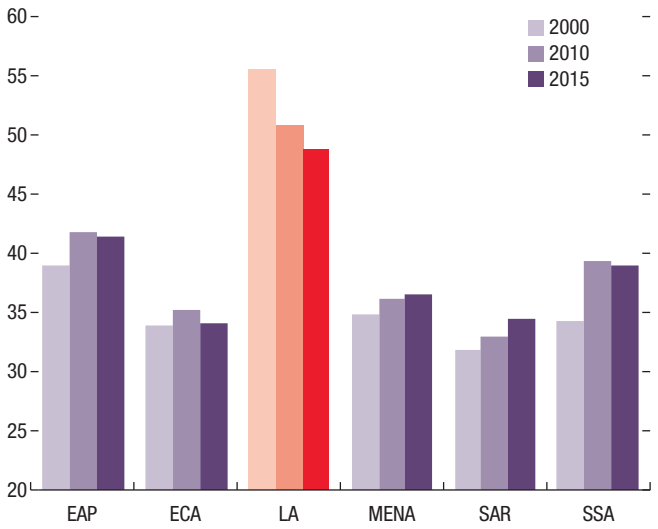
5. Poverty and Inequality in Latin America: Gains during the Commodity Boom but an Uncertain Outlook

Latin America has made impressive progress in reducing inequality and poverty since the turn of the century, although it remains the most unequal region in the world. The declines in inequality and poverty were particularly pronounced for commodity exporters during the commodity boom. Much of the progress reflected real labor income gains for lower-skilled workers, especially in services, with a smaller but positive role for government transfers. With the commodity boom over, a tighter fiscal envelope, and poverty rates already edging up in some countries, policies will have to be carefully recalibrated to sustain social progress. Increasing personal income tax revenues while rebalancing spending could help maintain key social transfers and infrastructure spending. Better targeting of social transfers and reforming decentralization frameworks also have an important role to play.

Throughout the 20th century, Latin America was associated with some of the highest levels of inequality in the world,[1] but since 2000 it has been the only region to have seen a significant reduction in inequality (Figure 5.1).[2] Poverty has also fallen significantly, although this has been replicated in other regions, and Latin America started from a relatively low base (Figure 5.2).[3]

Figure 5.1. Gini Coefficient
(Gini index; population-weighted average)



Sources: World Bank, PovcalNet database; and World Bank, World Development Indicators (WDI) database.
Note: For 2015, Latin America is the average of available values from WDI. Countries include Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Honduras, Panama, Paraguay, Peru, and Uruguay.
EAP = East Asia Pacific; ECA = Europe and Central Asia; LA = Latin America, MENA = Middle East and North Africa; SAR = South Asia; SSA = sub-Saharan Africa.

Of great concern looking ahead is that some of the gains have started to reverse (ECLAC 2017; Messina and Silva 2018).

Against this backdrop, this chapter documents recent regional trends in inequality and poverty, differentiating between South America and Central America (including Mexico), as well as between commodity importers and exporters. It finds that the gains were particularly pronounced for commodity exporters. It then asks why and explores the channels through which commodity cycles impact social progress by using micro-data case studies of commodity exporters. The chapter also examines the design of fiscal decentralization in the context of large revenue windfalls and

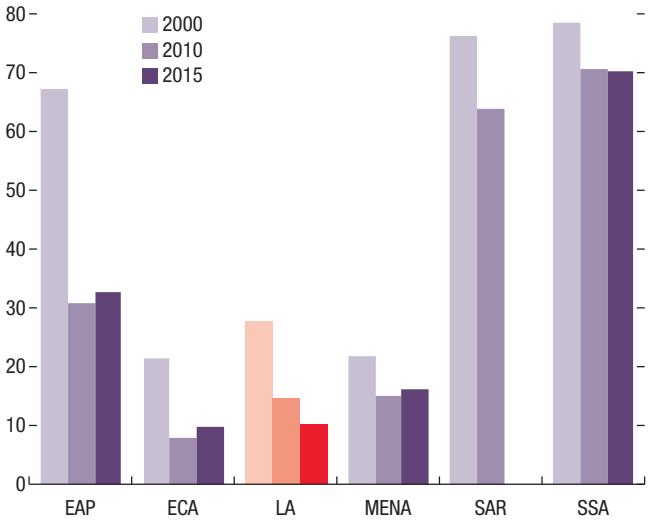
This chapter was prepared by Ravi Balakrishnan, Frederik Toscani, and Mauricio Vargas. Adrian Robles provided excellent research assistance and Pablo Bejar provided valuable support in production. The chapter is based on a forthcoming IMF Departmental Paper that will present further analysis and details on commodity cycles and inequality in Latin America.

[1]Analysts argue that this is a legacy of colonization and the institutions put in place by the conquistadores (Engerman and Sokoloff 1997, 2000, 2002; Acemoglu, Johnson, and Robinson 2001, 2002). Such a legacy has been linked to (1) the existence of strong elites, (2) capital market imperfections, (3) inequality of opportunities (in terms of access to high-quality education), (4) labor market segmentation (for example, due to informality), and (5) discrimination against women and non-whites (see Cornia and Martorano 2013 for a survey).

[2]Given that there are only limited data on inequality available for the Caribbean, this chapter focuses on Latin America.

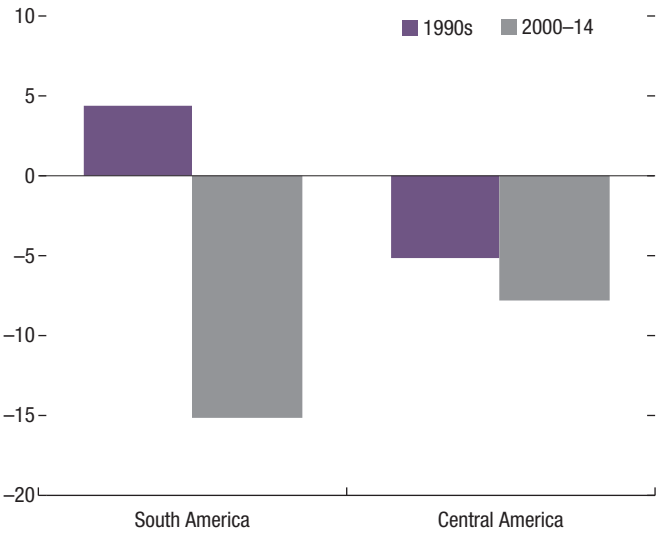
[3]Comparing poverty and especially inequality across countries and regions is challenging. The data used for Latin America are harmonized across countries. But given that inequality data for Latin America are generally income-based, while for other regions the data are consumption-based, cross-region comparisons have certain limitations.

Figure 5.2. Poverty Rate
(Percent; headcount ratio at $3.20 a day; 2011 PPP)



Source: World Bank, World Development Indicators (WDI) database.
Note: For 2015, Latin America is the average of available values from WDI. Countries include Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Honduras, Panama, Paraguay, Peru and Uruguay. No data available for SAR in 2015. EAP = East Asia Pacific; ECA = Europe and Central Asia; LA = Latin America; MENA = Middle East and North Africa; SAR = South Asia; SSA = sub-Saharan Africa; PPP = purchasing power parity.

Figure 5.3. Change in Poverty Rate
(Percentage points; headcount ratio at $3.10 a day)



Source: Inter-American Development Bank, SIMS database.
Note: South America comprises Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, and Uruguay. Central America comprises Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, and Panama.

policies that can help maintain progress in the current period of lower commodity prices.

Panoramic View of Social Gains during the Commodity Boom

Overall, poverty reduction was strong across the region during the commodity boom,[4] especially in South America (Figure 5.3).[5] Inequality as measured by the Gini coefficient declined in both Central and South America, but significantly more in the latter (Figure 5.4).[6] In South America, the difference between the 1990s (when poverty and inequality increased) and the boom period was particularly stark.

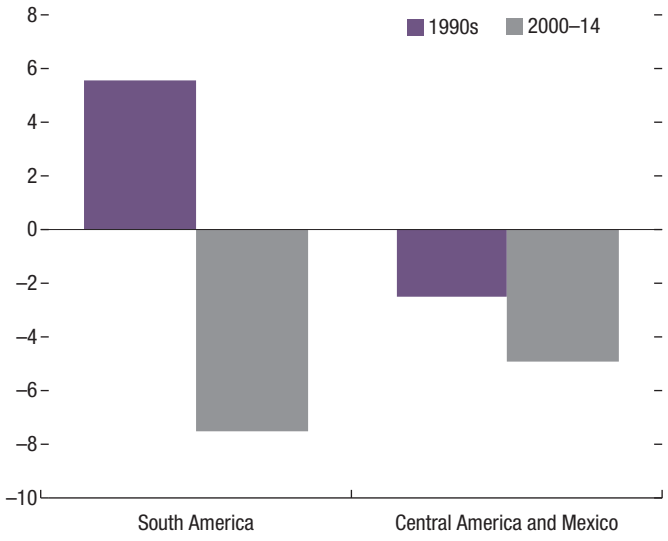
A large literature has shown that the widespread decline in inequality across the region during the 2000s was due to a reduction in hourly labor income inequality, and to more robust and progressive government transfers (Azevedo, Saavedra, and Winkler 2012; Cornia and Martorano 2013; de la Torre, Messina, and Pienknagura 2012; López-Calva and Lustig 2010; Lustig, López-Calva, and Ortiz-Juarez 2013). For poverty reduction, and to some degree for inequality declines, an obvious hypothesis is that higher growth across Latin America during the boom period might have been the key driver. Relative to the 1990s, Figure 5.5 shows that during the commodity boom growth did indeed increase in South America (where poverty fell the most), while in Central America growth was lower but remained high. Figure 5.6 shows that

[4]While the peak in commodity terms of trade varies across countries, for comparability purposes the end of the boom is defined here as the start of the 2014 oil price shock.

[5]Given data availability, country coverage includes Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, and Uruguay. Commodity exporters are determined according to whether net commodity exports surpassed 10 percent of total exports plus imports at the time of the October 2015 *World Economic Outlook*. Brazil is added because it has the largest estimated natural resource reserves in the region. Hence, the full list of commodity exporters is Argentina, Brazil, Bolivia, Chile, Colombia, Ecuador, Honduras, Paraguay, and Peru.

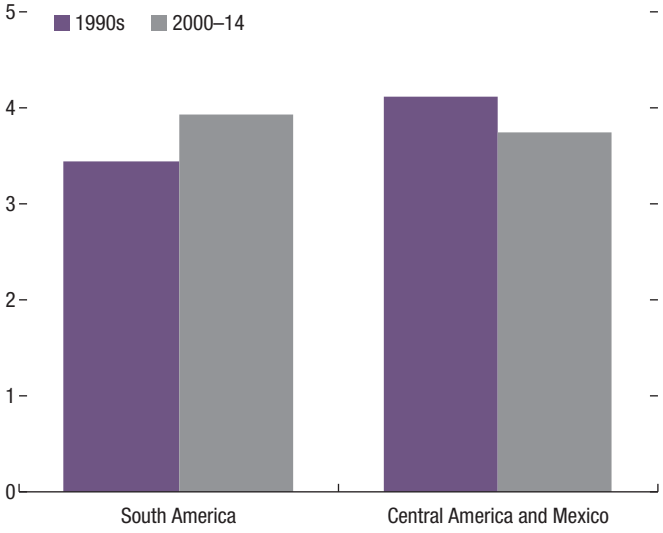
[6]This chapter examines income inequality (income Gini) rather than wealth inequality.

