Chapter 5

Ethiopia

Xinshen Diao, Alemayehu Seyoum Taffesse, Paul Dorosh, James Thurlow, Alejandro Nin Pratt, and Bingxin Yu

Agriculture is perhaps the most important economic sector for sustainable development and poverty reduction in Ethiopia. More than 85 percent of the population live in rural areas and depend crucially on agriculture for their livelihoods. The sector also accounts for more than 40 percent of national gross domestic product (GDP) and 90 percent of exports, and it provides basic needs and income to more than 90 percent of the country's poor population. In recent years the agricultural sector has driven economic growth in the overall economy while also improving food security and reducing poverty (World Bank 2007).

Although Ethiopia remains an agrarian economy, its agricultural development has been challenged by a large and rapidly growing population combined with limited and deteriorating land resources. Agricultural growth has also fluctuated considerably and, until recently, positive growth was rarely maintained for more than three consecutive years. There have thus been many doubts about agriculture's potential contribution to economic growth and poverty reduction in the country. Although the role of agriculture in leading industrialization and economic transformation has been debated for many years, it has remained fairly political and has not been well served by rigorous empirical evidence. As the second largest country in Africa, one of the key questions dominating the policy debate has been the con-

This chapter is based on research conducted under the project "The Economic Importance of Agriculture for Sustainable Development and Poverty Reduction," managed by the Organization for Economic Cooperation and Development. That study was financed by the Government of the Netherlands. Any errors are the responsibility of the principal authors.

straints that the diminishing size of farm plots is imposing on agriculture's growth potential. Moreover, although most of the population, particularly the poor, lives in rural areas, some observers doubt whether small-scale agriculture can continue to significantly reduce poverty.

Even among agriculture's proponents debate exists about what kind of agricultural growth should be pursued. Should the government promote large-scale agriculture, which is perhaps more likely to adopt modern technology and thus be more productive and competitive? Alternatively, should the government focus on smallholder agriculture, which might benefit the rural population more directly? More specifically, should specific policy supports or interventions focus on export-led agriculture targeting niche foreign markets, or should staple crops and livestock be emphasized to encourage broader-based agricultural growth? This chapter contributes to this ongoing debate in Ethiopia by evaluating the role of agricultural growth in future economic transformation and poverty reduction. The analysis below quantitatively measures agriculture's economywide linkages and the impact of growth in different agricultural subsectors on poverty reduction. As with other chapters in this volume, the analysis makes use of a spatially disaggregated recursive dynamic computable general equilibrium (DCGE) model (see Chapter 2).

The chapter is structured as follows. We first review Ethiopia's national development strategies and the recent performance of its agricultural sector. We then describe the structure of the Ethiopian DCGE model and the data sources used during calibration. The model results are then presented for the baseline growth scenario and the accelerated agricultural growth scenarios. Unlike other case studies in this volume, no detailed investment analysis is done for Ethiopia. However, the final section draws together our findings and summarizes their implications for future national and agricultural development strategies in Ethiopia.

Agriculture in Ethiopia

Overview of Agricultural Policies and Development Strategies

Although Ethiopia has experienced three major political regime changes in recent history, the importance of agriculture has been recognized by each government throughout this period. However, the policies pursued by successive administrations have resulted in very different outcomes. Only over the past two decades has the country's agricultural development strategy become more focused and policies more consistent with promoting sustainable improvements in agricultural productivity. The Derg regime (1975–1991) was characterized as an agrarian socialist regime with widespread government controls in all economic spheres, including agriculture. After overthrowing the imperial regime of Haile Selassie, the Derg announced

an agrarian reform program in which all rural land was made the property of the state. Almost all other assets in the industrial and services sectors were nationalized, including factories, financial institutions, large hotels, and many residential buildings.

The agrarian reform prohibited all tenancy relations and provided a large number of rural households with access to land for cultivation. However, restrictions on plot size per family, prohibition of hired agricultural labor, intensification of collectivization, establishment of large-scale state farms, and a series of other antimarket and state-controlled economic instruments created negative incentives for farmers and distorted market mechanisms guiding land allocation and productivity improvements. Although this central planning development strategy identified agriculture as a key engine of growth and targeted improved food security and agricultural productivity, most of these targets remained on paper, and few were achieved. As a result, the economy was approaching a macroeconomic crisis by the end of the Derg regime—a fact that was compounded by the onset of Ethiopia's worst famine on record in 1984.

