through various levels of the education system before entering the workforce. These long-term improvements are illustrated by economic gains in Central America and the Caribbean.

By 2060, the total cumulative GDP gains from Current Path improvements in education amount to $2.3 trillion in Central America and $1.9 trillion in the Caribbean. In the year 2060 in Central America, 2.6 million people are pulled out of poverty and 9,000 fewer people migrate. In the Caribbean, 1.4 million people are pulled out of poverty and 5,000 fewer people elect to migrate in 2060. Between 2017 and 2060, a total of 73,000 additional people choose to stay in the Caribbean and 135,000 choose to stay in Central America. This shows that the gains from education investments become greater over time, boosting GDP over the long-term, and reducing both poverty and emigration from both Central America and the Caribbean.

Comparing the Current Path to a world in which educational advancements stall demonstrates the importance of education for overall development. Education improvements have significant impacts on overall economic output, poverty reduction, societal violence, and migration. This analysis suggests that greater commitment to education quality and attainment in Central America and the Caribbean could generate even larger benefits for the countries within these regions.

Exploring alternative futures

Key takeaways:

- Education outcomes will continue to improve under the Current Path, but at a slower rate expected in North Africa and South Asia. To reach the SDG 4.1 – quality education through the secondary level – an additional funding push is required.

- The *SDG Achievement* scenario improves the following aspects of development. All percentages are compared to the Current Path:

  - *Informal sector*: Generates a better-educated workforce, reducing the number of informal sector workers in Central America by 4.9 percent in 2040 and 14.1 percent in 2060. In the Caribbean, it reduces the number of informal sector workers by nearly nine percent in 2040 and nearly 22 percent in 2060.

  - *GDP and GDP per capita*: In 2040, Central American GDP is 5.3 percent higher and GDP per capita is 4.5 percent higher. Better-educated workers continue to enter the workforce after 2040, boosting these economic gains. In 2060, GDP is 17.8 percent higher and GDP per capita is 14.3 percent higher. In the Caribbean, GDP is 4.1 percent higher and GDP per capita is 3.7 percent higher in 2040. In 2060, GDP is 13.1 percent higher and GDP per capita is 11.8 percent higher.

  - *Poverty:* Slight reductions in inequality combined with economic gains reduce the number of Central Americans living on less than $3.10/day by about 12 percent in 2040 and 33.3 percent in 2060. In the Caribbean, poverty is reduced by 3.7 percent in 2040 and about 20 percent in 2060.

  - *Violence:* In Central America, the slight reduction in inequality, paired with a smaller youth population reduces the homicide rate by 2.3 percent in 2040 and 5.6 percent in 2060. In the Caribbean, it does not lower the homicide rate in 2040, but in 2060, the rate is 6.8 percent lower.

  - *Emigration:* Increases in GDP and GDP per capita and slight reductions in homicide help lower emigration. Under the *SDG Achievement* scenario, emigration from Central America is 1.8 percent lower in 2040 and 4.9 percent lower in 2060. Caribbean emigration is 1.4 percent lower in 2040 and 4.1 percent lower in 2060.

- The impacts of education take time to materialize because students must move through the education pipeline before entering the labor force. Therefore, the impacts of the SDG Achievement scenario are far greater in 2060 than 2040.

Analysis to this point has largely emphasized the current issues in the education systems in Central American and the Caribbean and the Current Path of development across education systems. Under the Current Path, we project that education outcomes will continue to improve, and gains are projected to materialize at a slower rate in Central America and the Caribbean than regional peers.

The next step is to construct scenarios that simulate changes in key education indicators across Central America and the Caribbean and explore the effects of those improvements on both the education system and other key development indicators. Scenario construction and analysis is one of the primary uses of the IFs tool and can help policymakers better understand the effects of interventions in and across key sectors.

For this report, we constructed an *SDG Achievement* scenario, which simulates a world in which every country in Central America and the Caribbean reaches SDG 4.1 – the provision of quality education to all children through secondary school. This scenario is meant to provide insight into the benefits and costs of shifting regional priorities to focus heavily on the education system.

The scenario is built upon and compared to the Current Path of development across indicators – the Current Path provides a baseline of assessment that is grounded in the current trajectory of trends and dynamics in Central America and the Caribbean. Further, because education systems change slowly and effects of scenarios in the education system do not fully manifest until far into the future, we show results in both 2040 and 2060. It is worth noting that there is a time lag between investments in education and the benefits to development. There is great value associated with improving education, but our results demonstrate that impacts are larger in 2060 than in 2040 because there are a higher number of individuals in the workforce who have completed secondary education in the year 2060. Furthermore, the original cohorts who completed their secondary education have contributed to the workforce for many years, and may have passed some of these education benefits to their children.

The SDG Achievement scenario

The *SDG Achievement* scenario simulates a world in which all countries in Central America and the Caribbean heavily invest in education and reach SDG 4.1 – the provision of quality education to all children through upper secondary school. This scenario pushes education systems across Central America and the Caribbean to full enrollment and graduation across primary and secondary school by the year 2030. It also increases primary and secondary test scores by 20 percent and 14 percent, respectively (compared to the Current Path), reaching average test scores in sub-regional leaders today (Cuba and Costa Rica) by 2040. See Table 22 for details on the interventions and targets.

Table 21: Interventions and targets for SDG attainment scenario

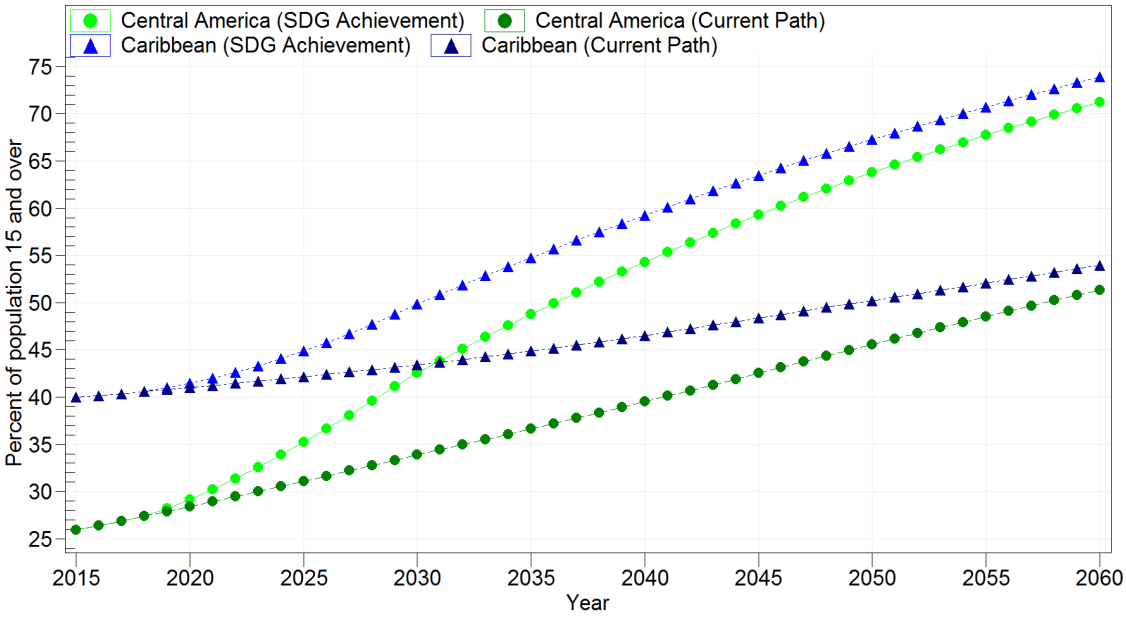
Variable(s)	Intervention	Time period
Full primary school	Increases the primary survival rate and transition rate between primary and secondary to 100%.	By 2026
Full lower secondary school	Increases lower secondary graduation and primary to lower secondary transition rates to 100%.	By 2028
Full upper secondary school	Increases upper secondary graduation and lower to upper secondary transition rates to 100%.	By 2030
Improved test scores	Improves primary and secondary test scores to or above or above sub-regional leaders (Cuba for the Caribbean; Costa Rica for Central America) at each level.	By 2030

There is significant variance in the rate in which individual countries achieve each of the goals outlined above. For example, Costa Rica currently registers 98 percent primary survival, while Guatemala registers only 76.7 percent. In this *SDG Achievement* scenario, Guatemala rapidly increases to reach 100 percent over the full five years (to 2024), while it only takes Costa Rica one year to reach the 100 percent target.

Reaching 100 percent enrollment and graduation (and improving education quality) by 2030 has large impacts on the stock of education over the long run. The *SDG Achievement* scenario increases the region's average adult educational attainment by 9.7 percent (10 months) and average adult test scores by 5.1 percent (1.0 point) compared to the Current Path in 2040. Furthermore, in 2040, 1.6 million more adults will have completed primary school.

By 2060, the *SDG Achievement* scenario has an even larger effect on the stock of education. This is because the gains associated with educational progress take time to materialize and tend to be more sizable after students have had time to acquire skills and enter the workforce. Average adult educational attainment increases by 13 percent (1 year and 3 months) and average adult test scores increase by 10.3 percent (six points) compared to the Current Path in 2060. The number of additional adults who have completed primary increases slightly (to 1.7 million), however, 23 million more adults will have completed secondary in 2060.

Figure 6: Adult secondary completion rates (Current Path and SDG Achievement scenario), Central America and the Caribbean, 2015 to 2060



Source: IFs 7.38.

Within Central America and the Caribbean, the countries that gain the most from this scenario, understandably, are those with very low current levels of education. Haiti, Belize, and Guatemala see the largest gains in average adult attainment in both 2040 and 2060, while those with relatively superior education systems (Trinidad & Tobago, St Lucia) see fewer improvements across the horizon. The same can be said of countries that achieve low test scores

today, such as Haiti, Nicaragua, and Guatemala. They experience more rapid improvements over the forecast horizon than peers at higher levels today.

Because education is a crucial driver of economic and development outcomes this has important though varying downstream effects on key sectors described in previous sections. (See Table 23 for the effects of this scenario on economic, labor, violence and migration indicators from both Central America and the Caribbean in 2040 and 2060.) We assess these results in both 2040 and 2060 because the gains from an *SDG Achievement* scenario (achieved in 2030) will not take full effect until later than 2040. The students who benefit from the *SDG Achievement* scenario will not make it through the entire education system for at least 12 years, which means the added skills and productive capacity from additional education will not be fully realized until much further down the line.

Table 22: Various outcomes indicators, Central America, 2040 and 2060

	GDP (billion $)	GDP per capita (thousand $)	Informal labor (millions)	Skilled labor (millions)	Emigration (millions)	Poverty (millions)	Homicide (rate)
In 2017							
Current Path	221.8	4.6	8.7	4.6	0.125	8.9	0.297
In 2040							
Current Path	566.3	13.7	10.1	7.6	0.126	6.8	0.220
SDG Achievement	596.1	14.3	9.6	7.8	0.124	6.0	0.216
Difference	29.8	0.6	-0.5	0.2	-0.002	-0.8	-0.004
In 2060							
Current Path	982.7	19.1	7.5	9.7	0.116	4.8	0.174
SDG Achievement	1,157.4	21.8	6.5	10.1	0.111	3.2	0.165
Difference	174.7	2.7	-1.1	0.4	-0.005	-1.6	-0.009

Source: IFs 7.38.