Figure 5.4. Change in Average Gini Coefficient
(Gini units)



Sources: World Bank, World Development Indicators database; and IMF staff calculations.
Note: South America comprises Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, and Uruguay. Central America comprises Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama.

Figure 5.5. Average Real GDP Growth
(Percent)



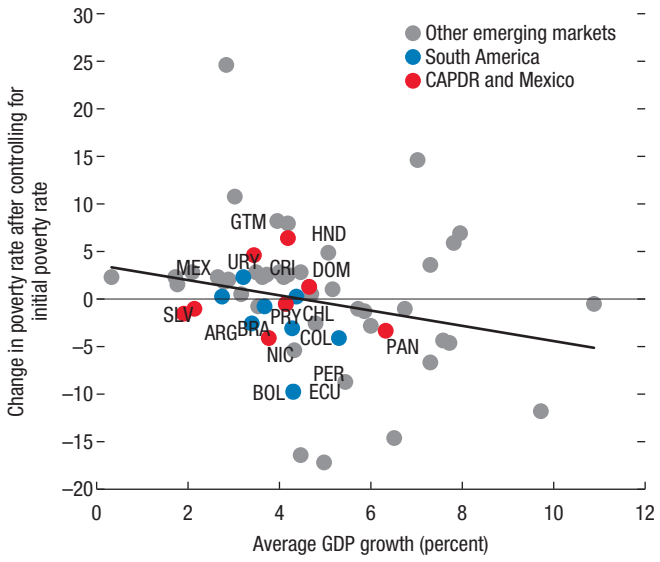
Sources: IMF, World Economic Outlook database; and IMF staff calculations.
Note: South America comprises Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, and Uruguay. Central America comprises Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama.

the association between GDP growth and poverty reduction for individual countries across emerging regions during the boom was positive.[7] South American countries, however, are generally below the fitted line, meaning that for every additional percentage point of growth, they reduced poverty by more than other countries. This suggests that factors beyond high growth have been behind the remarkable turnaround in poverty reduction in South America in the 2000s.

A key question then is why were the social gains greater in South America during the boom relative to other regions? Figure 5.7 provides a potential link: South America is home to many commodity exporters that experienced a significant boost in their terms of trade relative to other countries. Figures 5.8 and 5.9 zoom into the differences in inequality and poverty reduction between individual commodity exporters and importers. The largest gains on both fronts were made in

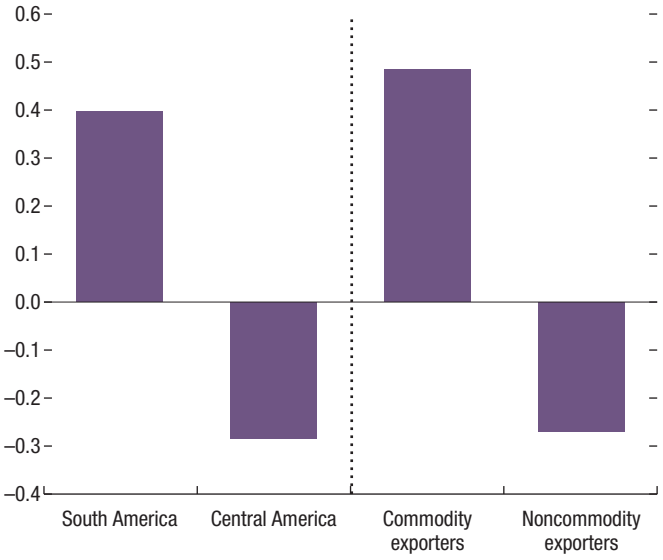
[7]To control for the initial level of poverty, the variable on the *y*-axis is the residual of a regression of the change in poverty on the initial poverty ratio.

Figure 5.6. Average GDP Growth and Change in Poverty Rate, 2000–14
(Headcount ratio at $3.10 a day; PPP)



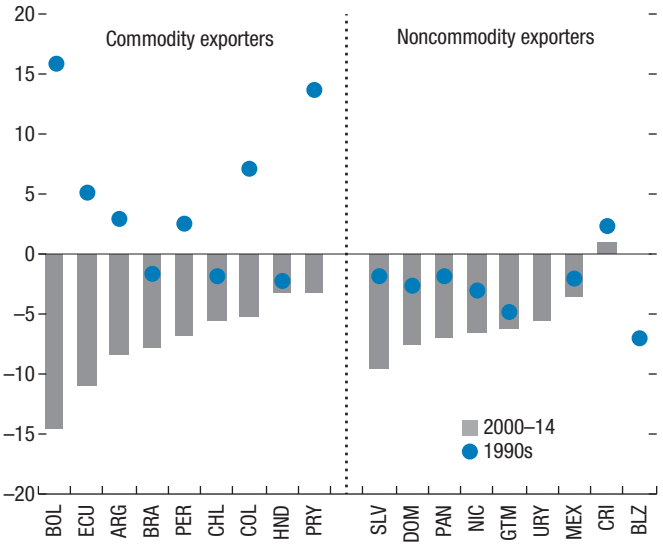
Sources: IMF, World Economic Outlook database; Inter-American Development Bank, SIMS database; and IMF staff calculations.
Note: South America comprises Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, and Uruguay. Central America comprises Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama. The graph controls for convergence effects. Specifically, the variable on the *y*-axis is the residual of a regression of the change in poverty on the initial poverty rate. For International Organization for Standardization (ISO) country codes used in data labels, see page 115. CAPDR = Central America, Panama, and the Dominican Republic; PPP = purchasing power parity.

Figure 5.7. Average Commodity Terms-of-Trade Growth during Boom, 2000–14
(Percent)



Source: IMF staff calculations.
Note: Terms of trade is the commodity net export price index weighted by GDP (see Gruss 2014). All countries in South America are commodity exporters except Uruguay. All Central American countries are noncommodity exporters except Honduras.

Figure 5.8. Change in Gini Coefficient
(Gini units)



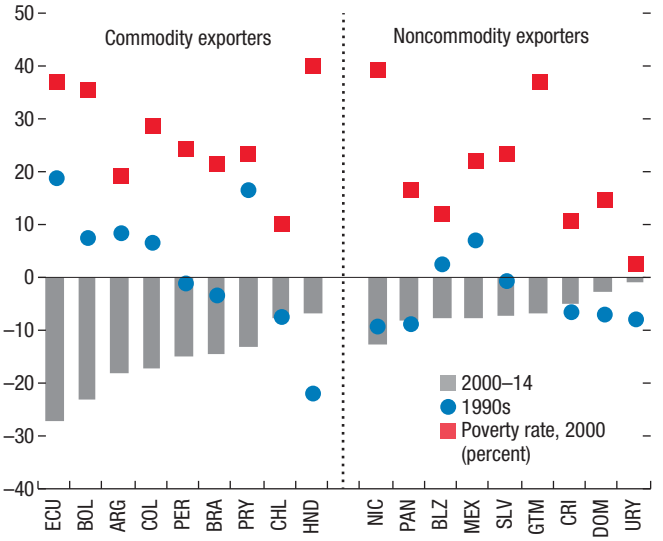
Sources: Inter-American Development Bank, SIMS database; World Bank, World Development Indicators database; and IMF staff calculations.
Note: Colombia uses 2003 and Brazil uses 2001 values for 2000 given data availability. For International Organization for Standardization (ISO) country codes used in data labels, see page 115.

two countries highly dependent on commodity exports, Bolivia and Ecuador. Indeed, commodity exporters made larger gains in poverty reduction across the board except for Chile and Honduras, which experienced smaller gains than some non-commodity exporters such as Nicaragua and Panama.[8]

For inequality, the same pattern holds but the picture is more mixed, with El Salvador and the Dominican Republic seeing bigger reductions in inequality than several commodity exporters (Chile, Colombia, Paraguay and Honduras).[9]

The significant progress in many commodity importers underscores the various factors driving

Figure 5.9. Change in Poverty Rate
(Percentage points; headcount ratio at $3.10 a day)



Source: Inter-American Development Bank, SIMS database.
Note: Colombia uses 2003 and Brazil uses 2001 values for 2000, given data availability. For International Organization for Standardization (ISO) country codes used in data labels, see page 115.

[8]That poverty fell less in Chile than in other commodity exporters largely reflects the fact that Chile had relatively low poverty rates before the boom: poverty in 2000 stood at 10.3 percent and fell to 2.6 percent by 2013.

[9]The mean poverty reduction during the boom period was statistically significantly larger in commodity exporters than nonexporters. For inequality, the mean reduction is also larger, but the result is not statistically significant.

social progress, of which commodity cycles is only one. Indeed, Messina and Silva (2018) argue that supply factors, such as an increasing supply of skilled workers, were likely the key drivers of lower inequality in Central America and Mexico, and played an important role across the region. Lustig, Lopez-Calva, and Ortiz-Juarez (2012) also point to the expansion of cash transfers in Mexico, while IMF (2017) highlights the role of government policies to boost low wages in Uruguay.

Commodity Cycles, Poverty, and Inequality

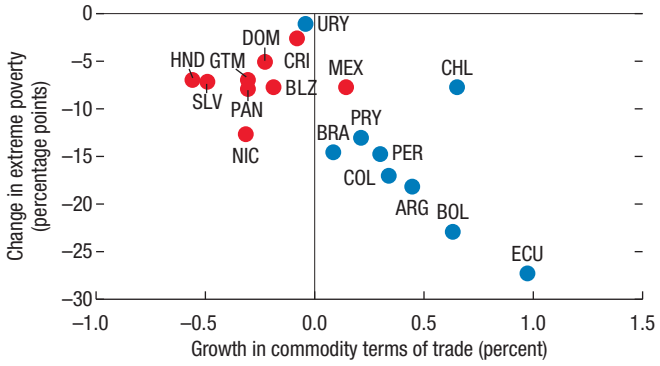
Is There a Statistical Association?

What is the relationship between social indicators and the commodity cycle? The correlation between the reduction in poverty and inequality during the boom and the change in commodity terms of trade points to an interesting story (Figure 5.10).[10] For noncommodity exporters, there is no clear association between changes in commodity terms of trade and those in poverty and inequality. For commodity exporters, however, the relationship is strong, particularly for poverty. The size of poverty reduction is directly proportional to the growth rate of the commodity terms of trade in commodity exporters.[11] For inequality, the relationship for commodity exporters is not as strong as for poverty but is still clearly visible. A closer relationship between the commodity cycle and poverty (rather than inequality) is an empirical regularity found throughout this chapter.