Weak policies and political repression during the Derg period not only generated disastrous economic outcomes but also led to civil conflict. The Derg regime collapsed in 1991, and the Ethiopian People's Revolutionary Democratic Front (EPRDF) assumed power. The years that followed witnessed a radical shift in government policy. Both the transitional government (1991–94) and the EPRDF government initiated extensive economic reforms, including market liberalization and a structural adjustment program. At the macro level, import protection was reduced, foreign exchange controls were eased, and state-owned enterprises were privatized, including banks. In agriculture, cooperative membership was made compulsory, grain delivery was discontinued, and fertilizers subsidies were discontinued. Consequently, the direct role of the state in economic activity declined dramatically.

The most important development strategy that emerged under the transitional government was the adoption of Agriculture Development Led Industrialization (ADLI), which has remained a central component of the current government's development program until recent years. ADLI focuses on the productivity growth of small farms and on labor-intensive industrialization. This strategy has been justified by agriculture's large contribution to national income, employment, and exports, and by the gaps between rural and urban incomes.

Consistent with ADLI, in the mid-1990s, the government refocused its policy reforms from market-based mechanisms ("getting the prices right") to more active public investment in agricultural extension aimed at boosting productivity through the widespread introduction of modern technology (MOFED 2002). An extensive extension program—the Participatory Demonstration and Training Extension

System (PADETES)—was implemented, and through this system, the government delivered off-the-shelf packages of fertilizer, improved seed, and credit, as well as information on input use and better agricultural practices to most rural smallholders. The promotion of the credit–fertilizer package was accompanied by further liberalization of fertilizer markets. By 1997, fertilizer subsidies were completely removed, and retail prices were fully liberalized, which also resulted in higher fertilizer prices. Fertilizer use increased, although diffusion and adoption rates remained disappointing, despite the vigorous promotion of the credit–fertilizer packages. Overall, agricultural output continued to fall behind population growth.

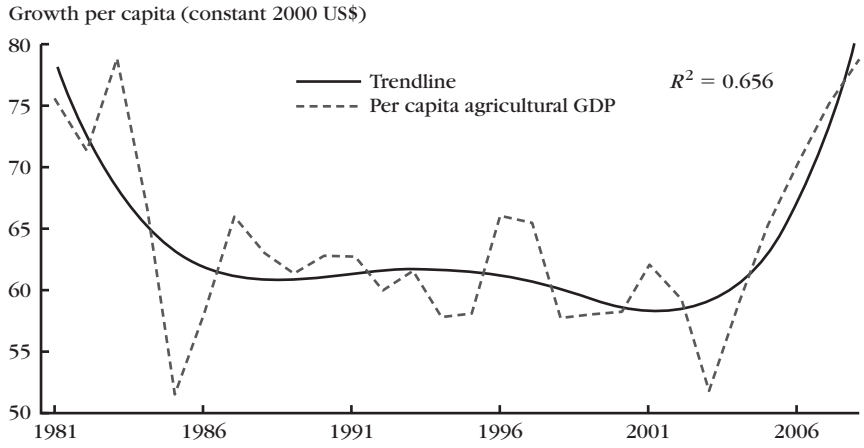
Acknowledging the limited success of PADETES, the government revisited the program and formulated an integrated rural and agriculture development strategy that was launched in 2002. The new strategy—officially known as the Sustainable Development and Poverty Reduction Program (SDPRP)—centered on the goal of poverty reduction (MOFED 2002). In line with SDPRP, the government introduced fiscal decentralization, judicial and civil service reform, and public sector capacity building. After the continuing evidence of widespread food insecurity during the drought of 2002/03, the government also implemented social safety nets, programs to build the assets of food-insecure households, land resettlement, and soil and water conservation (especially water harvesting).