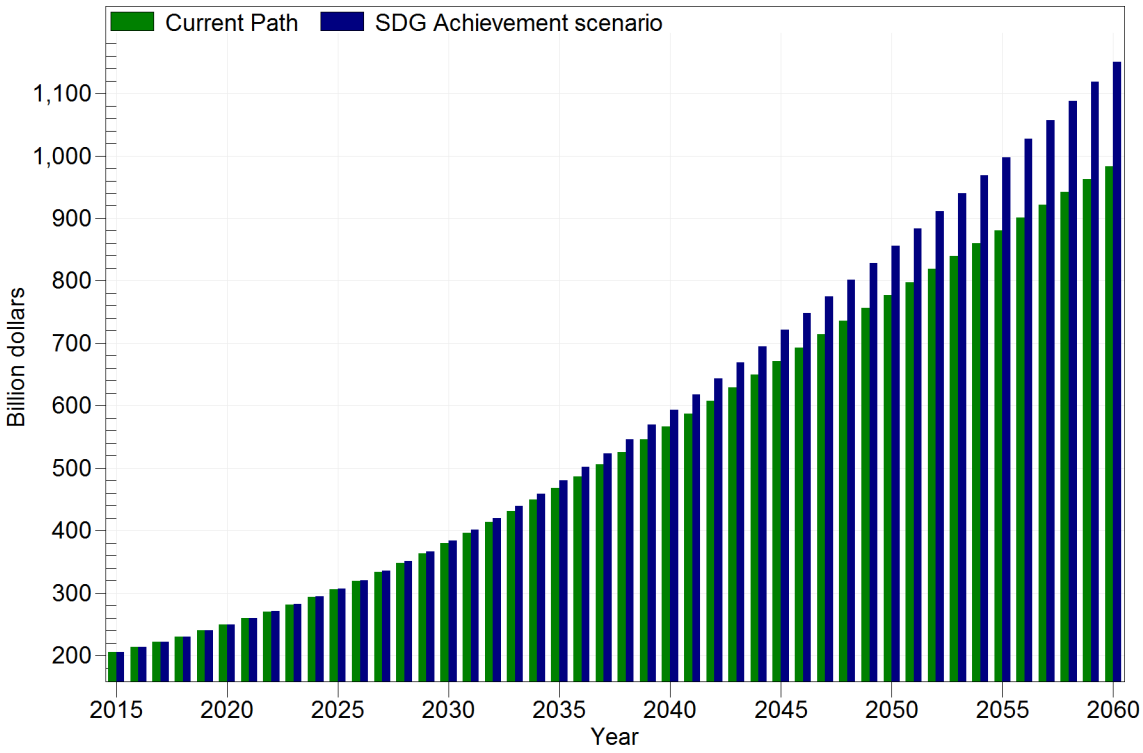
The increases in the total stock and quality of education under *SDG Achievement* scenario significantly improve economic potential and output (total and per person) over the forecast horizon. These gains in output are largely due to increased productivity from a more educated workforce – in 2040 the *SDG Achievement* scenario reduces the number of those in the informal sector by about five percent and increases the skilled workforce by 2.8 percent. Students have the opportunity to hone their skills and expand their knowledge of key subjects (such as reading, math, and science) over an extended period of time, preparing them for valuable contributions to the workforce. Improvements in the skill level and productivity of workers increase GDP output by 5.3 percent and GDP per capita by 4.5 percent compared to the Current Path in 2040.

By 2060, the improvements in education and subsequent increases in workforce productivity are even more pronounced, as are the effects on economic output. This can be attributed to the amount of time it takes to move students through the education system and to equip them with skills needed to contribute to the economy. Under the *SDG Achievement* scenario, over one million fewer individuals work in the informal sector and there are over 370,000 more skilled

workers in 2060. As a result, Central American GDP is 17.8 percent higher and GDP per capita is 14.3 percent higher than in the Current Path forecast in 2060. This means that the Central American economy is projected to produce $174 billion more in 2060 than under the Current Path scenario. In Figure 7 below, this is represented by the difference between the blue bar (GDP in the *SDG Achievement scenario*) and the green bar (GDP along the Current Path) in the year 2060.

Further, because the scenario increases productivity and economic output over time, the gains accrue and compound over time. Average growth rates are 0.4 percent higher in Central America and 0.3 percent higher in the Caribbean between 2018 and 2060. The cumulative gains from this sustained increase are represented in Figure 7 below by the sum of the difference between the blue bars and the green bars in each year. Under the *SDG Achievement* scenario, total aggregate economic GDP increases by $183 billion between 2018 and 2040. By 2060, Central America's cumulative gain in economic output is projected to reach over $2 trillion, an amount exceeding the size of the entire Brazilian economy today.

Figure 7: GDP (Current Path and SDG Achievement scenario), Central America, 2015 to 2060



Source: IFs 7.38.

Because the *SDG Achievement* scenario simulates universal provision of education it also results in slight reductions in inequality by increasing access and quality of education to the poorest in society. Indigenous and rural children often encounter barriers to accessing quality education, but this intervention helps bridge the gap between these groups and those with greater access. However, it does not get at the core issues that sustain long-term economic inequality. Increasing education access does not necessarily change the government's ability to provide

other services to vulnerable populations. Further, while the scenario reduces informality, much of the population remains in the informal sector, which has little to no institutional social safety net.

Nonetheless, the combination of economic gains and slight reductions in inequality under the *SDG Achievement* scenario reduces the number of people in poverty by 800,000 in 2040. Further, the slight reduction in inequality, paired with a slight reduction in the relative size of the youth population (due to reductions in fertility from female education) reduces the homicide rate by 2.3 percent in 2040. This is because the IFs model determines that differences in income and a greater number of youths can exacerbate violent crime. In 2060, the aggregate economic gains and continued reductions in inequality pull 1.6 million people out of poverty and reduce the homicide rate by approximately five percent.

Lastly, the immense increases in economic output (total and per capita) and slight reductions in homicide reduce the impetus for individuals to emigrate from Central America and the Caribbean. Under the *SDG Achievement* scenario, emigration from Central America is about two percent lower in 2040 and five percent lower in 2060. Between 2017 and 2040, an aggregate 20,000 fewer people emigrate from Central America. Bilateral migration from Central America to the United States is two percent lower in 2040 and six percent lower in 2060. Between 2017 and 2040, an aggregate of 18,055 fewer Central Americans migrate to the United States.

Because the Caribbean outperforms Central America across education indicators, the overall gains from the *SDG Achievement* scenario are smaller. Nonetheless, the *SDG Achievement* scenario contributes to improvements across a number of indicators in the Caribbean. As observed in Central America, the larger total stock and quality of education generated by the scenario augments economic potential and output (total and per person) over time. A better-educated workforce improves productivity, leading to greater economic gains.

Table 23: Various outcomes indicators, Caribbean, 2040 and 2060

	GDP (billion $)	GDP per capita (thousand $)	Informal labor (millions)	Skilled labor (millions)	Emigration (millions)	Poverty (millions)	Homicide (rate)
In 2017							
Current Path	208.6	5.4	6.3	5.5	0.101	9.1	0.104
In 2040							
Current Path	482.0	18.1	5.4	6.9	0.101	8.0	0.079
SDG Achievement	501.9	18.8	4.9	7.2	0.099	7.7	0.079
Difference	19.9	0.7	-0.5	0.2	-0.002	-0.3	0
In 2060							
Current Path	846.2	25.4	3.4	7.5	0.093	6.0	0.070
SDG Achievement	956.6	28.4	2.7	7.8	0.089	4.8	0.065
Difference	110.4	3.0	-0.7	0.3	-0.004	-1.2	-0.005

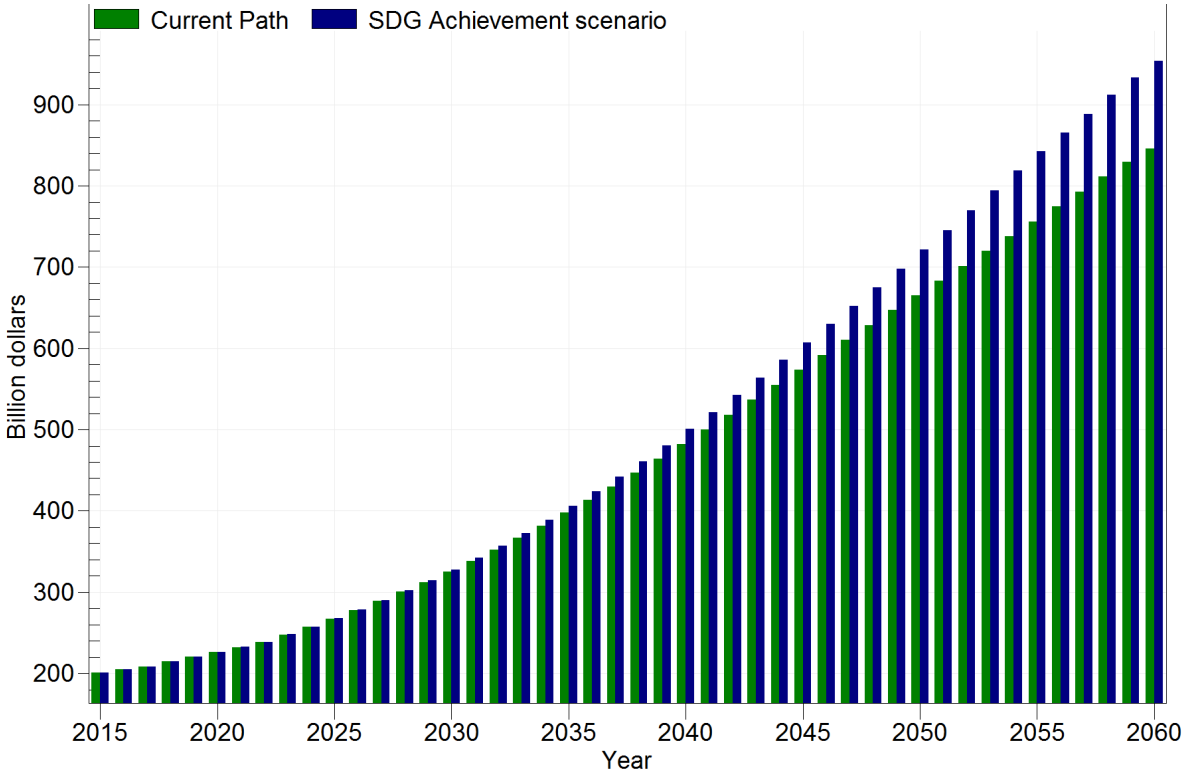
Source: IFs 7.38.