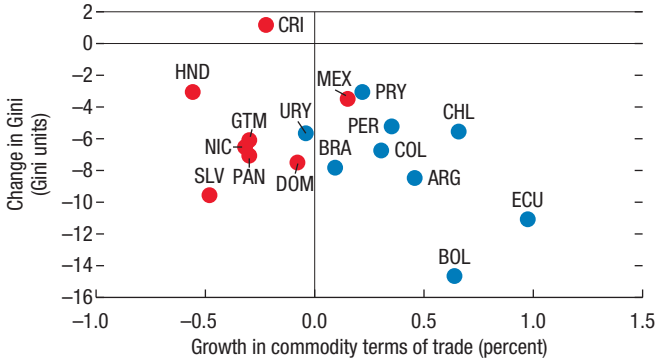
Table 5.1 reports regressions of the share of income by decile on commodity terms of trade as well as several control variables.[12] Income shares of the second to eighth deciles increased significantly, while the share of the top decile declined. Since both low-income and medium-to-high-income segments gained, the poverty result is stronger than the inequality result. Nevertheless, inequality did tend to fall, as the share of income going to

Figure 5.10. Commodity Terms of Trade, Poverty, and Gini Coefficient

1. Average Commodity TOT Growth and Change in Poverty Rate (During boom period 2000–14)



2. Average Commodity TOT Growth and Change in Gini Coefficient (During boom period 2000–14)



Sources: Inter-American Development Bank, SIMS database; World Bank, World Development Indicators database; and IMF staff calculations.
Note: Red dots correspond to CAPDR and Mexico and blue dots to South America. CAPDR comprises Central America and the Dominican Republic. Chile uses 2013 values for 2014 poverty headcount ratio due to data availability. For International Organization for Standardization (ISO) country codes used in data labels, see page 115. CAPDR = Central America, Panama, and the Dominican Republic; TOT = terms of trade.

[10]This captures the income gain or loss a country experienced during the period due to commodity price movements (Gruss 2014).

[11]While Honduras is classified as a commodity exporter given its high net commodity exports, its commodity terms of trade declined because it exports nonextractive commodities and imports extractive ones whose prices increased by more. Consequently, commodity price changes led to a negative wealth effect for Honduras and poverty fell significantly less than in most other Latin American countries.

[12]The sample here only includes commodity exporters, given that there is no statistical association for non-commodity exporters. The regression includes country fixed effects and lagged GDP per capita as a control variable.

Table 5.1. Commodity Terms of Trade and Income Share by Decile in Commodity Exporters

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	**Decile 1**	**Decile 2**	**Decile 3**	**Decile 4**	**Decile 5**	**Decile 6**	**Decile 7**	**Decile 8**	**Decile 9**	**Decile 10**
(Log) Net commodity	0.151	0.395**	0.392*	0.405*	0.476**	0.575**	0.716***	0.790***	0.436	−4.310**
Price index	(0.120)	(0.191)	(0.207)	(0.226)	(0.236)	(0.255)	(0.267)	(0.259)	(0.301)	(1.735)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	GDP per capita	GDP per capita	GDP per capita	GDP per capita	GDP per capita	GDP per capita	GDP per capita	GDP per capita	GDP per capita	GDP per capita
Period	2000–14	2000–14	2000–14	2000–14	2000–14	2000–14	2000–14	2000–14	2000–14	2000–14
Observations	114	114	114	114	114	114	114	114	114	114
R-squared	0.608	0.627	0.664	0.674	0.685	0.658	0.604	0.488	0.020	0.638
Number of countries	9	9	9	9	9	9	9	9	9	9

Sources: Socio-Economic Database for Latin America and Caribbean (CEDLAS and World Bank); and IMF staff calculations.

Note: *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

the highest decile fell substantially on average.[13] Interestingly, the bottom income decile did not see its share go up in a statistically significant way in response to higher commodity terms of trade, although its absolute income went up. As expected and consistent with Figure 5.9, poverty reduction was driven more by developments closer to the poverty line, namely the second to fourth decile, depending on the country.[14]

What Are the Channels?

The statistical relationship naturally leads to the question of the channels through which the commodity cycle influences social indicators. Essentially, a commodity boom is a positive wealth shock that propagates through the economy via various channels, as described in the sections that follow.[15]

Market and Private Sector Channels

The positive wealth shock has a direct impact on the commodity sector and spillovers to the rest of the economy, many of them transmitted via the labor market:

- First, the booming commodity sector expands. This draws in labor and other resources. Higher labor demand pushes up real wages and/or employment. It can also reduce or increase the skills premium, depending on the relative labor intensity of the commodity sector.[16]
- Second, improved terms of trade and the expansion of the commodity sector have spillovers to other sectors. With higher wealth and incomes, domestic demand increases, benefiting the nontradable sector. Higher investment by the commodity sector leading, for example, to more construction is another way through which the positive wealth shock feeds into the economy, again expanding the nontradable sector.
- Third, changes in relative wages (a compression in the skills premium if the commodity sector and the nontradable sector are intensive in unskilled labor) will benefit more skill-intensive sectors and lead to further reallocation (Benguria, Saffie, and Urzua 2017).

Overall, the above channels should lead to more employment in the commodity and nontradable sectors. The impact on the noncommodity tradable sector is not clear ex ante. On the one hand, the classic natural resource curse ("Dutch disease") could be operating—higher demand expands the nontradable sector but crowds out the noncommodity sector due to a more appreciated real exchange rate (Harding and Venables 2016). On the other hand, if key tradable inputs are provided locally, there can be positive spillovers from the commodity sector to the manufacturing sector, as has been shown for the United States.[17] Given the relatively narrow initial manufacturing base in most Latin American countries, both effects might be modest, but commodity booms are likely to hamper export diversification to some degree.

In terms of social outcomes, the expansion of the commodity and nontradable sectors, and the related increase in wages, should reduce poverty if those sectors employ workers from the lower end of the income distribution. Additionally, inequality will fall if the expanding sectors are intensive in low-skilled labor, causing the skills premium to decline.

[13]It is not possible to infer what happened to the income level of the top decile from these income-share regressions. Nonetheless, Figure 5.13 shows that real wages grew across all skill levels in commodity exporters on average during the boom, suggesting that in most countries the result in Table 5.1 reflects a relative rather than absolute loss for the top decile.

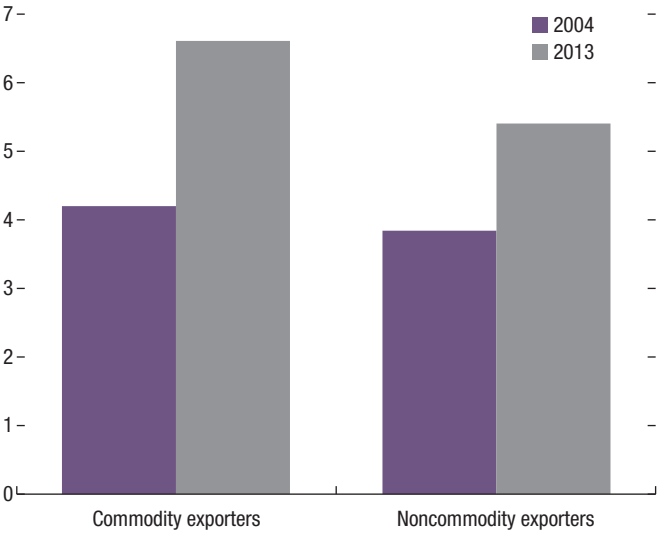
[14]For example, in Bolivia nearly 40 percent of the population was below the poverty line in 2000.

[15]On the larger question of the long-term impact of natural resource abundance on GDP growth and development, there is no consensus. Van der Ploeg (2011), for example, shows that results supporting "the natural resource curse" are sensitive to sample periods and countries.

[16]Oil and gas production, for example, is substantially less labor-intensive than agriculture but is more intensive in skilled labor.

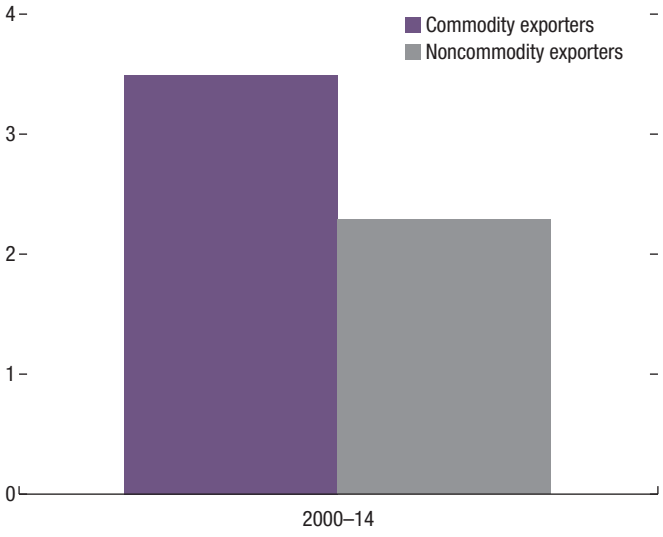
[17]Allcott and Keniston (forthcoming) demonstrate positive spillovers of the oil and gas sector to manufacturing in the United States. Michaels (2011) finds a similar positive result for the United States.

Figure 5.11. Public Investment in Latin America
(Percent of GDP)



Sources: IMF, World Economic Outlook database; and IMF staff calculations.

Figure 5.12. Total Employment Growth
(Percent)



Source: Inter-American Development Bank, SIMS database.

Fiscal Channels

The positive wealth shock is also transmitted via higher fiscal revenues and expenditures:

- Higher government investment operates in a manner similar to higher commodity sector investment. It leads to more domestic demand, for example via increased construction, with a resulting impact on wages and thus poverty and inequality.[18]
- Larger transfers will have a direct impact on poverty and inequality, especially if the transfers are targeted toward lower-income individuals.

Other General Equilibrium Effects

While not a focus in the remainder of this chapter, the wealth shock can be transmitted via other general equilibrium effects, for example via migration or the financial system.[19]

Regional Macroeconomic Evidence

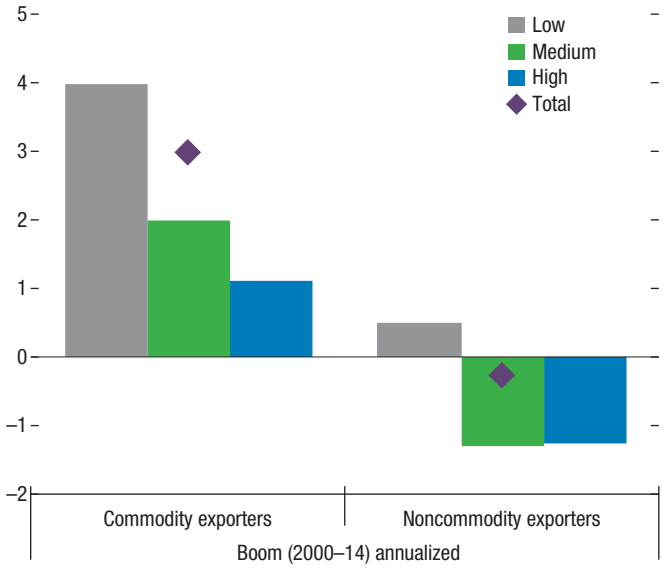
In aggregate, then, commodity booms should reduce poverty and inequality through labor market developments and fiscal transfers.[20] And indeed, these mechanisms seem to have played out in the region. Public investment and employment growth were higher in commodity exporters than importers (Figures 5.11 and 5.12). In line with the results of de la Torre and others (2015), commodity exporters also experienced significantly larger real labor income gains than noncommodity exporters across all skill levels (Figure 5.13). Low-skilled workers gained the most, compressing the skills premium and reducing inequality in both commodity exporters and nonexporters (Figure 5.14) but due to different underlying wage dynamics. Specifically, as Messina and Silva (2018) note, the skills premium reduction reflects not just demand factors tied to the commodity boom, but also an increase in the supply of high-skilled labor. In addition to labor income, government transfers also increased more in commodity exporters than

[18]Of course, public and private investment can also expand supply, not just demand.