The SDPRP, which covered the three years between 2002/03 and 2004/05, was the first full Poverty Reduction Strategy Paper (PRSP) developed and implemented by the Ethiopian government. It was followed by the current PRSP titled "Plan for Accelerated and Sustained Development to End Poverty" (PASDEP). PASDEP formed Ethiopia's guiding strategic framework for the five-year period 2005/06–2009/10 (MOFED 2005). PASDEP aims to significantly accelerate growth via the commercialization of agriculture and the promotion of private sector development. It focuses on several areas in setting its targets and designing interventions, including adopting a geographically differentiated strategy, addressing population growth, expanding and improving infrastructure, managing risk, and creating employment (MOFED 2005). The instruments to achieve these goals include farm-to-market roads, agricultural credit, extension services, national business plans tailored to specialized export crops (for example, spices, cut flowers, fruits, and vegetables), irrigation and multipurpose dams, land tenure security and provision of land for large-scale commercial farming, and reforms to improve the availability of fertilizer and seeds.

Recent Agricultural Performance

In recent years policy reforms, agricultural investments, and public service provisions have boosted agricultural production, particularly cereals. After 2003, Ethiopian agriculture witnessed its most rapid growth period in history. As Figure 5.1 indi-

Figure 5.1—Per capita agricultural GDP in Ethiopia, 1981–2009



Source: Authors' calculations using World Bank (2011).
Note: GDP = gross domestic product.

cates, this rapid growth has continued for at least six years, until 2009 (the last year for which data are available). Even excluding the highest growth rate of 17 percent in 2004, which reflects recovery from a major drought in 2002/03, the average annual growth rate during 2005–09 is 9.5 percent. The accuracy of these production numbers is of some concern, and a rigorous, comprehensive investigation into the sources of such rapid agricultural growth has not yet been conducted. Some evidence to support rapid agricultural growth comes from the agricultural sample surveys, whose measured cereal production growth is consistent with agricultural GDP growth rates. This recent performance has reversed the three-decade downward trend in per capita agricultural GDP.

Cereals are the dominant staples for most Ethiopians. They account for 62 percent of average daily calorie intake and for 45 percent of food expenditure for an average household. Thus, cereals, including barley, maize, teff, sorghum, and wheat, are the most important crops in Ethiopian agriculture. Although 64 percent of agricultural value-added comes from crops, more than 70 percent of cropland is devoted to cereal production. More than 11 million smallholders engage in cereal production, and total cereal production was 13.6 million metric tons in 2007/08—an increase of 4.8 million metric tons over production in 2003/04 (Table 5.1). Total cropland area allocated to cereals also expanded by 27 percent, from 6.8 million hectares in 2003/04 to 8.8 million hectares in 2007/08. At the same time, average cereal yield exhibited a 22 percent growth from 1.3 mt/ha in 2003/04 to 1.6 mt/ha in 2007/08.

Table 5.1—Cereal production in Ethiopia, 2003/04 and 2007/08

	2003/04			2007/08		
Cereal	Area (thousands of hectares)	Output (thousands of metric tons)	Yield (metric tons/ hectare)	Area (thousands of hectares)	Output (thousands of metric tons)	Yield (metric tons/ hectare)
Produced with and without modern inputs						
Barley	911	1,071	1.18	985	1,355	1.38
Maize	1,300	2,455	1.89	1,767	3,750	2.12
Teff	1,985	1,672	0.84	2,565	2,993	1.17
Wheat	1,075	1,589	1.48	1,425	2,314	1.62
Millet	303	304	1.00	399	538	1.35
Sorghum	1,242	1,695	1.36	1,534	2,659	1.73
Total	6,816	8,786	1.29	8,675	13,609	1.57
Produced with modern inputs						
Barley	390	492	1.26	499	688	1.38
Maize	783	1,518	1.94	1,106	2,441	2.21
Teff	1,059	919	0.87	1,763	2,076	1.18
Wheat	687	1,108	1.61	1,024	1,743	1.7
Total	2,919	4,037	1.38	4,392	6,948	1.58
Produced without modern inputs						
Barley	521	579	1.11	486	667	1.37
Maize	517	937	1.81	661	1,309	1.98
Teff	926	753	0.81	802	917	1.14
Wheat	388	481	1.24	401	571	1.43
Total	2,352	2,750	1.17	2,350	3,464	1.47

Source: Authors' calculation using data aggregated from Ethiopian Agriculture Sample Survey (Ethiopia, CSA 2004, 2008a, 2008b).