The provision of quality universal secondary education in the Caribbean helps clear the bottlenecks at the secondary level. The *SDG Achievement* scenario increases the supply of skilled workers by 3.5 percent and reduces the number of individuals working in the informal sector by nearly nine percent by 2040. By 2060, there are 4.4 percent (320,000) more skilled workers and nearly 22 percent (730,000) fewer people working in the informal sector than under the Current Path.

This increase in the stock of education and skills in the workforce translates to increased economic output. In the year 2040, GDP output is 4.1 percent higher and GDP per capita is 3.7 percent higher than in the Current Path. Further, as more and more educated workers enter the workforce after 2040, gains become even more apparent. In the year 2060, GDP output is 13.1 percent higher and GDP per capita is 11.8 percent higher than along the Current Path. This substantial increase in the GDP between 2040 and 2060 is linked to the delayed impacts of education investment; it takes time for students to complete primary and secondary education, which contributes to a gradual unfolding of associated gains. However, by 2060, there are more cohorts in the labor force that have completed secondary education.

Framed differently, the *SDG Achievement* scenario increases GDP output across Central America and the Caribbean by a total of $126 billion by 2040 and $1.4 trillion by 2060 compared to the Current Path scenario. These cumulative gains are represented in Figure 8 below by the sum of the difference between the blue bars and the green bars in each year.

Figure 8: GDP (Current Path and SDG Achievement scenario), Caribbean, 2015 to 2060



Source: IFs 7.38.

Further, while the scenario does not address the core issues driving inequality in the Caribbean, it does slightly reduce inequality. This reduction in inequality, paired with the immense economic gains, significantly lowers poverty. The *SDG Achievement* scenario reduces poverty by nearly four percent by 2040, but, by 2060, poverty is reduced by over 20 percent. This means that over 1.2 million fewer Caribbeans will be living on less than $3.10 a day in 2060 under the *SDG Achievement* scenario. The reductions in inequality and in the relative proportion of the youth population lower the homicide rate by over six percent in 2060.

Lastly, increased economic growth and slight reductions in violence decrease the emigration rate by four percent in 2060 in the *SDG Achievement* scenario. Between 2017 and 2040, about 10,000 fewer Caribbeans emigrate. Between 2017 and 2060, 64,000 fewer total individuals emigrate from the Caribbean compared to the Current Path. Bilateral migration from the Caribbean to the United States is 1.4 percent lower in 2040 and 4.5 percent lower in 2060. Between 2017 and 2040, an aggregate of 7,700 fewer Caribbeans migrate to the United States. By 2060, this climbs to an aggregate of 45,500.

Costs of the SDG Achievement scenario

Key takeaways:

- Significant mobilization of resources would be needed to realize the *SDG Achievement* scenario, but high returns on investment are projected in 2060.

- To determine the cost, we calculated the per pupil cost of boosting test scores, enrollment, and graduation rates by 2030 and applied that cost to all students entering the system in the *SDG Achievement* scenario out to 2060. Then, we subtracted the cost of the Current Path scenario.

    - In 2060, the cost per pupil under the Current Path is projected to be $3460 in Central America and $4660 in the Caribbean. Under the *SDG Achievement* scenario, it is projected to be $4460 for Central America and $5690 for the Caribbean

- It would cost roughly $410 billion additional dollars (180 percent of current total regional GDP) to help Central America realize the *SDG Achievement* scenario. However, if Central America improves per pupil spending efficiency by 15 percent by 2030, the cost of the scenario would drop to $310 billion (75 percent of current total regional GDP) by 2060. The total minimum cost of the scenario for the Caribbean equates to $260 billion (120 percent of current total regional GDP) by 2060. If efficiency increases by 15 percent, the cost would fall to $178 billion (82 percent of current total regional GDP) by 2060.

- By 2060, the *SDG Achievement* scenario creates a four-and-a-half-fold return on total investment in Central America and a five-fold return on total investment in the Caribbean. If education spending efficiency improves by 15 percent by 2030, the returns on investment are six-fold in Central America and 7.5-fold in the Caribbean.

Ensuring that all children in Central America and the Caribbean receive a quality education through secondary school has immense benefits, but it also requires significant political will and mobilization of resources. As such, we calculated an estimated minimum cost of achieving SDG 4.1 by 2030 for Central America and the Caribbean. This analysis does not represent a traditional cost-benefit analysis, bit it aims to frame the returns on a minimum investment in education from a regional perspective.

To estimate the cost of this scenario we calculated the per pupil cost needed to improve test scores and raise enrollment and graduation rates across primary and secondary levels by 2030 and applied that cost to all students entering the system in the *SDG Achievement* scenario out to 2060.[18] We then subtracted the cost of the Current Path scenario (calculated using the same method) to arrive at a minimum additional cost for the *SDG Achievement* scenario.

This cost per pupil can also be calculated for individual countries in Central America and the Caribbean. Generally, the cost per pupil increases over time as countries grow. The economic growth lends itself to increased spending on education, but the fraction of total spending devoted to education in 2060 is comparable to that of 2017.

Less developed countries typically see the greatest difference in spending between the Current Path and *SDG Achievement* Scenario. This is because they have lower levels of educational attainment and quality, and therefore require more funding to reach education targets. For example, in 2030, the cost per pupil in Guatemala is projected to be $490 under the Current Path, $1,290 under the *SDG Achievement* scenario, and $1,090 under the SDG + Efficiency scenario. However, in a wealthier Central American country with higher test scores and attainment, like Belize, the cost difference between scenarios is lower.

These country-level differences can be found the Caribbean. For example, we forecast that the Dominican Republic will continue to underperform in both education quality and attainment out to 2060. In 2030, it is forecast to spend $1,920 per pupil under the Current Path, $3,790 under the *SDG Achievement* Scenario, and $3,200 under the SDG +Efficiency Scenario. However, Barbados outperforms the Dominican Republic across key education indicators, and actually spends less under the *SDG Achievement* scenario than the Current Path. This is because Barbados (along with a few other island countries in the Caribbean) is forecast to spend more under the Current Path than the target set forth by the *SDG Achievement* scenario.

[18] It is important to note that the costs (per pupil) of the SDG Achievement scenario differ significantly by country. The costs reported here are aggregated across sub-regions (Central America and the Caribbean).

Table 24: Cost per pupil, Countries in Central America and the Caribbean, 2020, 2030, 2060

	Cost per pupil (in thousands)								
	Current Path			SDG Scenario			SDG + Efficiency Scenario		
	2020	2030	2060	2020	2030	2060	2020	2030	2060
Central America	**0.84**	**1.19**	**3.46**	**0.93**	**1.87**	**4.46**	**0.89**	**1.57**	**4.46**
Belize	0.99	1.16	3.07	1.00	1.35	3.20	0.97	1.14	3.20
Costa Rica	3.32	4.55	9.84	3.29	4.57	10.70	3.20	3.85	10.70
El Salvador	0.51	0.73	2.88	0.61	1.49	4.15	0.58	1.26	4.15
Guatemala	0.37	0.49	2.02	0.47	1.29	3.12	0.44	1.09	3.12
Honduras	0.70	1.00	2.56	0.71	0.92	2.75	0.69	0.77	2.75
Nicaragua	0.36	0.60	2.11	0.39	0.88	2.43	0.37	0.74	2.43
Panama	1.54	2.54	7.83	1.94	5.60	11.38	1.85	4.72	11.38
Caribbean	**1.49**	**1.77**	**4.66**	**1.49**	**2.12**	**5.69**	**1.50**	**1.79**	**5.69**
Bahamas	4.28	4.59	11.84	4.54	6.42	13.37	4.39	5.40	13.37
Barbados	4.79	5.56	11.82	4.67	5.07	10.30	4.55	4.27	10.30
Cuba	2.67	2.87	5.54	2.55	1.89	4.86	2.51	1.59	4.86
Dominican Republic	1.15	1.92	8.05	1.36	3.79	11.27	1.30	3.20	11.27
Grenada	2.15	3.40	13.12	2.16	4.02	11.45	2.09	3.39	11.45
Haiti	0.08	0.11	0.38	0.11	0.26	0.63	0.10	0.22	0.63
Jamaica	1.45	1.74	3.78	1.45	1.89	4.07	1.41	1.59	4.07
St Lucia	1.91	2.40	5.72	1.91	2.78	6.01	1.86	2.34	6.01
St Vincent and the Grenadines	1.41	2.03	5.98	1.51	2.65	6.46	1.46	2.23	6.46
Trinidad and Tobago	2.99	3.83	8.10	3.35	5.63	9.31	3.23	4.74	9.31

Sources: IFs 7.38 and authors' calculations.

Note: The SDG and SDG + Efficiency scenario have the same value in 2060 because they both converge to a target in 2060. Here, we have assumed that the countries converge to the OECD average per pupil spending per capita from 2030 to 2060. Also, the per pupil cost is a weighted average and is in 2011 dollars.

When examining Central America as a whole, we estimate that it would cost, at minimum, $410 billion additional dollars (180 percent of current total regional GDP) over the next 42 years to ensure that every child attends and graduates school through secondary and receives a quality education. However, improvements in the effectiveness and efficiency in which education funds are spent could help lower these costs. If Central America improved its per pupil spending efficiency by 15 percent, the cost of the *SDG Achievement* scenario would drop to $310 billion (75 percent of current total regional GDP) by 2060.

Costs are lower in the Caribbean, but still substantial. The total minimum cost of the *SDG Achievement* scenario for the Caribbean amounts to $260 billion (120 percent of current total regional GDP) by 2060. If the Caribbean increased educational spending efficiency by 15

percent by 2030, the cost would fall to $178 billion (82 percent of current total regional GDP) by 2060.

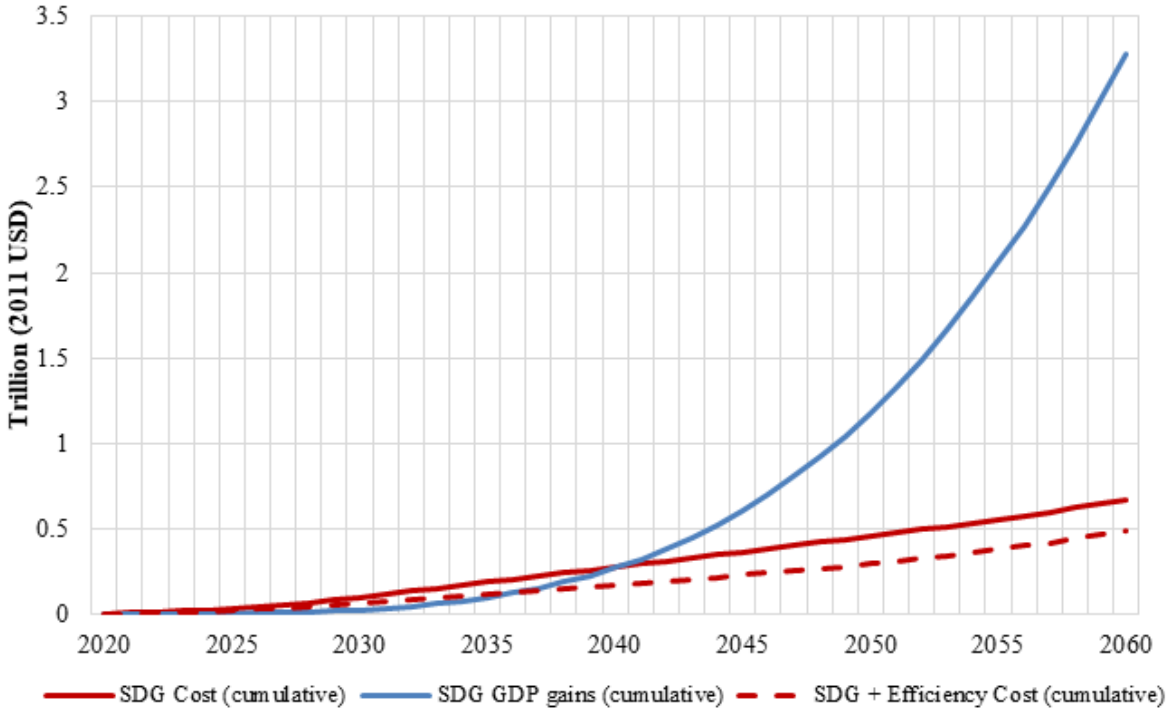
Even though the costs are high, the long-term gains from this type of investment in education are far higher. The *SDG Achievement* scenario produces a four-and-a-half-fold return on total investment in Central America and a five-fold return on total investment in the Caribbean by 2060. If both sub-regions improve education spending efficiency by 15 percent by 2030, the returns on investment in the *SDG Achievement* scenario are six-fold in Central America and 7.5-fold in the Caribbean.