[19]See, for example, Alberola and Benigno (2017).

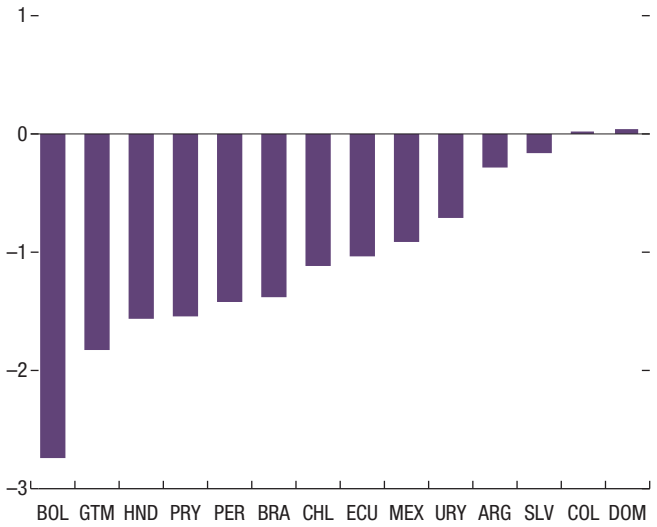
[20]Note that the vast majority of households in Latin America outside the highest-income segments do not receive any capital income, so transfers and labor income account for the overwhelming share of their total income.

Figure 5.13. Real Labor Income Growth by Educational Level
(Percent)



Source: Inter-American Development Bank, SIMS database.

Figure 5.14. Skill Premium Change in the 2000s
(Percentage point change in the ratio of hourly wage; high to low education)



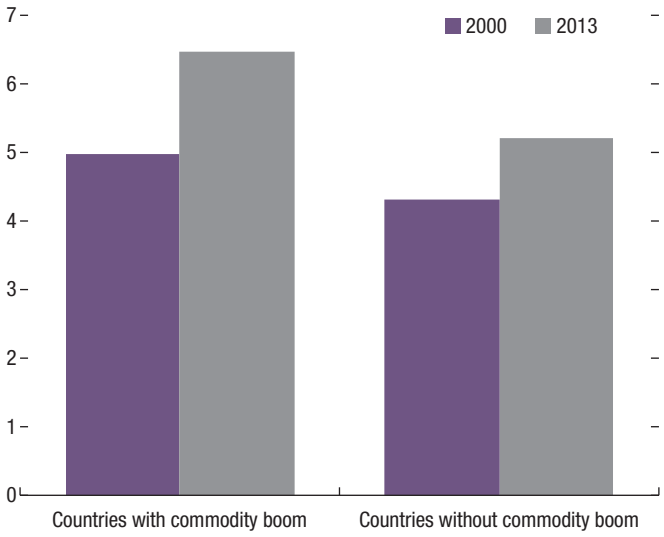
Sources: Socio-Economic Database for Latin America and Caribbean (CEDLAS and World Bank); and IMF staff calculations.
Note: For International Organization for Standardization (ISO) country codes used in data labels, see page 115.

nonexporters, further contributing to greater poverty and inequality declines in commodity exporters (Figure 5.15).

Micro-Data Case Studies: Bolivia, Brazil, and Peru

This section examines Bolivia, Brazil, and Peru, all of which experienced significant reductions in poverty and inequality. They are also commodity exporters, although Brazil is more diversified. The analysis first uses Shapley decompositions of household survey data for Bolivia and Peru to analyze the drivers of the national inequality and poverty decline.[21] This helps identify whether labor income or transfer income played a larger role.[22] Within-country studies are then conducted for Brazil and Bolivia to disentangle the impact

Figure 5.15. Average Government Transfers in Latin America
(Percent of GDP)

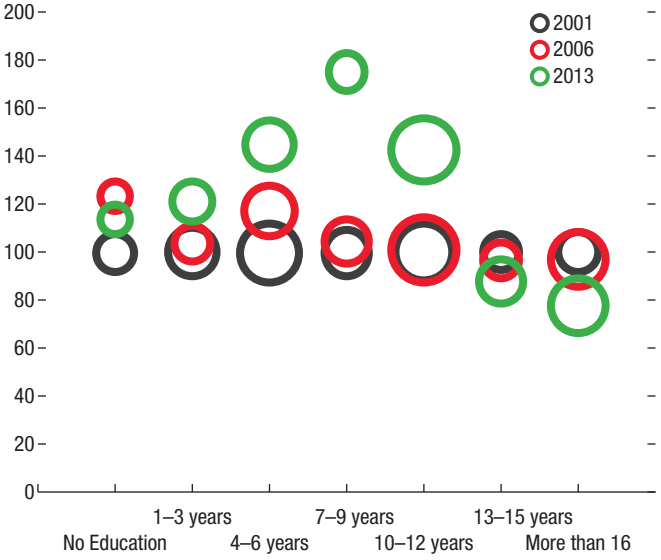


Sources: IMF, World Economic Outlook database; and IMF staff calculations.

[21]Official household survey data are used. For Bolivia, 2013 data are compared to 2007 data, while in Peru that comparison is between 2011 and 2007. For both countries, the official poverty lines are used to define poverty thresholds.

[22]Broadly speaking, a Shapley decomposition is a rigorous way to calculate how much any one factor contributed to changes in the income distribution. It isolates the contribution of one specific factor (say, an increase in wages in the agricultural sector) by calculating a counterfactual distribution holding all other factors constant. See Azevedo, Inchauste, and Sanfelice (2013) for more details.

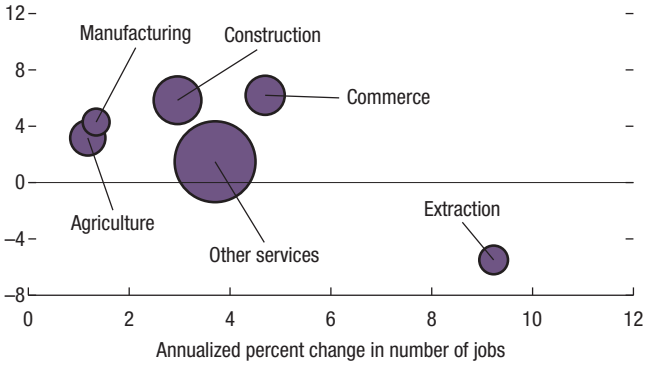
Figure 5.16. Bolivia: Index of Monthly Real Labor Income by Educational Level
(Index: 2001 = 100)



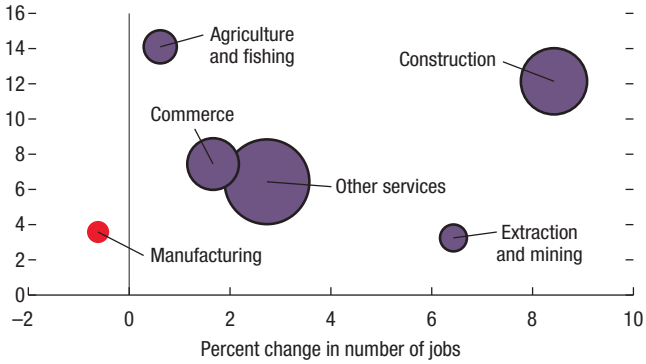
Sources: Programa de mejoramiento de las encuestas y medicion sobre condiciones de vida (MECOVI) household survey; and IMF staff calculations.
Note: The size of the bubble corresponds to the relative size of workers in each category.

Figure 5.17. Real Labor per Capita and Sectoral Employment in Bolivia and Peru

1. Bolivia: Annualized Percent Change in Real Labor Income per Capita, 2006–13



2. Peru: Annualized Percent Change in Real Labor Income per Capita, 2007–11



Sources: Encuesta nacional de hogares (ENAHO) household surveys for Peru; programa de mejoramiento de las encuestas y medicion sobre condiciones de vida (MECOVI) household surveys for Bolivia; and IMF staff calculations.
Note: The size of the bubble corresponds to the absolute change between 2006 and 2013 in the number of workers in each sector whose income depend on each of the sectors for Bolivia, and the absolute change between 2007 and 2011 in the number of workers in each sector whose income depend on each of the sectors for Peru. In red, a negative change.

of a fiscal windfall from the pure market impact associated with a commodity boom.

What Do Household Survey Data Show regarding Wage, Employment, and Government Transfer Developments in Bolivia and Peru?

In Bolivia, real labor income increased for all skills segments except for the highest segments during the boom. The largest gains were for workers with intermediate levels of education (Figure 5.16), consistent with the cross-country regression results on changes in income share by decile.

Figure 5.17 looks at real per capita labor income and employment by sector for Bolivia (Panel 1) and Peru (Panel 2). In terms of employment growth, the biggest winners were construction and the extractive sector in Peru, and the extractive sector and commerce in Bolivia, in line with the previous discussion on channels. In terms of numbers of jobs created, the broad services sector contributed the most in both countries, in part reflecting its size. Overall, employment growth came from extractive and nontradable sectors. Interestingly, the picture is more mixed for real wage growth. Average wages in the extractive sector fell in Bolivia, likely reflecting a compositional effect, with the number of informal (poorly paid) miners increasing faster than employees in larger, capital-intensive mines during the boom. Manufacturing did poorly in both countries, especially in terms of employment

Table 5.2. Composition of Household Total Income

		2006	2007	2011	2012	2013
Bolivia	Labor	82.8	82.4	81.8	80.9	79.1
	Nonlabor	16.4	17.0	17.9	18.4	20.4
	Of which: Transfers from government	5.7	5.4	9.8	11.2	. . .
		2007	**2008**	**2009**	**2010**	**2011**
Peru	Labor	83.6	84.2	84.9	84.8	85.8
	Nonlabor	16.4	15.8	15.1	15.2	14.2
	Of which: Current transfers[1]	9.4	9.0	9.0	8.6	8.3
	Of which: Programa JUNTOS	0.5	0.7	0.3	0.3	0.3

Sources: Encuesta Nacional de Hogares (ENAHO) household surveys for Peru; Programa de Mejoramiento de las Encuestas y Medicion sobre Condiciones de Vida (MECOVI) household survey for Bolivia; and IMF staff calculations.
Note: Figures for Bolivia do not exactly sum to 100 percent since extraordinary retirement benefits, scholarships, and insurance compensation are not included.
[1]Includes transfers within the country: pensions and transfers from individuals and institutions, public and private.

growth, again in line with a standard crowding-out story as well as with global trends.[23]

Finally, Table 5.2 reports the share of labor versus transfers in gross income (which includes transfers from the government and from family members or others). In Bolivia, government transfers increased markedly during the boom, partly reflecting the introduction of a noncontributory pension scheme. In Peru, transfers from the government did not increase substantially. In both countries, however, transfers account for a much smaller share of income than labor income, mechanically limiting their scope to lower poverty and inequality.