Teff is the favored staple crop for both rural and urban consumers at all income levels and has high income elasticity of demand relative to other cereals (see Table 5A.1 in the appendix to this chapter). Not surprisingly then, more than 30 percent of total cereal land in 2007 was allocated to teff production. The next most important foodcrop is maize, which occupies 20 percent of total cereal land, followed by sorghum (18 percent), wheat (16 percent), and barley (12 percent). Although most cereal crops are used as staple foods, barley is also used for local alcohol production. In terms of volume of production in the same year (2007), maize actually ranked first, with 3.8 million metric tons of output (teff is 3.0 million metric tons). Despite occupying 30 percent of cereal land, teff output is only equivalent to 22 percent of cereal output. Thus, teff is much less productive in terms of land use. Indeed, the national average yield of maize is 2.1 mt/ha in 2007, whereas teff yields are only 1.2 mt/ha—the lowest yield among all major cereal crops. Teff is only grown in a few countries, and its yield response to fertilizer is relatively limited, given that the technology needed to develop high-yield teff varieties is more difficult to develop than that for other cereal crops, which are more broadly grown and researched around the world. This inconsistency between the technology potential and consumer preference presents a potential challenge for Ethiopian food security.

Under ADLI, the government emphasized intensification to increase agricultural production, especially through a centralized extension system to push technological packages that combined credit, fertilizers, improved seeds, and better farm management practices. Under this program, fertilizer use almost doubled between 1990 and 2000 to 290,000 metric tons (World Bank 2007). However, the intensity of fertilizer nutrient use per hectare stagnated in the latter half of 1990s and the present decade. According to World Bank (2007), only 37 percent of farmers use inorganic fertilizer, and application rates remain low at 16 kg/ha of nutrients (about 33 kg/ha for commercial products).

Following the 2002/03 drought, a large-scale food security program was scaled up in poor and vulnerable areas, amounting to a significant share of total public spending. More recently, weaknesses in the marketing system have been recognized, and a new marketing strategy is being developed based on scaling-up cooperatives and establishing a commodity exchange (and its associated institutions). As a result of these various programs, public spending on agriculture, natural resources, and food security increased from 5 percent of the total government budget in 1997/98 to more than 10 percent in 2003/04.

Concerted efforts to promote intensification seem to be showing some positive results in recent years. Consistent with growth in total agricultural GDP, 2003/04–2007/08 registered record cereal production growth in Ethiopian history. Total cereal production increased by 54.9 percent in four years (that is, more than 10 percent per year). Against the historical trend in which almost all increased produc-

Table 5.2—Cereal growth and growth contribution, 2003/04–2007/08

				Growth contribution (percent)					
	Total growth (percent)			Share of crop's output growth due to increase in			Share of total cereal's output growth due to increase in		
Cereal	Area	Yield	Output	Area	Yield	Output	Area	Yield	Output
Barley	8.1	17.0	26.5	30.6	69.4	100.0	3.0	6.9	10.0
Maize	35.9	12.4	52.7	68.1	31.9	100.0	18.8	8.8	27.6
Teff	29.2	38.5	79.0	37.0	63.0	100.0	8.1	13.9	22.0
Wheat	32.6	9.9	45.6	71.4	28.6	100.0	12.1	4.9	17.0
Millet	31.7	34.4	77.0	41.2	58.8	100.0	1.6	2.3	4.0
Sorghum	23.5	27.0	56.9	41.3	58.7	100.0	8.1	11.5	19.5
All cereals	27.3	21.7	54.9	49.7	50.3	100.0	49.7	50.3	100

Source: Authors' calculation using data aggregated from Ethiopian Agriculture Sample Survey (Ethiopia, Central Statistical Agency 2004, 2008a, 2008b).