However, the costs of each scenario are significantly frontloaded (in years 2018 through 2030) and returns do not begin to manifest for quite some time. Increasing enrollment and graduation rates to 100 percent and improving quality by 2030 requires a rapid increase in both students in the system and spending on each of those students over the next 11 years. Further, the students who benefit from the *SDG Achievement* scenario will not make it through the entire education system for at least 12 years, which means the added skills and productive capacity from the *SDG Achievement* scenario will not be full realized until after 2040.

Without the spending efficiency gains, the costs (as measured by overall GDP gains) associated with the *SDG Achievement* scenario exceed the gains until the early 2040. This is true for both Central America and the Caribbean. In the cost scenario in which both sub-regions improve education spending efficiency, GDP gains surpass costs in the mid- to late-2030s.

Figure 9 shows the cumulative GDP gains and estimated minimum costs of the *SDG Achievement* scenario for Central America and the Caribbean as a whole out to 2060. While this should not be taken as a pure cost-benefit analysis, the graph shows that the initial costs outweigh the long-term GDP gains out to 2040 for the cost scenario without efficiency gains. With efficiency gains (15 percent to 2030), the GDP gains outweigh the total costs beginning in the mid-2030s. Either way, this graph illustrates long-term gains associated with education investments. Education has significant impacts on GDP, and broader development outcomes, but it can take time for these benefits to unfold.

Figure 9: SDG Achievement gains and costs, Central America and the Caribbean, 2020 to 2060



Sources: IFs 7.38 and authors' calculations.

Note: These gains and costs are both compared to the Current Path scenario. The Current Path does also forecast increases in spending (relative to GDP) as countries develop and have more resources available to allocate to education.

The *SDG Achievement* scenario is very ambitious, but demonstrates the immense societal benefits of providing a quality education for all children through secondary school. It also emphasizes the need for long-term thinking in education. The costs of the *SDG Achievement* scenario are notable, and the societal benefits materialize slowly. This type of scenario requires a substantial policy will and spending over a long period of time.

The *SDG Achievement* scenario also shows that education investments are critical to various development outcomes, including economic outputs, poverty reduction, and emigration. Education quality and attainment augment economic growth, while the income-related returns of education can lower the financial incentive to engage in informal labor. Further, education can reduce emigration through improved economic outputs (total and per capita) and slight reductions in violence (such as homicides).

Conclusion

The findings in this report are based on analysis conducted using the IFs platform, a quantitative modeling tool, to develop scenarios that can be used to assess the impacts of education investments. IFs uses data and a mix of different quantitative modeling approaches to provide an alternative way to think about tradeoffs in policymaking. Because education is

modeled within IFS, as are the economy, violence and migration, we can shed light on the effects of education investments on these other outcomes. In the IFs model, education has direct (and indirect through other modules) effects on the economy (GDP and inequality) and labor. Education affects violence and migration indirectly through its impacts on the economy and labor. We believe that IFs provides a good way to help frame this work in the future, though we recognize that there is not a large literature documenting these relationships that affected the modeling choices made, and the relationship and findings are affected by the quality of the data. As more information is available on these relationships, modeling can be updated.

This report emphasizes the benefits of greater investments in education in Central America and the Caribbean. Historically, the outward flow of migrants, a sizeable informal labor market, and high levels of poverty have characterized Central America and the Caribbean. While these outcomes are expected to improve along the current development path, certain challenges may persist. Underperformers in Central America and the Caribbean, including Haiti, Guatemala, and Honduras (and to a lesser extent Nicaragua and the Dominican Republic) will require extra attention. Furthermore, Central America and the Caribbean are projected to lag behind regional comparison groups in certain education indicators.

Education outcomes in the Caribbean and Central America improved historically and are forecast to continue to improve, but certain regional peers outperform in either attainment or test scores. Education attainment in the Caribbean has continued to improve since the mid-20th century and in 2017 was on par with levels observed in Southeast Asia and South America. However, Caribbean attainment remains higher than in many other regions, such as Central America, South Asia, and North Africa. Average primary test scores in the Caribbean are above the global average and those of Southeast Asia, Central America, North Africa, and South Asia. They are projected to improve from 37.6 to 40.4 and secondary test scores from 44 to 46.9 on a scale from zero to 100 (in which all countries have average scores between 20 and 60). In Central America, educational attainment is projected to improve from seven years in 2017 to 8.5 years in 2040. Average attainment has increased since the mid-20th century, but average fall behind many of the regions in this report, including the Caribbean and South America. Average overall primary test scores are projected to increase from 32.5 to 37.2 and secondary test scores from 40.2 to 44.7. Central American test scores rank above North Africa and South Asia, but below Southeast Asia, the Caribbean, South America, and the global average.

Investments in education are projected to help Central America and the Caribbean address some of these obstacles. By 2040, the investments have a positive impact on development, but gains are even greater out to 2060. It takes time for students to acquire knowledge and skills, generating a time lag between investments in education and the development impacts. Between 2017 and 2040, educational investments (that are expected to continue to increase given historical patterns) are projected to boost regional GDP by $400 billion. By 2060, cumulative GDP gains increase to $1.9 trillion in the Caribbean and $2.3 trillion in Central America. In the Caribbean, in the year 2060, 1.4 million fewer people are forecast to live in poverty and 5,000 fewer are projected to emigrate. In Central America, 2.6 million fewer people are impoverished in 2060 and 8,000 fewer emigrate.

Additional investments are needed to help Central America and the Caribbean catch up to regional peers and reach SDG 4.1– full enrollment and graduation across primary and secondary

school by the year 2030, the *SDG Achievement* scenario. If Central America implements this scenario, it will experience improvements in development in 2040, and even greater gains out to 2060. GDP is forecast to be 5.3 percent higher and GDP per capita is forecast to be 4.5 percent higher in 2040. In 2060, GDP is 17.8 percent higher and GDP per capita is 14.3 percent higher. In the Caribbean, GDP is 4.1 percent higher and GDP per capita is 3.7 percent higher in 2040. In 2060, GDP is 13.1 percent higher and GDP per capita is 11.8 percent higher. Implementation of the scenario also improves other economic indicators; Central America's informal labor market shrinks by five percent in 2040 and 13 percent in 2060. In the Caribbean, the *SDG Achievement* scenario reduces the number of informal sector workers by nearly nine percent in 2040 and nearly 22 percent in 2060.

Beyond these economic indicators, the investments in the *SDG Achievement* scenario have slight impacts on emigration rates and violence. In Central America, the slight reduction in inequality combined with a smaller youth bulge reduces the homicide rate by 2.3 percent in 2040 and 5.6 percent in 2060. In the Caribbean, it does not lower the homicide rate in 2040, but in 2060, the rate is 6.8 percent lower.

Increases in economic outcomes and slight reductions in homicide help lower emigration, reducing Central American emigration by about two percent in 2040 and 4.6 percent in 2060. In the Caribbean, emigration is 1.4 percent lower in 2040 and 4.1 percent lower in 2060.

Implementation of the *SDG Achievement* scenario offers Central America a four-and-a-half-fold return on investments and the Caribbean a five-fold return on investments. However, it is costly to implement and would require political will. Efficiency gains can help reduce costs and enable countries to reach targets in less time than under a scenario that does not incorporate efficiency gains.

Broadly speaking, these findings suggest that education investments generate gains in development, especially in the long term, after students have had time to move through the education pipeline and enter the labor force. Achieving SDG 4.1 would lead to better outcomes than those expected along the Current Path, particularly in 2060. Improvements to education quality and quantity would not solve all development challenges, but would facilitate progress in a range of development objectives. Implementation of the *SDG Achievement* scenario would enable Central America and the Caribbean to catch up to (and even surpass) regional peers in educational attainment and quality.

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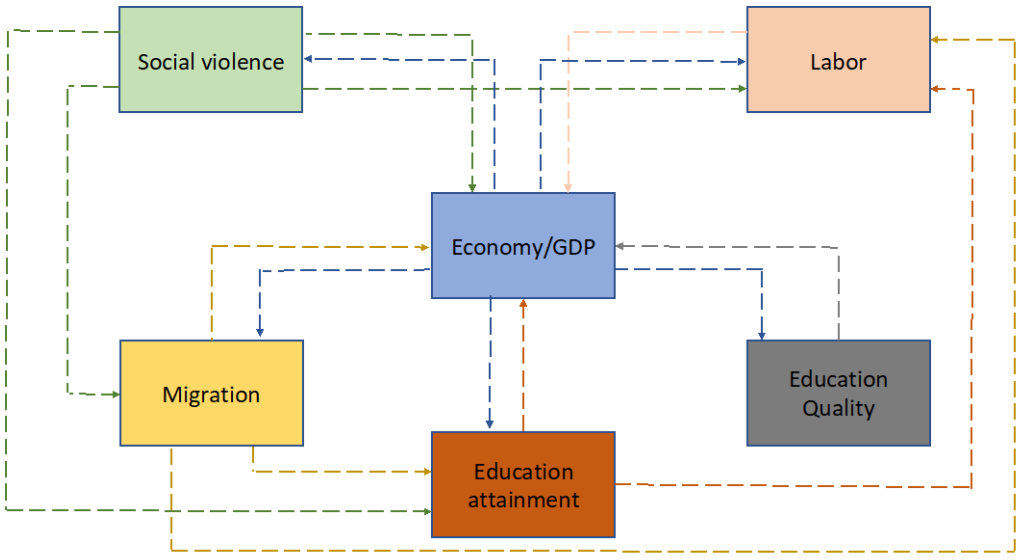
Appendix 1: Modelling documentation

IFs integrates variables across 186 countries and 12 core systems, including: agriculture, demographics, economics, education, energy, environment, finance, governance, health, infrastructure, international politics, and technology (see Figure 1 in the Methodology section of the report). The sub-models for each system are dynamically connected, so IFs can simulate how changes in one system may lead to changes across all others. As a result, IFs endogenizes more variables and relationships from a wider range of key development systems than any other model in the world.