Shapley Decompositions

The formal Shapley decompositions largely confirm the earlier conclusions. For both Bolivia and Peru, labor income played a larger role than nonlabor income in reducing inequality and poverty. Across sectors, changes in labor income of the nontradable (services) sector explain much of the social progress (Figure 5.18).[24]

Across skill levels, changes at the lower end of the distribution were important for understanding changes in social indicators. Specifically, low-skilled workers—defined as having complete primary or incomplete secondary education—were one of the biggest contributors to the fall in poverty and inequality. Interestingly, skilled workers in both countries (with complete secondary or tertiary education) were also important contributors to poverty reduction, even though they have the highest wages on average and their wages grew the least. This is because while average income did not increase for skilled workers, wages at the lower end of their wage distribution moved up during the boom. This allowed a nontrivial fraction of skilled workers to exit poverty.[25]

In summary, the case studies for Bolivia and Peru show that poverty and inequality in both countries fell largely due to labor income gains for low-to-medium-skilled workers in the nontradable sector. Whether such gains are sustainable after the boom is a question to which the final section of this chapter will return.

Municipal-Level Analysis

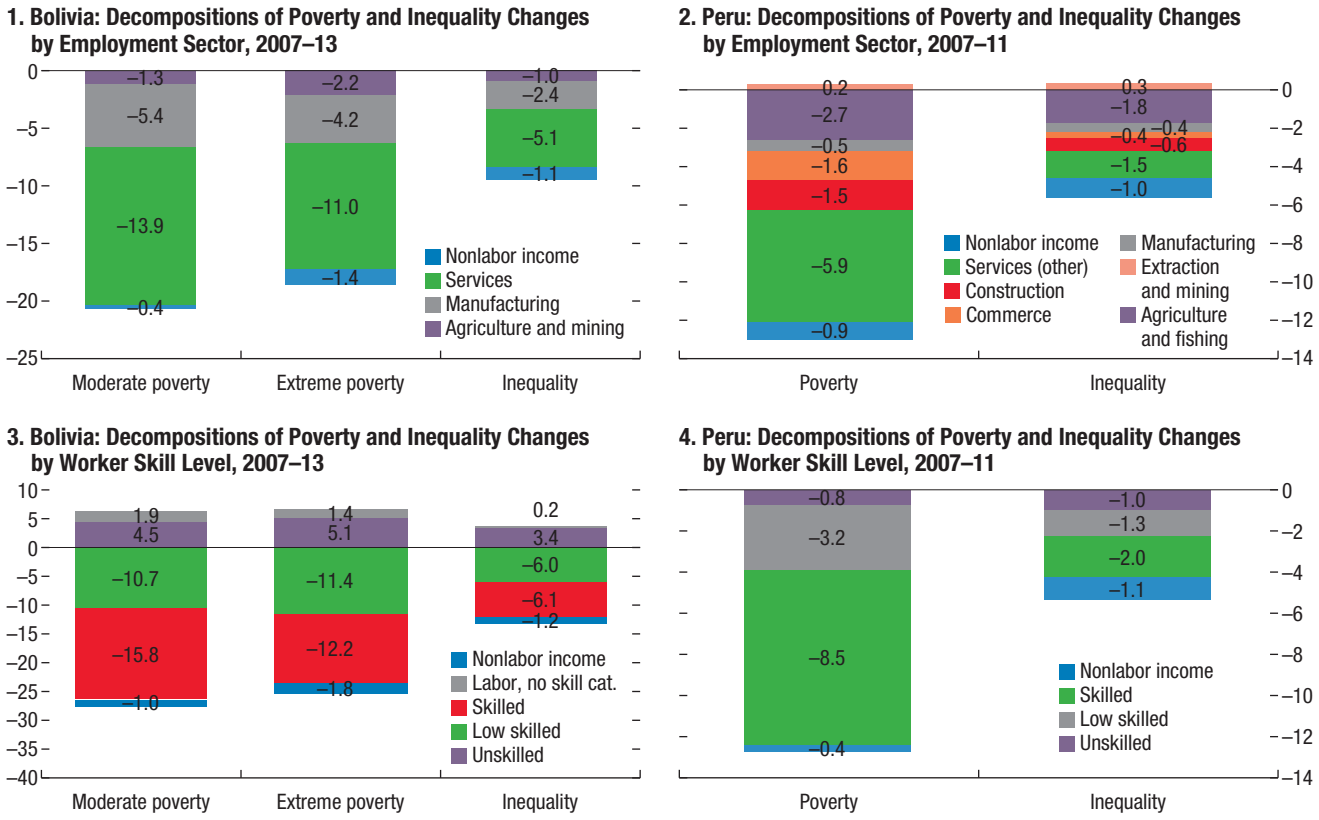
This section studies the differences between commodity-producing and non-commodity-producing regions within Brazil and Bolivia. Both Brazil and Bolivia produce commodities with a range of labor intensity and redistribute a large share of the commodity windfall to producing regions.

[23]A decline in manufacturing employment has been a phenomenon not only in commodity exporters (see Chapter 3 of the April 2018 *World Economic Outlook*).

[24]See Vargas and Garriga (2015) for more details on the Shapley decomposition for Bolivia.

[25]For example, in Peru, skilled workers make up about a third of the poor, with many close to the national poverty line.

Figure 5.18. Shapley Decompositions of Poverty and Inequality by Employment Sector and Skill Level for Bolivia and Peru



Sources: Encuesta Nacional de Hogares (ENAHO) household Surveys for Peru; Programa de Mejoramiento de las Encuestas y Medicion sobre Condiciones de Vida (MECOVI) household surveys for Bolivia; and IMF staff calculations.
Note: Gini coefficient change based on rescaled gini coefficients in the range (0–100); Poverty changes in percentage points. Unskilled (never attended school or incomplete primary education); low skilled (complete primary or incomplete secondary education); skilled (complete secondary, incomplete tertiary, or complete tertiary education). Cat. = category.

Did Poverty Fall across the Whole Country or Only in Certain Regions?

Based on census data, poverty reduction was broad-based in both Bolivia and Brazil, with the entire municipal poverty distribution shifting toward less poverty during the boom period (left shift in Figure 5.19).[26] Indeed, poverty fell in 97 percent of Bolivian municipalities and in 99 percent of Brazilian municipalities between the two census rounds.[27] On average, poverty fell by 14 percentage points in Bolivian municipalities and by 18 percentage points in Brazilian ones.

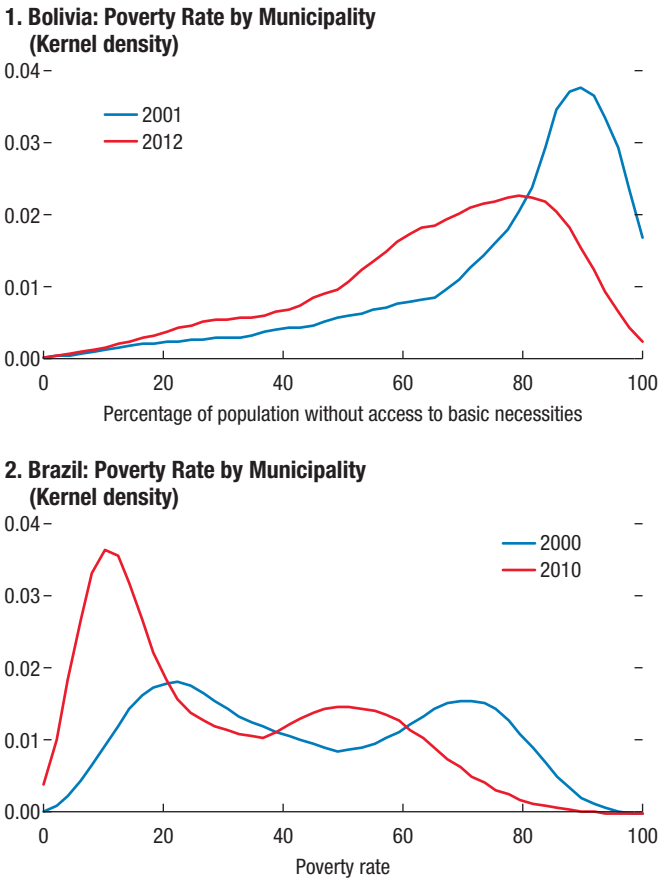
Did Municipalities Producing Natural Resources Improve More than Others?

For Brazil, information from the national oil and gas regulator (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis - ANP) and the Ministry of Mining were combined to construct the real value of natural resource production per capita for each municipality (Figure 5.20). For Bolivia, data at this level of precision were not

[26]Population census data are used because household survey data are generally not representative at the municipal level. Typically, such data are only available at one-decade intervals (2001 and 2012 for Bolivia; 2000 and 2010 for Brazil). Importantly, poverty measures from the Brazilian and Bolivian censuses are not directly comparable. Specifically, the Bolivian population census does not provide data on monetary income, so it is not possible to calculate inequality or a standard income-based poverty measure. To capture poverty, measures of access to basic necessities were used (sanitation, water, electricity, adequate living space, etc.). See Feres and Mancero (2001).

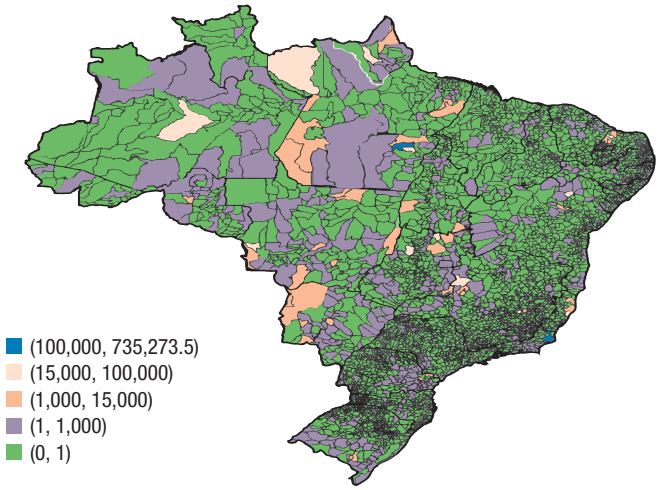
[27]The "hump-shape" in the Brazilian distribution mostly reflects large differences between the south and north of the country, with much higher poverty in the north and northeast than in other regions.

Figure 5.19. Poverty Rate Density Distributions by Municipality in Bolivia and Brazil



Sources: Instituto Brasileiro de Geografia e Estadistica (IBGE) for Brazil; Instituto Nacional de Estadistica (INE) for Bolivia; and IMF staff calculations.
Note: These figures show the density of the municipal level poverty distributions for Bolivia and Brazil.