Education attainment and the new model additions - education quality, labor market dynamics (with updated data), societal violence, and bilateral migration – are fully integrated within the broader IFs platform (see Figure 1). These additions are endogenized within the broader modeling framework and have been developed using a combination of literature and statistical analysis. While there are "hard links", or connections in which one variable impacts another through (potentially) multiple separate links within the model, between each of these model additions (discussed in more detail below), Figure 1 captures the effects observed if changes are made to the module included in a scenario. [19]

Figure 1: Model connections



Education quality and attainment, variables on which this report focuses, have hard links in the model to the other variables of interest in this report, namely the economy/GDP, labor, societal violence, and migration. Education has direct (and indirect through other modules)

[19] Note: The economy/GDP and labor are all connected to migration, violence, and education in the IFs model, but the effects may not be observed in the particular scenario. This figure is not exhaustive of all connections between variables in IFs.

effects on the economy (GDP and inequality) and labor. Education affects violence and migration indirectly through its impacts on the economy and labor.

Specifically, education quality impacts human capital, which affects multifactor productivity (MFP), which drives GDP. Economic factors influence other variables in the model, including emigration and violence. This is because voluntary emigration is driven in part by the ratio of household income between the home and destination countries. Also, the youth bulge and inequality (GINI co-efficient), which are affected by demographics and the economy (both of which are affected by education), drive homicides.

Also, educational attainment influences the total fertility rate (TFR), which affects the population size, influencing GDP per capita (providing another channel through which education can impact the economy). Attainment also impacts the skill profile of workers, which influences labor dynamics. By pushing cohorts through the education system, the SDG achievement scenario generates a more highly educated workforce. A change in the labor force can influence the GINI, impacting societal violence.

Labor impacts the economy through its effect on economic output. Further, there is a hard link between labor and violence whereby labor impacts the GINI coefficient, which influences societal violence. Labor's effects on the economy also impact migration and education.

Societal violence also has hard links to the additions in this report. Homicides and government risk and instability impact forced migration. Further, violence impacts education via the security index. Violence can affect labor through homicides, which contribute to total deaths, affecting the population size, and thus the size of the labor force. Finally, violence affects MFP via the security index.

Migration impacts education attainment, labor and the economy, all of which impact other variables in the model. Migration impacts educational attainment and labor because it changes the population in the country, thereby changing those in school, the labor supply and the size of the informal labor market. Migration impacts the economy through its effects on remittances from the foreign population and the link between household consumption and migration. Migration can impact household consumption by influencing the population growth rate.

Each of these modules is discussed in more depth in the sections that follow.

Economy

The population model provides forecasts of cohorts within the population and the economic model provides forecasts of spending in accordance with the GDP of regions. These two models become the basis for the education model. Thus the education model is able to produce forecasts of the pipeline of education at different levels (primary, secondary and tertiary) and by genders (male, female, total). This model generates a number of final outcome variables, the most important of which are average years of education for the population aged 15+ (and 25+), and quality of education (overall and at each level of education).

Education can impact other variables in the IFs system through impacts on multifactor productivity (MFP). This is because average years of education amongst adults ages

15+ impacts human capital, which (along with social capital, physical capital, and knowledge) affects MFP. Then, MFP has forward linkages to economic growth, which is tied to health, violence, migration, and other aspects of development.

There is a multitude of other ways in which the economy is tied to variables explored in this report. For example, education attainment impacts the skill level of workers, which affects labor dynamics. Labor is tied to the GINI coefficient, which influences societal violence. Furthermore, attainment impacts the fertility rate, which impacts the population size, a driver of GDP per capita.

Demographics

As mentioned above, the population model provides forecasts of cohorts within the population and serves as a basis for the education model. The dominant population equation is a simple addition of births at the bottom of the cohort distribution, subtraction of deaths from each population cohort, and advance of people to the next cohort over time.

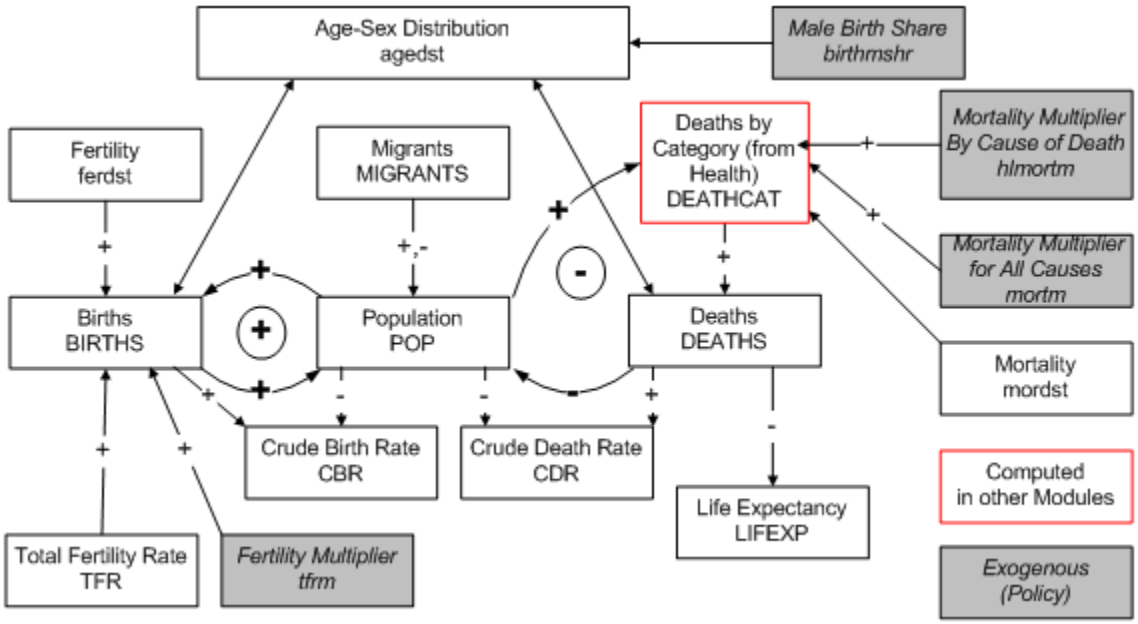
The following key dynamics are directly linked to the Dominant Relations:

- Births are primarily a function of the total fertility rate, which in the longer term responds especially to education level of the adult population. The model user has direct control over TFR with a multiplier, but also much control for low fertility countries with a parameter specifying long-term stabilization level and lower boundary for fertility. There is also a secular trend reduction in fertility.

- Deaths are primarily a function of life expectancy, itself computed within the IFs health model where, like fertility, it responds in the long run to adult education and also to GDP per capita and technology change. The model user has direct control over all deaths with a mortality multiplier and over those specific to a cause of health with an alternative multiplier. There is also a secular trend reduction in mortality.

The larger demographic model (Figure 2) in combination with the health model provides representation of and control over migration; the fertility impact of infant mortality and contraception use rates; and the mortality impact of many factors including undernutrition, smoking rates, and indoor air pollution from open burning of solid fuels.

Figure 2: Representation of demographic model



Migration

This project has supported expansion of the IFs tool to include a representation of international bilateral migration forecasts (see Figure 3). Forecasts are disaggregated by motivation, being voluntary (i.e. seeking better economic opportunity, education, or reuniting with family) or forced (i.e. seeking asylum from the threat of violence or persecution).

The bilateral migration model has four major procedures (1) initialization of migration stock and flow forecasts with data, (2) distribute country-level outflows among all partner-countries using a gravity equation, (3) balancing of bilateral migration flows with gross, country-level forecasts of outward and inward flows, and (4) options for scenario analysis.

The initialization process draws migration stock and flow data from multiple sources to provide first-year values for forecasts of bilateral and country-level migration stocks and flows (inward and outward) for total migration and forced migration.[20] Voluntary migration is calculated as the annual residual between these two values.[21] In the current Base Case, outflows and inflows are adjusted so that they are equal to forecasts of country-level net migration from the UNPD (2017). Forced migration is currently forecast as a function of IFs' existing forecast of domestic instability (SFINTLWARMAG) divided by population (POP). The goal is for this

[20] Total migration stock data comes from UNDP 2017. Abel (2016) estimated migration flow data from an earlier version of UNDP 2017. Forced migration stock data comes from UNHCR (2017). Forced migration flow data has been estimated by the Pardee Center using a methodology similar to that of Abel (2016).

[21] This method can sometimes lead to negative voluntary flows given discrepancies in the primary data sources. In such cases, we assume voluntary migration flows to be equal to 5 percent of forced migration flows and adjust total migration accordingly.

driver to be replaced by one measuring broad societal violence, which is currently under development as part of this project.

The bilateral distribution of inward and outward migration flows is determined by the initial data and evolved according to a gravity model which includes a set of push and pull drivers such as physical distance between origin and destination countries, origin country population size, the ratio of household income per capita between origin and destination countries, and the size of origin-country population living in the destination country. The resulting bilateral migration flow pattern is then adjusted through an iterative process until the sum of all inward (outward) flows to a country is equal to the country-level forecast value of inward (outward) migration.

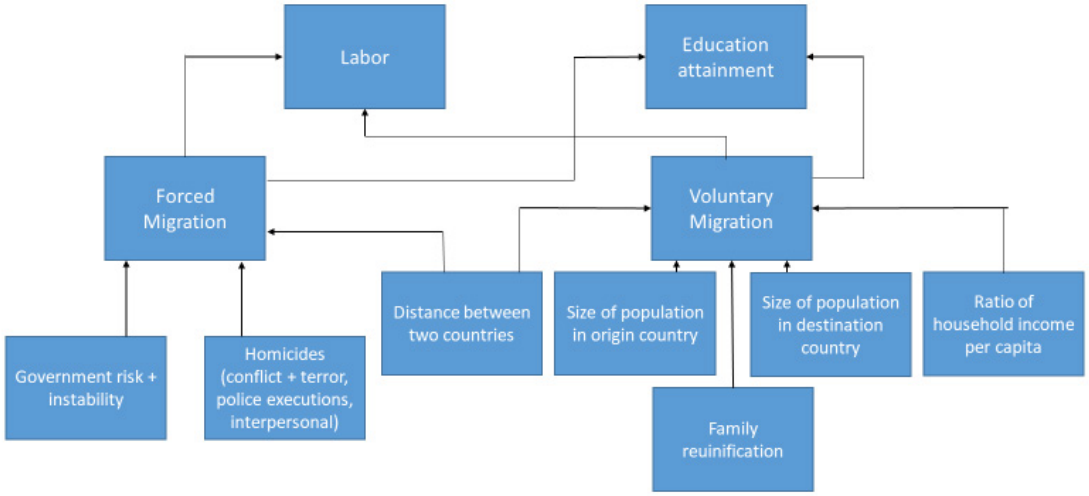
Bilateral migration flows directly augment bilateral stocks. Stocks decrease with deaths and return migration.[22] In the case of forced migration stocks, it is assumed that annually a portion of forced migrants make the decision to voluntarily remain in the country.[23] If forced migration flows are lower than voluntary flows, forced migrants are assumed to return to their country of birth over a period of 5 years.