Figure 5.20. Value of Natural Resource Production per Capita by Municipalities, 2010



Sources: Agência Nacional de Petróleo (ANP); Brazilian Mining Ministry; Instituto Brasileiro de Geografia e Estatística (IBGE) (2010); and IMF staff calculations.
Note: The map shows natural resource (hydrocarbons + minerals) production per capita in 2010 for 5,565 Brazilian municipalities. Population data from the 2010 population census. Data on hydrocarbon production volumes by field are from Agência Nacional de Petróleo (ANP). These data are assigned to municipalities based on geographic information and are valuated according to annual price data by state, also from ANP. Mineral production values data are from the Brazilian Mining Ministry. Values are in constant 2010 Brazilian reais.

available. Instead, a list of all municipalities that produce either hydrocarbons or minerals was constructed, without obtaining the precise volume or value of production.

In both countries, many municipalities produce natural resources, but in terms of the total volume and value, production is regionally concentrated, creating a relatively small group of municipalities with high per capita natural resource production. For example, out of Brazil's more than 5,500 municipalities, the top 20 producers account for 75 percent of total production. In Bolivia, the region of Tarija produced about 70 percent of total natural gas in 2012.

To study the impact of natural resources, the change in poverty in producer municipalities is compared to the change in poverty in other municipalities, controlling for other factors (see Annex 5.1 for details of the identification strategy).

Poverty fell by more in natural resource municipalities (Table 5.3). For Brazil, higher real values of natural resource production are associated with larger declines in poverty, with producer municipalities reducing poverty by 1.4 percentage points on average relative to nonproducer ones.[28] For Bolivia, the natural resource municipalities reduced poverty by 2.7 percentage points more than other municipalities. Regarding inequality, the results are mixed for Brazil, with statistical significance

[28]To construct the natural resource producer dummy variable in Brazil, a municipality is defined as a producer if it produces more than the mean amount of natural resources per capita (this essentially captures larger producers as opposed to municipalities with only, for example, very small-scale mining).

Table 5.3. Impact of Natural Resource Boom on Producer Municipalities in Brazil and Bolivia

	Brazil		Bolivia
	Poverty	Gini Coefficient	Poverty
Impact of increase in real per capita natural resource production (range for top 20 increases)	−0.39*** to −9.1***	0 to −0.05**	N/A
Impact of being a natural resource producer municipality (dummy variable analysis)	−1.44***	0	−2.75*

Source: IMF staff calculations.
Note: *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

depending on which technique is used. This is consistent with the earlier cross-country results of a clearer result on the poverty front.

In summary, the social gains in Brazil and Bolivia were broad-based across municipalities, but natural resource producers experienced larger gains.

What Can within-Country Analysis Show about the Channels through Which the Commodity Boom Affected Poverty and Inequality?

To isolate the fiscal impact from other channels, natural resources can be divided into offshore oil and gas production and domestic mineral mining for Brazil; and into onshore gas megacampos[29] and mineral mining for Bolivia.[30] Mineral mining tends to yield smaller fiscal windfalls but generates substantial labor demand in the local extractive sector. Offshore oil and gas has a minimal labor demand effect (and labor may not even be located in the municipality closest to the rig), but generates important fiscal windfalls for municipalities closest to the oil field (see Annex 5.2 for details). Hence, for Brazil, the impact of offshore oil and gas production proxies the pure fiscal channel while mining picks up the combined impact. This can be seen in Table 5.4. A similar logic applies to the distinction between gas megacampos and mineral mining in Bolivia, although the analysis is less precise because neither the value or volume of production nor exact fiscal windfalls at the municipal level are known.

In Brazil, the pure fiscal impact (as measured by the impact of offshore oil and gas production) leads to some reduction in poverty and a marginal increase in labor formality (Figure 5.21).[31] It also

Table 5.4. Impact of Mineral and Offshore Hydrocarbon Production on Municipal Revenues and Extractive Sector Employment

	(1) Natural Resource Royalties per Capita	(2) Current Revenues per Capita	(3) Share of Workers in Extractive Industries
Change in mineral production per capita	0.0174***	0.0241***	1.33e-05***
	(0.000922)	(0.006010)	(0.000004)
Change in offshore oil and gas production per capita	0.0209***	0.0248***	−2.56E-06
	(0.001300)	(0.002640)	(0.000002)
Geographic controls	Yes	Yes	Yes
Dependent variable in 2000	Yes	Yes	Yes
Change in dependent variable between 1991 and 2000	No	No	No
State fixed effects	Yes	Yes	Yes
Observations	5,507	4,982	5,507
R-squared	0.886	0.834	0.223

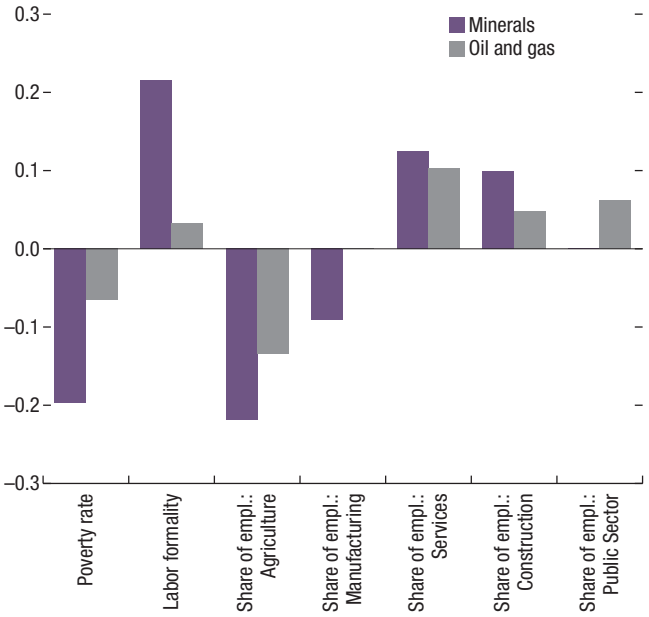
Source: IMF staff calculations.
Note: *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

[29]So-called gas "megacampos" are the largest gas fields in Bolivia.

[30]For each country there is an additional category (onshore oil and gas production for Brazil and non-megacampo onshore oil and gas production for Bolivia) for which no impact is found (production is significantly smaller), so that category for each country is omitted from the discussion.

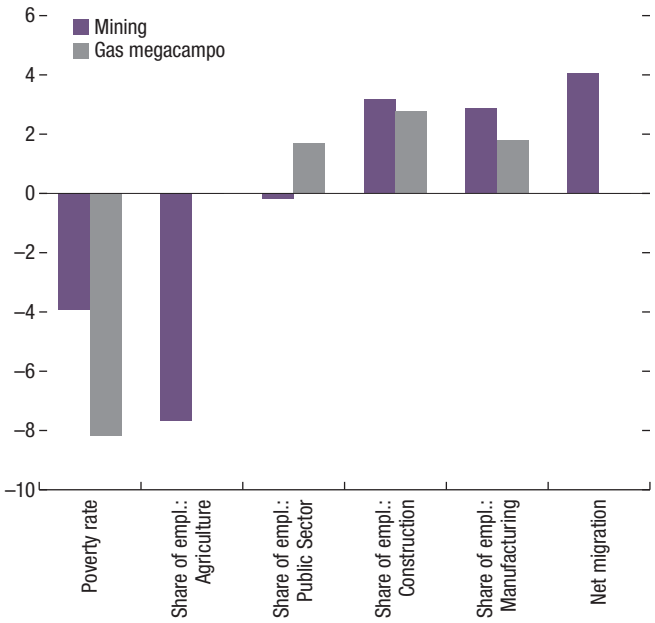
[31]All coefficients shown in Figures 5.21 and 5.22 are statistically significant. When a coefficient is not statistically significant the corresponding bar chart is zero (for example, public employment in Brazilian mineral municipalities).

Figure 5.21. Brazil: Impact of One Standard Deviation Increase in Natural Resource Extraction at the Municipal Level
(Percentage points)



Sources: Instituto Brasileiro de Geografia e Estatística (IBGE); and IMF staff calculations.
Note: The change between the 1991 and 2000 census is included in the regressions as a control variable when available. Standard errors are clustered at the state level. Estimated coefficients are set to zero when they are not significant at least at the 10 percent level. When they are significantly different from zero, the graph shows the impact of a one-standard deviation increase in the value of natural resource production per capita between 2000 and 2010.
Empl. = employment.

Figure 5.22. Bolivia: Impact of Natural Resource Extraction at the Municipal Level
(Percentage points)



Sources: Instituto Nacional de Estadistica (INE); and IMF staff calculations.
Note: Empl. = employment.

leads to a shift of labor out of agriculture and into nontradables, essentially services and construction, because of the increased fiscal resources being partly used for public investment.[32] Additionally, part of the fiscal windfall is used to increase public sector employment. In mineral municipalities, the labor market effects are much larger. Labor formality increased significantly and labor shifted from agriculture and manufacturing into construction and services. The results thus point to an important role for both fiscal and market channels, but especially the latter, in reducing poverty.[33]

Similarly, in Bolivia, while poverty fell by more in gas megacampo municipalities, the labor market impact is greater in mining municipalities given that the fraction of agricultural employment decreased significantly and net migration increased (Figure 5.22). In megacampo municipalities, public sector employment increased significantly, in line with the Brazilian results, and pointing to the fiscal windfall being used for public employment. Indeed, the increase in public employment is notable considering the small share of public sector workers in the average Bolivian municipality—the increase of around 2 percentage points in public sector employment in gas megacampo municipalities is greater than one standard deviation.

[32]From regressions with local budget data, fiscal windfalls tend to increase mainly capital expenditure but also current expenditure, including wages.

[33]The effects are small for most municipalities—a one standard deviation increase in the value of mineral production per capita reduces the poverty rate by only 0.2 of a percentage point. For the big producers, however, the impact is economically significant, with an estimated reduction in poverty of between 3 and 9 percentage points for the top five producers.

Overall, the results for Brazil and Bolivia are in line with growing evidence from other within-country studies in Latin America.[34]

Fiscal Decentralization in the Context of Large Commodity Windfalls

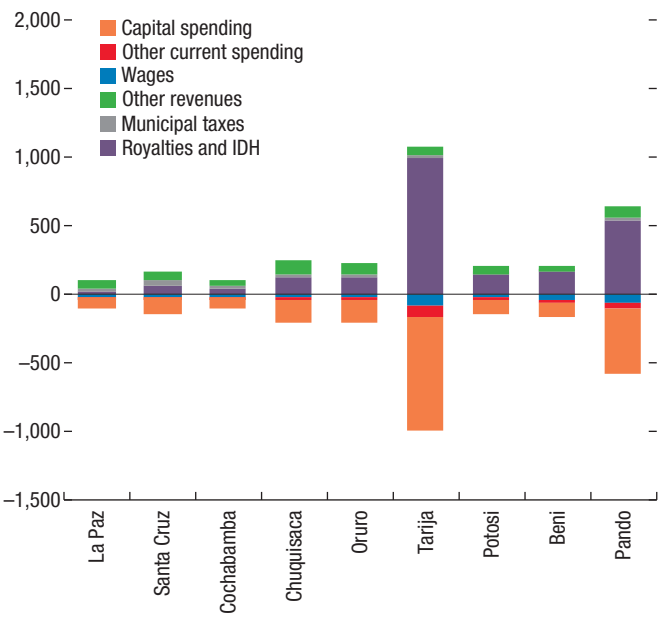
In Latin America, Bolivia, Brazil, and Peru redistribute large parts of the fiscal windfalls from natural resource extraction back to subnational producers. Colombia also redistributes royalties to subnationals but with less focus on producers since a reform in 2012 (see Annex 5.2 for further details, including on the frameworks in advanced economies such as Canada and Norway).

While fiscal windfalls do have some beneficial effects for producer regions, sharing large amounts of natural resource revenues with subnational producers has several conceptual drawbacks. First, it is not clear whether geographical and geological differences between regions should determine fiscal envelopes given the large horizontal inequities this implies. Second, the volatile nature of natural resource revenues calls for careful intertemporal planning, which is even harder to achieve at the local level than at the national level. Third, resource revenues are essentially transfer revenues from a local government's perspective and thus do nothing to encourage accountability and the building of own-revenue bases. Fourth, when the fiscal windfall is large in per capita terms, it can lead to problems with absorptive capacity as well as governance (IMF 2009). Of course, the environmental impact of mining activity needs to be considered, and creates a case for an additional transfer to producing regions.

Consider the departmental budget breakdown of Bolivia for 2012 (Figure 5.23). The main gas region (Tarija) has a population share of around 5 percent. Yet its budget accounted for over a third of all departmental revenues and wages, and nearly half of all departmental capital expenditure. In Peru in the same year, the main natural-resource-producing departments (Moquegua and Cusco) received more than S/ 2,000 per capita in commodity-related transfers (canons), while some other departments received less than S/ 1 per capita. Indeed, 12 of the 183 provinces in Peru receive about 50 percent of canon revenues (Santos and Werner 2015).

In both Peru and Bolivia, some local governments with the biggest windfalls per capita began to accumulate large deposits during the boom, while acute investment needs existed in other regions (Santos and Werner 2015, Chapter 10). Since the boom, the most important commodity-producing regions in Bolivia and Brazil, Tarija and Rio de Janeiro, respectively, have suffered severe fiscal sustainability problems. This is consistent with the drawbacks noted above, and several papers provide evidence that governance problems and/or capacity constraints at the subnational level

Figure 5.23. Bolivia: Departmental Budgets, 2012
(US dollars per capita)



Sources: National authorities; and IMF staff calculations.
Note: IDH = Impuesto Directo a los Hidrocarburos.

[34]See Benguria, Saffia, and Urzua (2017) and Cavalcanti, Da Mata, and Toscani (2016) on Brazil; Pellandra (2015) and Alvarez, Garcia, and Ilabaca (2017) on Chile; and Aragon and Rud (2013) and Loayza and Rigolini (2016) on Peru. Cust and Poelhekke (2015) provide a review of the literature.

often limit the effectiveness of public spending, especially in the context of high per capita natural resource revenues.[35]

Given this, when the opportunity exists for substantive reforms to decentralization frameworks, those reforms should aim to minimize horizontal inequities, avoid boom-bust revenue cycles at the local level, and, crucially, clarify the goals of the revenue-sharing agreement. To help avoid boom-bust cycles leading to large spending shocks, further use could be made of precautionary stabilization funds, such as in Chile, Colombia, and Norway. To reduce horizontal inequities, the reform of royalty-sharing arrangements in Colombia in 2012 is a good example of what can be done.[36]

Notwithstanding the Colombia example, achieving consensus on larger reforms of revenue-sharing arrangements is difficult. Other steps can still play an important role, including building capacity at the subnational level and encouraging local governments to build their own-revenue bases to reduce reliance on transfers (for example, via property taxes). Transfer arrangements should also be made as transparent as possible to facilitate planning and oversight. Such measures will increase ownership and accountability, and reduce revenue volatility. Finally, nonresource transfers can potentially be used to offset some of the horizontal inequities by using measurable criteria of local needs in some of the allocation formulas (for example, the equalization scheme in Canada).

Can Social Progress Be Sustained with Lower Commodity Prices?

To sum up, Latin America made tremendous progress in reducing inequality and poverty in the 2000s, especially in commodity-exporting countries. Much of the decline in poverty and the Gini coefficient was because labor income inequality fell, linked to a declining skills premium and the expansion of services and lower-skill jobs. But increasing social transfers did also play a role.

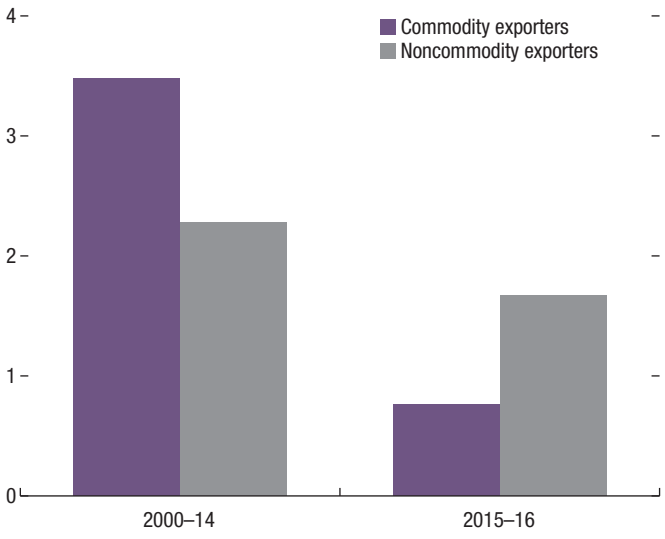
Looking ahead, given that commodity prices have been significantly lower since the end of the boom in 2014, there are concerns that the social progress is under threat, especially in commodity exporters. Indeed, post 2014, employment growth has slowed much more in commodity exporters than importers, while real wage growth has been negative for all skill groups (Figures 5.24 and 5.25). The poverty cycle has also turned in some commodity exporters, with increases in poverty rates in Brazil and Paraguay. As discussed earlier, the impact of commodity cycles on inequality is not as strong as on poverty. Nonetheless, inequality in commodity exporters has largely moved sideways post 2014 following the tremendous reduction in the boom years. At the same time, fiscal space in many commodity exporters has fallen, given a decline in commodity-related revenues and slowing growth. All this suggests that absent policy measures, lower commodity prices carry with them a significant risk of slower poverty reduction and possibly higher inequality in commodity exporters in the coming years.

How should commodity exporters respond to this challenge? While the channels by which commodity prices affected inequality and poverty during the boom will also be present in reverse during the post-boom period, they need not be symmetric. For example, many commodity exporters saw significant migration to urban areas from rural areas. This may not reverse in the post-boom period given high costs associated with moving. Moreover, countries that built up fiscal cushions during the boom can use the buffers in the post-boom period to smooth the adjustment to lower commodity prices. Some countries, such as Bolivia and Peru, have been doing this already, while the adjustment in countries without fiscal buffers (such as Ecuador) has been more difficult.

[35]See Caselli and Michaels (2013) for Brazil; Arrellano-Yanguas (2011) for Peru; and Perry and Olivera (2009) for Colombia.

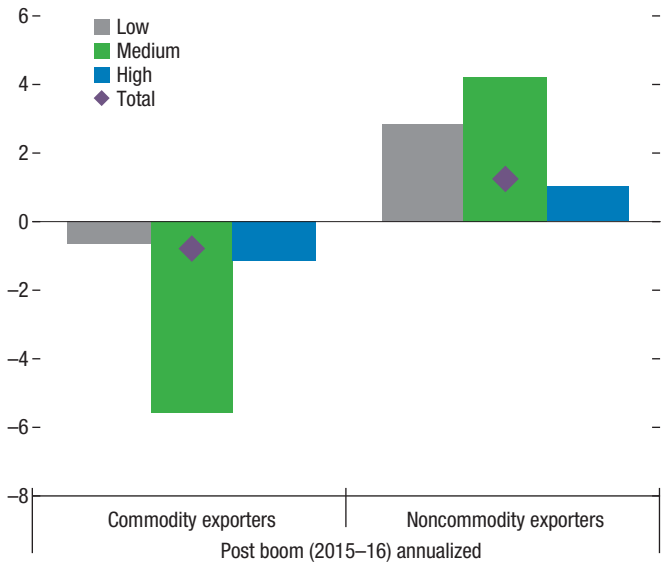
[36]Colombia's royalty sharing arrangements are not fully integrated into the annual budget. A unified budget would be a preferable option for most countries.

Figure 5.24. Total Employment Growth
(Percent)



Source: Inter-American Development Bank, SIMS database.

Figure 5.25. Real Labor Income Growth by Educational Level
(Percent)



Source: Inter-American Development Bank, SIMS database.

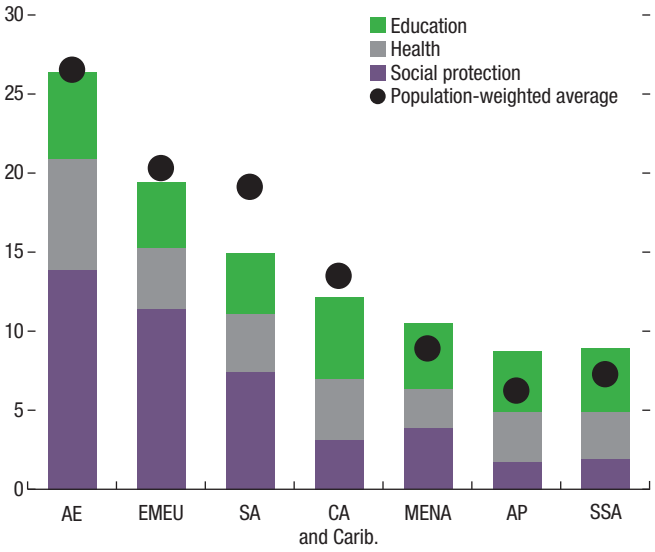
And as shown in the social progress made in many commodity importers in Latin America despite a negative commodity terms-of-trade shock, there is still a clear role that other policies can play to mitigate the impact of lower commodity prices on social progress:

- For central governments, especially in countries with limited fiscal buffers, there is potential to maintain the quality of social and infrastructure spending by increasing revenues and reprioritizing spending.[37] Indeed, on the social protection side, Latin America already spends significantly less than emerging Europe or advanced economies (Figure 5.26). Space to maintain such spending levels could, for example, be created by (1) increasing revenues from progressive personal income taxes, which as Figure 5.27 shows tend to be less in Latin America compared to other regions;[38] and (2) reducing universal price subsidies (for example, energy subsidies), which are present in Latin America and typically highly regressive, although at lower levels than in other emerging regions (Figure 5.28). Increasing the efficiency of spending could also play a role. For example, existing social transfers could be better targeted in many countries by making further use of means testing where feasible (IMF 2014).
- The allocation of revenue-capacity and spending responsibilities at different levels of government could be improved. Enhancing capacity at the local level is essential. Apart from reforming formulas for revenue-sharing

[37]Latin American tax and transfer systems are substantially less progressive than such systems in Organisation for Economic Co-operation and Development countries (Lustig 2012; Hanni, Martner, and Podesta 2015; OECD 2018). Lustig (2012) finds that in some Latin American countries, the net income of the poor and near-poor can be lower than it was before taxes and cash transfers. In-kind transfers in education and health, however, are progressive throughout the region.