Through scenario analysis, users have the flexibility to change many of the assumptions around country-level flows, bilateral patterns, death rates, return rates, as well as relax the exogenous specification of net migration using UNPD forecasts. Doing so results in forecasts which are determined to a greater extent by the gravity equations.

[22] The death rate of migrant stocks is assumed to be equal to the weighted average of death rates in the countries of origin and destination, with parameterized weights of 0.2 and 0.8 respectively. The share of return migrant flows in any bilateral flow is assumed to be equal to the ratio of bilateral migrant stocks between the origin and destination countries. This assumption is also a parameter and can be modified through scenario analysis.

[23] This conversion of forced migrant stocks to voluntary migrant stocks occurs at a similar rate as the expected voluntary flows from country of origin to country of destination.

Figure 3: Representation of Bilateral Migration



Education attainment

The education model of IFs (Figure 4) simulates patterns of educational participation and attainment in 186 countries over a long time horizon under alternative assumptions about uncertainties and interventions (Irfan 2008). Its purpose is to serve as a generalized thinking and analysis tool for educational futures within a broader human development context.

Educational attainment of the adult is obtained through an accounting system that splits population into five-year cohorts starting from the age of fifteen. Each of the cohorts are initialized with an average level of educational quality (EDQUALAG15) and quantity (EDYRSAG15). The cohort averages change as people join or leave the cohorts bringing in or taking away their education with them. The computation of the educational attributes of the youngest couple of cohorts uses the high school and college graduation rates from the enrollment model.

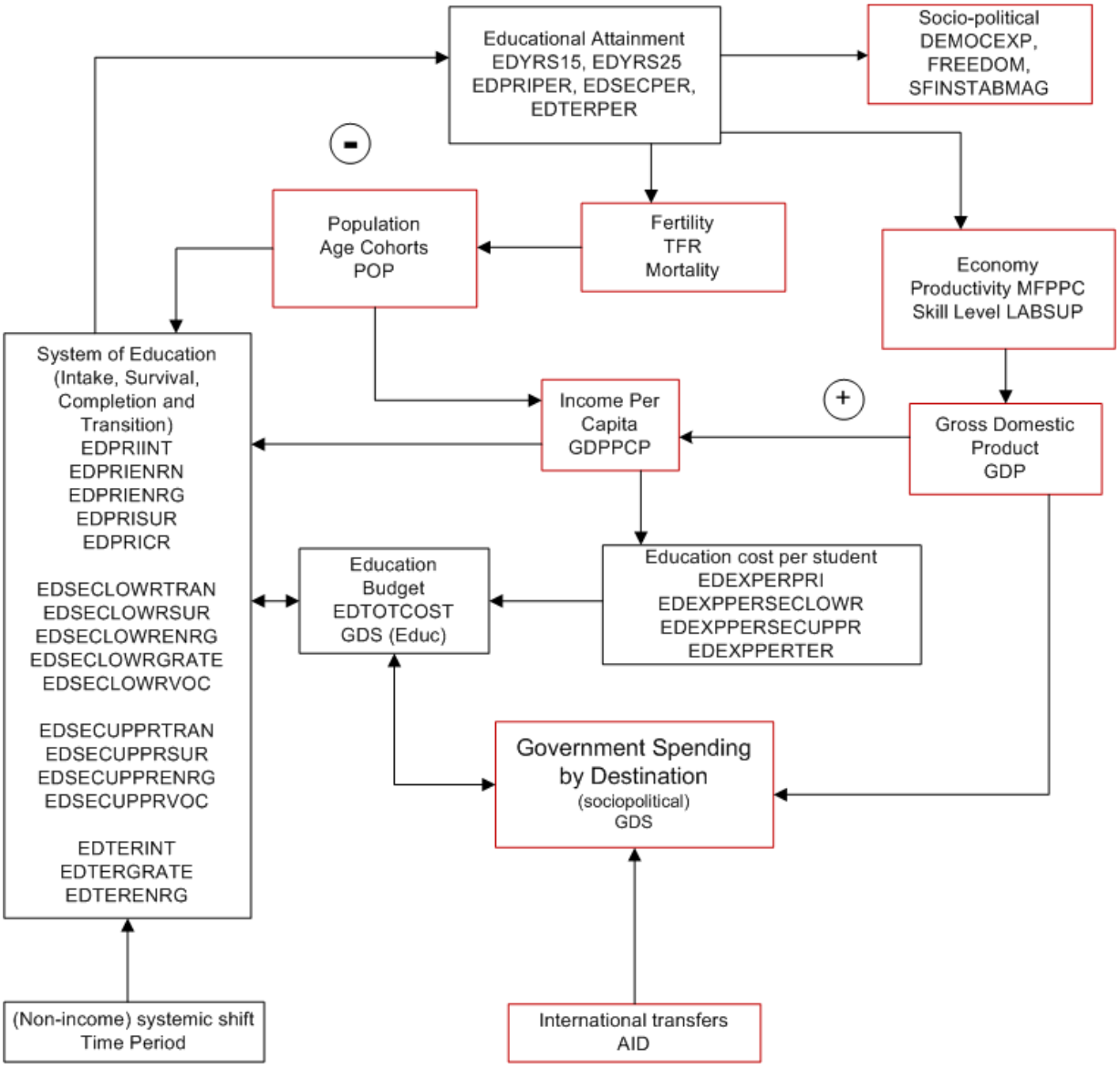
The model forecasts gender- and country-specific access, participation and progression rates at levels of formal education starting from elementary through lower and upper secondary to tertiary. The model also forecasts costs and public spending by level of education. Dropout, completion and transition to the next level of schooling are all mapped onto corresponding age cohorts thus allowing the model to forecast educational attainment for the entire population at any point in time within the forecast horizon.

From simple accounting of the grade progressions to complex budget balancing and budget impact algorithm, the model draws upon the extant understanding and standards (e.g., UNESCO's ISCED classification explained later) about national systems of education around the world. One difference between other attempts at forecasting educational participation and attainment (e.g, McMahon 1999; Bruns, Mingat and Rakotomalala 2003; Wils and O'Connor 2003; Delamonica, Mehrotra and Vandemoortele. 2001; Cuaresma and Lutz 2007) and our forecasting, is the embedding of education within an integrated model in which

demographic and economic variables interact with education, in both directions, as the model runs.

We emphasize the inter-connectedness of the components and their relationship to the broader human development system. For example, during each year of simulation, the IFs cohort-specific demographic model provides the school age population to the education model. In turn, the education model feeds its calculations of education attainment to the population model's determination of women's fertility. Similarly, the broader economic and socio-political systems provide funding for education, and levels of educational attainment affect economic productivity and growth, and therefore also education spending.

Figure 4: Representation of the education model



Education quality

Education quality is a recent addition to the IFs education model. This part of the model compares and forecasts quality of learning at the educational levels of primary and secondary for 186 model countries. To initialize the quality variables IFs model pre-processor uses the World Bank Global Achievement database of country scores in international achievement tests or regional equivalent of such tests in the test areas of reading, science and math.

Test score forecasts in our model are driven by three factors representing three different areas – society, family and school system. Variables that represent these three areas are – income per capita as a proxy for the level of development of the society, average educational attainment of the adults as an aggregate indicator of family environment and expenditure per student as an indicator of the quality of the school system. Each of the subject area scores are regressed against these three variables using data for the base year or the most recent year with data. The regression relationships compute the scores in the forecast-years using values for the independent variables obtained from other IFs models. Any difference in scores obtained from historical database with those obtained from regression is considered as a country-specific situation. The base-year country shifts in the scores, added to the regression output in the subsequent years, decrease gradually as the country merge towards the general relationship.

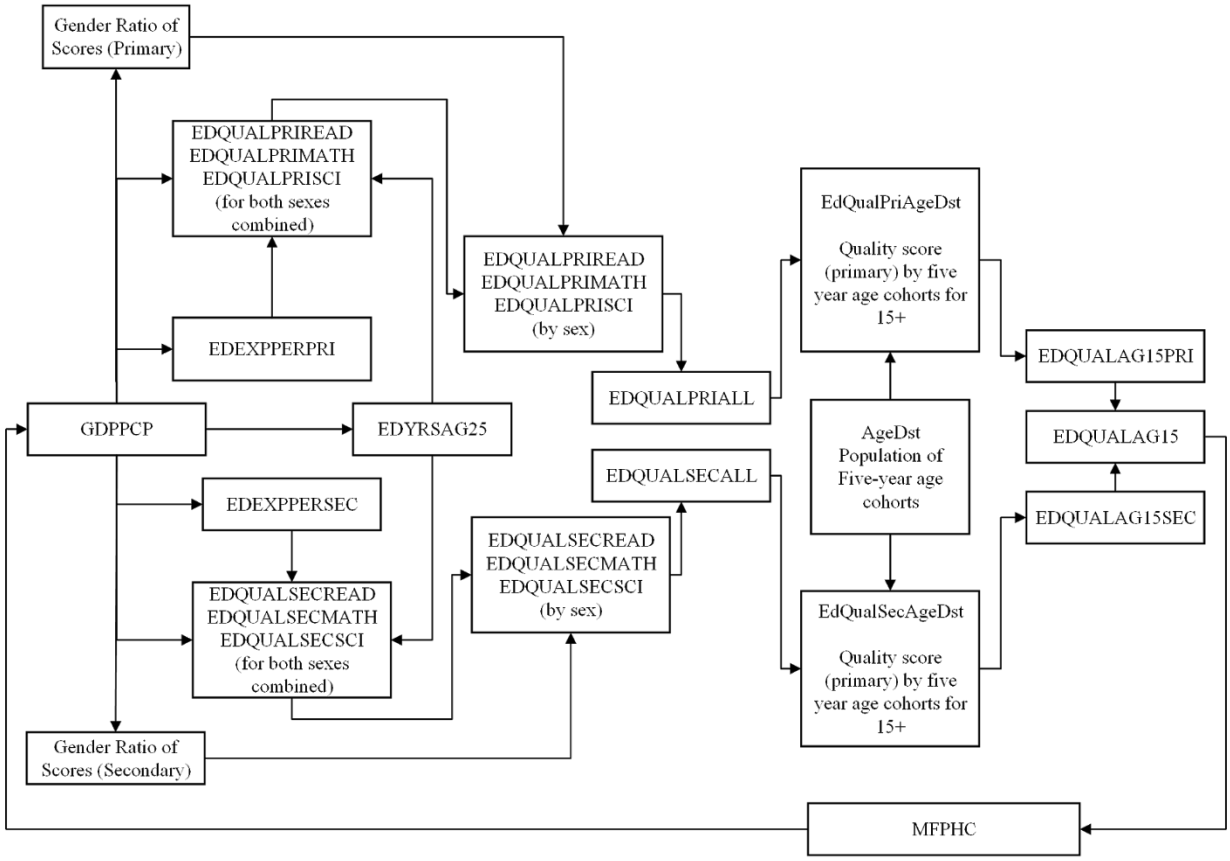
Learning quality indicators for primary and secondary education (EDQUALPRI, EDQUALSEC) are driven by level of development, parental education and spending in the corresponding level of education.

We have used test score data from twenty-five years back as an average measure for the learning quality of the adults in the model base year. Historical quality scores for primary and secondary, for all subjects combined, are used in this way to initialize adult quality scores. This is not a very accurate way of measuring adult education quality. It incorporates several crude assumptions, for example, the quality score of adults of a certain age are same as the quality score when these adults were in school. This is the best we could do given the availability of data.

The model starts with spreading these quality scores into scores for each of the five-year age-sex cohorts. As the model runs, students age and join the youngest of the adult cohorts carrying their quality score with them. Also, as the model runs, each year each of the five-year cohorts is joined by some from the younger cohorts and left by others who move to the older cohort. The scores of the cohort are re-aggregated each year to reflect the score changes from these entry and exit. Population weighted average of all five-year age-sex cohorts gives two quality scores (EDQUALAG15PRI and EDQUALAG15SEC) for the adults, 15 years and older. An overall adult score (EDQUALAG15) is obtained by averaging these two. This score drives multi-factor productivity in the economic model of IFs.

Figure 5 is a diagrammatic representation of the education quality model in IFs.

Figure 5: Representation of the education quality model

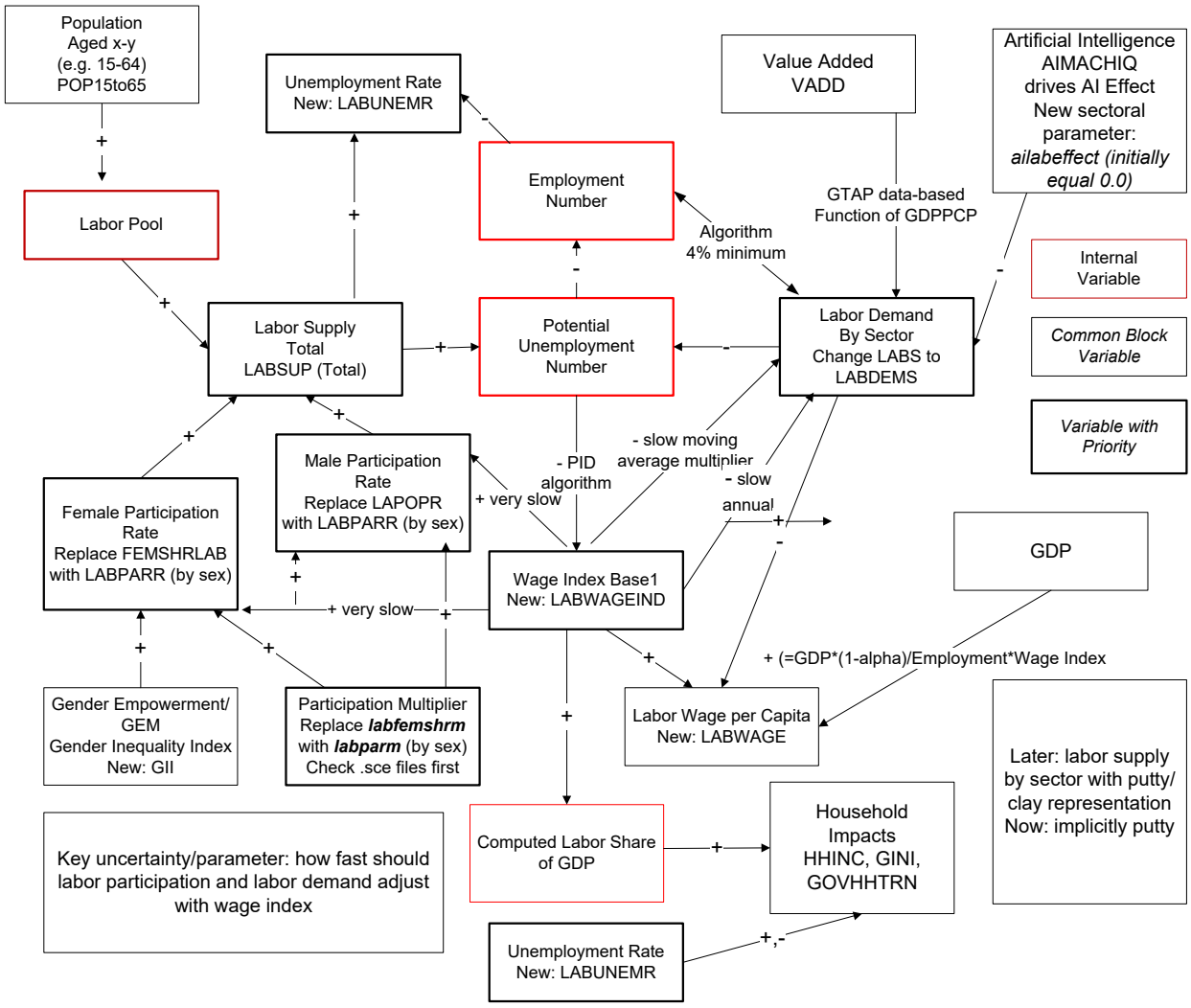


Labor

The labor model in IFs (Figure 6) was modified by incorporating unemployment through this contract. Labor supply is determined by the working age population and the share of that population who are willing to work. The labor supply is relatively stable. It is the demand instability that gives rise to most of the imbalances in the labor market. Economists generally use a demand curve of labor which shows the quantity of labor the employers are willing to hire at a given wage. These demand curves are helpful in studying the short-term demand fluctuations, for example, those that result from the business cycle. In the longer-term labor demand is driven by technological progress. The advent of new technology in a particular sector usually reduces the demand for labor in that sector, more so for the labor with less or no skills.

Neoclassical assumptions are used to balance the market. The higher the wage the more willing are the workers to work. Firms, in contrast, prefer to hire when the wage is low. The imbalance shows up first in the rate of unemployment. Shifts in the rates of unemployment beyond what is usual impacts wage, the price of labor. For example, wages drop in the event of rising unemployment as there are more people to hire from. Wage adjustments feed back to the demand for labor thus bringing the system back to the equilibrium.

Figure 6: Representation of labor model



Description of initial labor market modelling in IFs:

IFs model follows the notion of an equilibrium market. However, instead of computing an analytical solution at each point in time, as is usually done in comparative statics models, we balance the market through an equilibrium seeking algorithm. We use an algorithm borrowed from the control systems engineering.

This PID controller algorithm, described also in the IFs economic model documentation, works basically by computing corrective signals for equilibrating variables using a buffer variable, for example wage, as the buffer moves towards or away from a target value. The signal is computed from two quantities, the distance of the buffer from the target and the current rate of change of the buffer, and scaled to a suitable base. The computed signal is then applied on the variable/s which need to be balanced, demand and supply of labor in our case, thus getting closer to a balance at each step of simulation. The target value for the buffer variable and the parameters of the control algorithm are obtained through expert judgment and model calibration.

IFs labor model uses two PID controllers to balance the demand and supply of labor. One of the controllers use unemployment (LABUNEMPR) as a buffer variable and the other uses wage (LABWAGEIND) as a buffer. The model assumes labor to be perfectly substitutable across all sectors of the economy with an overall wage and unemployment rate for the entire labor market. This assumption is rather simplistic but this is the best we can do with the data we have at our hand.

Violence

The IFs system includes a representation of mortality from different types of societal violence. The types of violence represented are homicides, police violence, violence from conflict, self-harm and violence against vulnerable populations (women & children). Total violence is calculated using a weighted average of mortality rates for each of the above and using population of the respective age-cohorts as a weight. The different types of violence are then fed into the security index in IFs (GOVINDSECUR) which has forward linkages to multifactor productivity, forced migration and educational enrollment.

In the first year of the model, data for the different types of violence are initialized using mortality data from the Institute for Health and Metric Evaluation (IHME). Note that we currently do not forecast prevalence of any kind of violence due to a lack of data related to the same. There is a switch that a user can activate to normalize violence related mortality to violence related to intentional injuries (based on data from UNPD) in the first year of the model.

Levels of homicide deaths and levels of deaths of vulnerable populations are determined in the forecast years using the youth bulge and inequality (GINI co-efficient) as drivers. Conflict deaths are driven using the probability of internal war, police violence is driven by levels of homicides and corruption and self-harm is driven using deaths from mental health and levels of homicides.

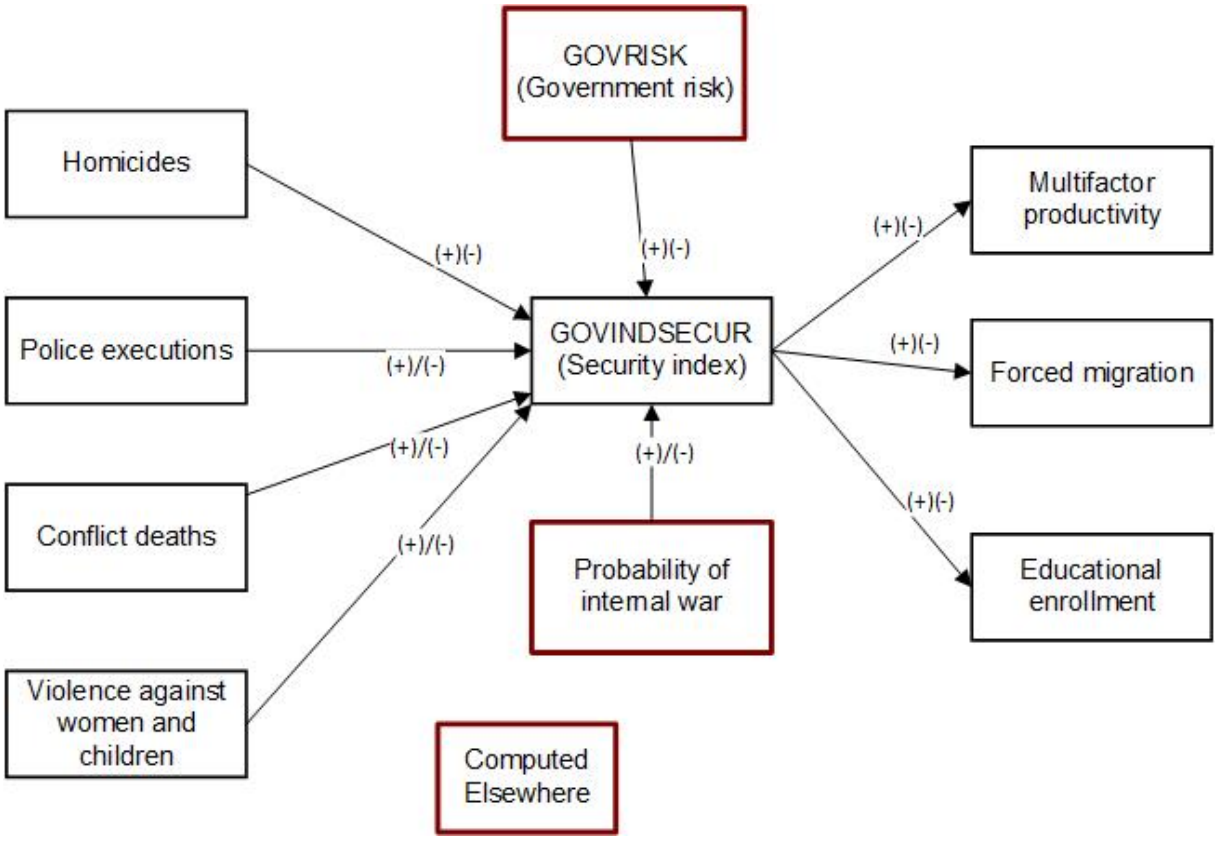
In addition to the variables themselves, there are multiplicative and additive parameters available to the user to simulate an increase or decrease in levels of violence.