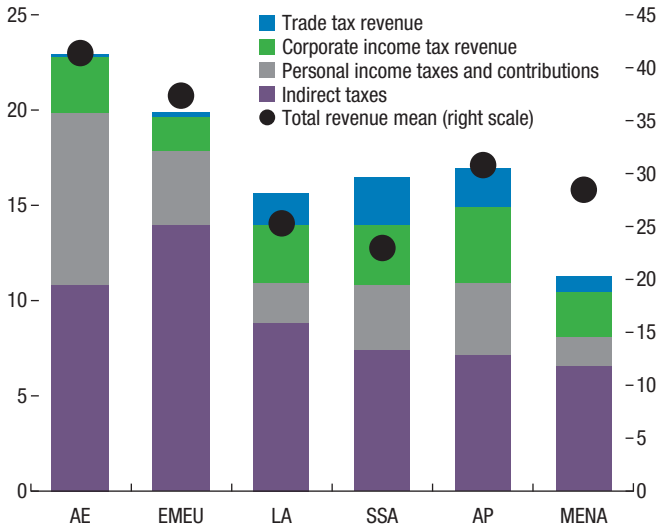
[38]Hanni, Martner, and Podesta (2015) find that while maximum legal personal income tax rates in Latin America range from 25 to 40 percent, the effective tax rates tend to be substantially lower, with the effective rate for the top decile only at 5.4 percent on average. Consequently, the redistributive impact of personal income taxes in Latin America is very limited, achieving a reduction of just 2 percent in income inequality, which contrasts markedly with the countries of the European Union, whose distribution improves more than 12 percent after income taxes (OECD 2018). IMF (2014) recommends progressive personal income taxes as an important tool to achieve fiscal redistribution.

Figure 5.26. Composition of Social Spending, 2010
(Percent of GDP)



Sources: IMF, Fiscal Affairs Department database; and IMF staff calculations.
Note: AE = advanced economies; EMEU = emerging Europe; SA = South America; CA and Carib. = Central America and the Caribbean; MENA = Middle East and North Africa; AP = Asia Pacific; SSA = sub-Saharan Africa.

Figure 5.27. Global Revenue Mix by Regions, 2015
(Percent of GDP)

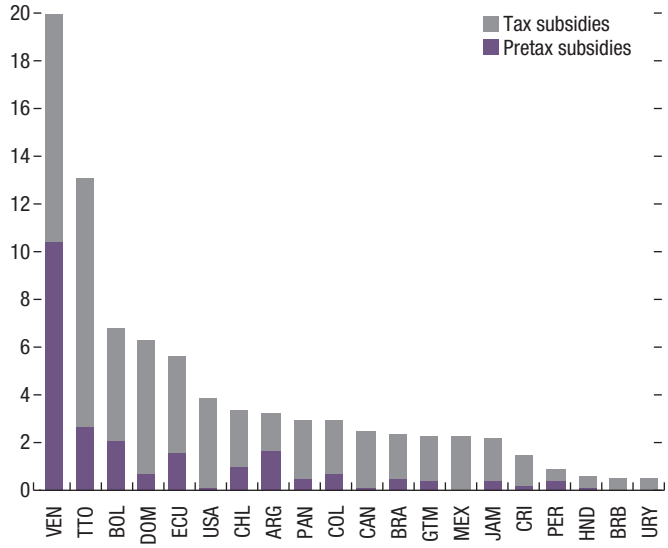


Sources: IMF, Fiscal Affairs Department database; and IMF staff calculations.
Note: AE = advanced economies; EMEU = emerging Europe; LA = Latin America; MENA = Middle East and North Africa; AP = Asia Pacific; SSA = sub-Saharan Africa.

to take greater account of spending needs (for example, population size and poverty levels), thought should be given to greater use of stabilization funds, with clear rules and governance arrangements, in commodity exporters.

- Increasing the flexibility of labor markets and deploying policies aimed at retooling workers would help smooth the necessary adjustment to the rebalancing of demand caused by lower commodity prices. And while always challenging, continuing structural reforms to help diversify the production base would increase the resilience of commodity exporters to commodity price shocks.
- Given that better education was an important structural factor that helped reduce inequality and lift people out of poverty during the boom, pushing for further improvements in the quality of education should remain a priority, although gains from any policy measures will take time and only accrue in the longer run.

Figure 5.28. Subsidies in Latin America, 2015
(Percent of GDP)



Sources: IMF, Fiscal Affairs Department database; and IMF staff calculations.
Note: For International Organization for Standardization (ISO) country codes used in data labels, see page 115.

Latin America, and especially South America, faces an important challenge in managing the impact of lower commodity prices on social progress, especially their impact on the inequality and poverty reductions since the turn of the century. Implementing the right policies will be key to meeting this challenge.

Annex 5.1. The Local Impact of Natural Resource Booms in Latin America: Methodology

Brazil: The following equation is estimated to capture the local impact of the resource boom:

$$\Delta y_{i,2010} = \alpha + \beta \Delta x_{i,2010} + \gamma \Delta y_{i,2000} + \delta y_{i,2000} + \theta_s + \rho Z_i + \epsilon_i, \quad \text{(A5.1.1)}$$

in which $\Delta y_{i,2010}$ is the change in the dependent variable between 2000 and 2010 in municipality i and $\Delta x_{i,2010}$ is the change in the explanatory variable (natural resource production per capita measured in constant 2010 Brazilian reais) in municipality i. β is the coefficient of interest. We include both the level of the dependent variable in 2000 ($y_{i,2000}$) to capture convergence effects, and the change in the dependent variable between the previous census rounds (1991 to 2000 – $\Delta y_{i,2000}$) to control for municipality-specific pretreatment trends. Additionally, we include state fixed effects θ_s to account for regional dynamics and a vector of geographic controls Z_i that measure whether a municipality is located on the coast, for example. Standard errors are clustered at the state level.

Bolivia: The following simple difference-in-difference regression model is estimated using data from the 2001 and 2012 population census:[1]

$$y_{it} = \alpha + \gamma EM_i + \theta T_t + \rho(EM_i * T_t) + X'_{it}\beta + \varepsilon_{it}, \quad \text{(A5.1.2)}$$

in which y_{it} is the dependent variable, EM_i is a dummy variable that is 1 for extractive sector municipalities, T_t is a time dummy that is 1 in 2012, and the interaction $D_{it} = (EM_i * T_t)$ is the treatment variable, so that ρ is the coefficient of interest. X'_{it} is a vector of municipality and time-varying covariates. A differentiation is made between mineral producers, "small" oil and gas producers, and the natural gas megacampo producers.

Since data prior to 2001 are not available for Bolivia, the parallel trend assumption or control for pretreatment trends in the estimation cannot be explicitly tested. To improve identification, the control group is limited to those municipalities that have the best covariate overlap with the treatment group. In other words, the aim is to compare extractive sector municipalities to municipalities that prior to the resource boom looked very similar to them. To do this, an entropy balancing technique is used (Hainmueller and Xu 2013). The method assigns weights between 0 and 1 to municipalities in the control group to achieve optimal covariance overlap and is well suited to the setup with many more control municipalities than treatment municipalities.[2]

[1]See Toscani (2017) for more details.

[2]Entropy balancing achieves virtually perfect overlap both for the first and the second moment of the distribution. Like the now-popular synthetic control method, entropy balancing implicitly makes a strong linearity assumption, however.

Annex 5.2. Details of Natural Resource Revenue Sharing in Latin America and Elsewhere

Natural resource revenues are largely centralized in Chile, Ecuador, Mexico, Norway, Trinidad and Tobago, and Venezuela, with either very limited or no redistribution to subnational producers. In the three case study countries and Colombia, significant amounts go to subnational governments (see Viale 2015 for an overview). In Canada, provinces manage nonrenewable natural resources.

Bolivia: Out of the total 18 percent hydrocarbon royalty, 11 percentage points go to producing departments, 6 percentage points stay with the central government, and 1 percentage point goes to the lightly populated departments of Pando and Beni. The 32 percent hydrocarbon tax (Impuesto directo a los hidrocarburos—IDH) is allocated in a more complicated way, going to both producing and nonproducing departments as well as municipalities, with 20 percentage points remaining with the central government. Mining royalties are distributed only to producing departments and municipalities, with an 85–15 split between the two. For more details, see IDB (2015).

Brazil: Sixty-five percent of mineral royalties are distributed directly to the producing municipality, while 23 percent go to the producing state and the remainder to the federal government. For oil and gas, the allocation formula is much more complicated, but since the 1997 royalties law, substantial amounts of oil and gas revenues have been distributed to municipalities that either host an onshore oil and gas field or face on offshore oil and gas field. In some cases, royalties can account for over 50 percent of a municipality's revenues.

Canada: In addition to being subject to the federal and provincial corporate income tax, natural resource income is subject to mining taxes, royalties, and land taxes at the provincial level. There is also a fiscal stabilization program that enables the federal government to provide financial assistance to any province faced with a year-over-year decline in nonresource revenues greater than 5 percent and caused by an economic downturn. Finally, Canada has an equalization program to reduce fiscal disparities between provinces. The equalization transfers are unconditional and determined by measuring provinces' ability to raise revenues.

Colombia: Prior to the 2012 reform, roughly 80 percent of royalties went directly to producer departments and municipalities, which only had 17 percent of the population. Following the 2012 reform, this was reduced to roughly 10 percent, with the remainder of the resources assigned to a number of central funds with specific goals. Around 30 percent is saved in a stabilization fund, 10 percent goes to a science and innovation fund, 10 percent to a regional pension fund, and the remainder is allocated to subnational investment projects with a relatively complex distribution formula based on poverty levels and other factors. As a result, 1,089 municipalities received a share of commodity royalties in 2012 compared to 522 in 2011.

Norway: Government revenues from petroleum activities are transferred to the Government Pension Fund Global. Under the fiscal rule, petroleum revenues are phased into the economy gradually. Specifically, over time government spending must not use any of the fund's capital, only its expected real return, which is currently estimated at 3 percent. The fiscal rule also provides for petroleum revenue spending to be increased during economic downturns and decreased during economic upturns.

Peru: Overall, about 60 percent of fiscal revenues from the mining sector go to subnational governments, mainly consisting of mining sector corporate income taxes (canon minero) and mining royalties. There are various canons and they are only transferred to the department where production of the natural resource takes place. Resources are then further distributed within producing departments, resulting in producing provinces and municipalities receiving a large share of the pie. See Santos and Werner (2015, Chapter 10) for more details.

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