Finally, the different types of violence are used in the calculation of a violence term which is one of three terms used in the computation of the government security index (GOVINDSECUR). The other two terms used are a term for government risk and a term for probability of war.

The security index has a forward linkage to multifactor productivity, a forward linkage to forced migration and a forward linkage to educational enrollment. All forward linkages are represented through elasticities in the model. In addition to these, the violence model itself has a linkage to the demographic model since it contributes to the death rate.

The flowchart in Figure 7 provides a diagrammatic representation of the violence model along with relevant forward linkages

Figure 7: Representation of the violence model



Appendix 2: Education attainment and quality model in IFs

The education model of IFs simulates patterns of educational participation and attainment in 186 countries over a long time horizon under alternative assumptions about uncertainties and interventions (Irfan 2008). Its purpose is to serve as a generalized thinking and analysis tool for educational futures within a broader human development context.

The model forecasts gender- and country-specific access, participation and progression rates at levels of formal education starting from elementary through lower and upper secondary to tertiary. The model also forecasts costs and public spending by level of education. Dropout, completion and transition to the next level of schooling are all mapped onto corresponding age cohorts thus allowing the model to forecast educational attainment for the entire population at any point in time within the forecast horizon.

From simple accounting of the grade progressions to complex budget balancing and budget impact algorithm, the model draws upon the extant understanding and standards (e.g., UNESCO's ISCED classification explained later) about national systems of education around the world. One difference between other attempts at forecasting educational participation and attainment (e.g, McMahon 1999; Bruns, Mingat and Rakotomalala 2003; Wils and O'Connor 2003; Delamonica, Mehrotra and Vandemoortele. 2001; Cuaresma and Lutz 2007) and our forecasting, is the embedding of education within an integrated model in which demographic and economic variables interact with education, in both directions, as the model runs.

We emphasize the inter-connectedness of the components and their relationship to the broader human development system. For example, during each year of simulation, the IFs cohort-specific demographic model provides the school age population to the education model. In turn, the education model feeds its calculations of education attainment to the population model's determination of women's fertility. Similarly, the broader economic and socio-political systems provide funding for education, and levels of educational attainment affect economic productivity and growth, and therefore also education spending.

Education quality is a recent addition to the International Futures (IFs) education model. This part of the model compares and forecasts quality of learning at the educational levels of primary and secondary for 186 model countries. To initialize the quality variables IFs model pre-processor uses the World Bank Global Achievement database of country scores in international achievement tests or regional equivalent of such tests in the test areas of reading, science and math. There are a total of eight new variables, four for primary and four for secondary. At each level, there are three subject area scores – science, math and reading – and an overall score. The scores will be further disaggregated by sex of the student depending on the availability of necessary data.

Test score forecasts in our model are driven by average educational attainment of the adults as an aggregate indicator of family environment and expenditure per student as an indicator of the quality of the school system. Each of the subject area scores are regressed against these variables using data for the base year or the most recent year with data. The regression relationships compute the scores in the forecast-years using values for the independent variables obtained from other IFs models. Any difference in scores obtained from historical database with those obtained from regression is considered as a country-specific situation. The base-year

country shifts in the scores, added to the regression output in the subsequent years, decrease gradually as the country merge towards the general relationship.

Some researchers have discovered that the quality of education is an important determinant of economic growth and productivity. The education quality model contains a forward linkage from learning quality to economic productivity. This linkage is implemented through the introduction of an elasticity of productivity to learning quality.

Data for education quality are initialized in the model using the global education dataset from the World bank. This dataset does not provide education quality disaggregated by gender. Eight variables are initialized namely education quality at the primary level (Math, Science, Reading, Total) and at the secondary level (Math, Science, Reading, Total)

Education Quality Conversion (Honduras)

This section explains the methodology followed to make the MIDEH scores that are the national level test scores for Honduras comparable to the education quality test scores from the World Bank Global achievement database which are currently being used in the education model pre-processor. The document lists all the data sources that are currently available, coverage of these datasets, scales followed by these data sets and then explains the methodology used. The final section of this document presents the converted test scores over time for Honduras.

Test score data available for Honduras:

Currently there are three main types of test score data that are available for Honduras at the primary and secondary level for math and reading,

- *World Bank Global Achievement Database (WB data)* - Test score data available for primary reading and math for Honduras for one year (1995). Scale of the scores is from 30 to 60. No disaggregation available by sex.

- *Education Quality Test Scores from Nadir Altinok (Altinok data)* - Test score data compiled by Altinok, Patrinos, Angirst and Harry. Test score data available for primary math and reading from 1995 to 2015. Scale of the test scores is from 100 to 700. Disaggregation available by gender.

- *MIDEH test score data* - Test score data collected for Honduras by USAID for math and reading. Scale of test scores is from 100 to 500. Data is available from 2007 to 2016 for both genders.

Objective and methodology used:

Ideally, we would have converted the MIDEH scores directly to the World Bank scale for Honduras. However, there is no overlap between the two test score data. Hence, we have to use the Altinok test scores to arrive at a value that is similar to the World Bank value for Honduras.

Step 1: Creating a relationship between the Altinok test score and the WB test score

We initially created a relationship between the total Altinok test score data and the total WB test score data at each level of education (Primary and Secondary) and for each subject (Math and Reading).

However, when creating the cross-sectional relationship, we used the reference year as 2005. The WB Data for Central American countries is based on two main tests. First is the LLECE conducted in 1992 and the second is the SERCE conducted in 2005. This yields two data points for most Central American countries (one in 1995 and one in 2005). However, the quality of the tests is quite different. Therefore the 1995 data point is much higher than the 2005 data point. In the case of Honduras, the only data point available is from 1995 which is why the model initializes the country much higher than Costa Rica whose data comes from the 2005 data point. Given the difference in the test scores, we used a regression based on the 2005 data rather than the latest data point.

Step 2: Generating Altinok test scores for each year

Another challenge is that the Altinok test score data is only available in 5 year intervals. In order to have a complete dataset, we used the growth rates from the MIDEH dataset and applied the same to the Altinok test scores to get a more complete dataset.

Note that we used the average of Grade 5 and Grade 6 scores from the MIDEH dataset for Primary and the Grade 9 test scores from the same dataset for Secondary.

Step 3: Using the co-efficient from the above relationships to arrive at WB scores

Finally, we used the above co-efficients and the more complete Altinok data set to compute test score data for Honduras for math and reading at the primary and secondary levels. As mentioned above, we did not use the co-efficients from the relationship between the World Bank data set and the Altinok data set in the computation of the secondary reading data point for Honduras. We used the co-efficients for primary reading instead.

Appendix 3: Description of interventions for scenario analysis

Scenario name	Parameter name	Parameter description	Base value	Changed value	Justification for intervention
200_HEdFlat	edyrsagm	Years of Education Multiplier	1	0.6	Simulates a decrease of years of education attained by 40%
210_HEd5year	edseclowrgram	Education, Lower Secondary, Graduation rate, Multiplier	1	1.1	Simulates a 10% increase in graduation rate in lower secondary education in Guatemala over a 5 year period
210_HEd5year	edseclowrtranm	Education, Lower Secondary, transition rate, Multiplier	1	1.2	Simulates a 20% increase in education quality in secondary education in Honduras over a 5 year period
210_HEd5year	edqualsecallm	Education, quality, multiplier on secondary	1	1.075	Simulates a 7.5% increase in education quality in secondary education in Honduras over a 5 year period
210_HEd5year	edsecupprgram	Education, Upper Secondary, Graduation rate, Multiplier	1	1.1	Simulates a 10% increase in graduation rate in upper secondary education in Honduras over a 5 year period
210_HEd5year	edprisurm	Education, primary, survival rate, Multiplier	1	1.075	Simulates a 7.5% increase in survival rate in primary education in Honduras over a 5 year period
210_HEd5year	edqualpriallm	Education, quality, multiplier on primary	1	1.0925	Simulates a 9.25% increase in education quality in primary education in Honduras over a 5 year period
211_HEdPriTest	edqualpriallm	Education, quality, multiplier on primary	1	1.0925	Simulates a 9.25% increase in education quality in primary education in Honduras over a 5 year period
220_HSDG2030	edpriintntrgtyr	Education, Primary, Net Intake Rate, Target Year	0	6	Simulates an increase of et intake rate at the primary rate to 100% by 2030, thus achieving SDG
220_HSDG2030	edprisurtrgtyr	Education, Primary, Survival Rate, Target Year	0	6	Simulates an increase of survival rate at the primary rate to 100% by 2030, thus achieving SDG

Scenario name	Parameter name	Parameter description	Base value	Changed value	Justification for intervention
220_HSDG2030	edseclowrtrantrgtyr	Education, Sec Lower, Transition Rate, Target Year	0	9	Simulates an increase of transition at the lower secondary rate to 100% by 2030, thus achieving SDG
220_HSDG2030	edseclowrgratrgtyr	Education, Sec Lower, Graduation Rate, Target Year	0	9	Simulates an increase of graduation at the lower secondary rate to 100% by 2030, thus achieving SDG
220_HSDG2030	edsecupprtrantrgtyr	Education, Sec Upper, Transition Rate, Target Year	0	12	Simulates an increase of transition at the upper secondary rate to 100% by 2030, thus achieving SDG
220_HSDG2030	edsecupprgratrgtyr	Education, Sec Upper, Graduation Rate, Target Year	0	12	Simulates an increase of graduation at the upper secondary rate to 100% by 2030, thus achieving SDG
220_HSDG2030	edtergradgr	Education, tertiary, graduation rate, annual growth	0	0.8	Simulates an decrease in tertiary graduation rate by 20%
220_HSDG2030	edqualpriallm	Education, quality, multiplier on primary	1	1.185	Simulates a 18.5% increase in education quality in primary education in Honduras over a 12 year period
220_HSDG2030	edqualsecallm	Education, quality, multiplier on secondary	1	1.135	Simulates a 13.5% increase in education quality in secondary education in Honduras over a 12 year period

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