tion was accounted for by area expansion, Table 5.2 shows that about half of recent growth has been due to yield increases. The table also presents the growth of individual crops and decomposes this into area expansion and yield increases. Among the four main cereal crops, there are two crops, teff and sorghum, for which growth in production is a dominant result of yield increases, which contributes to 63 and 58.7 percent of teff and sorghum output growth, respectively. Even though area expansion is the main source of growth for maize and wheat, increases in yields still account for 32 and 29 percent of their output growth, respectively.[1]

An important characteristic of Ethiopia's agricultural sector is the high geographic concentration of cereal cultivation. Almost 80 percent of total area under cereals is in the Amhara and Oromia regions (that is, northwest, west, southwest, and south of Addis Ababa). This area includes a diverse set of conditions for agricultural production. The spatial conditions for crop production and access to markets are characterized in Diao and Nin Pratt (2007) and Taffesse (2007).

Table 5.1 also separates production of the four main cereals by whether modern inputs are used in their production. Recently, Ethiopia has witnessed a rapid increase in modern input use, particularly fertilizer. The government's fertilizer-promotion policy currently focuses on the four main cereal crops, which are relatively more responsive to fertilizer and have higher producer prices. Table 5.1 shows the result of this program: in 2003/04, fewer than 3 million hectares used to grow barley, maize, teff, and wheat (over 50 percent of the total area devoted to these crops) used modern inputs; by 2007/08, the area that used modern inputs had increased to more than 4 million hectares (over 60 percent of the total area devoted to these four crops). In these four years, total harvest areas of these four crops increased by 28 percent, but the areas not using modern input remained constant at about 2.3 million hectares.

Unfortunately, the observed yield difference between production with and without modern inputs is fairly modest for all four cereals crops. With the exception of wheat, the average yield when using modern inputs is less than 15 percent higher than the average yield without such inputs. Even for wheat, the yield gap was 30 percent in 2003/04 but has since fallen to 19 percent in 2007/08. Although many factors affect fertilizer efficiency, increased use of fertilizer without use of high-yield seed varieties seems to be the most important factor. The combined use of fertilizer and improved seed is extremely low for teff and wheat farmers. Moreover, the low yield response to combined seed–fertilizer use indicates that the so-called "improved" seed are not really high-yielding varieties. Further assessment is needed to understand farmer's behavior and the constraints to promoting modern input use in Ethiopia.

Agricultural performance in recent years also reflects the new direction taken in the country's development strategy (that is, PASDEP), which targets market-

driven diversification and commercialization and the increase of private sector exports. After improving incentives for private investment in the flower industry, for example, more than 100 new investors entered the industry, and exports increased to nearly US$13 million by 2005. Other investments in high-value products and supply chains include exports of green beans to Europe and provision of higher quality milk and poultry to local urban centers. Several of these emerging industries involve outgrower or contract arrangements with small farmers, often linked to an emerging indigenous entrepreneurial class of farmers and agribusinesses. Exports of oilseeds and pulses (two traditional cash crops) have also experienced impressive growth—increasing their value by a factor of 10 between 1997 and 2006 and demonstrating their increasing competitiveness and the uptake of new technologies. Although coffee is still the most important export crop in Ethiopia, the combined exports of other crops and leather has sometimes surpassed the value of coffee exports in recent years.

The Ethiopian DCGE Model

We apply the DCGE model described in Chapter 2 to assess the contribution of agricultural sectors to economywide growth and poverty reduction. The DCGE model for Ethiopia was developed by Dorosh and Thurlow (2009) based on an adapted version of the social accounting matrix developed by Ahmed et al. (2009). Given that the Ethiopian economy is still dominated by agriculture and that more than 80 percent of the population lives in the rural areas, special attention has been paid to the structure of agriculture in the model. There are 24 agricultural sectors (see Table 5A.2 in the appendix). Crop production is the most important agricultural activity, hence the model defines five broad crop groups:

1. Cereal crops, which are separated into teff, barley, wheat, maize, and sorghum and millet.

2. Pulses and oilseeds, both of which are aggregated crop groups in the model. In Ethiopia, the most important oilseed crops are sesame and groundnuts.

3. Horticulture, which is separated into fruits, vegetables, and *enset.*

4. High-value export-oriented crops, which are separated into coffee, cotton, cut flowers, sugarcane, tea, and tobacco.

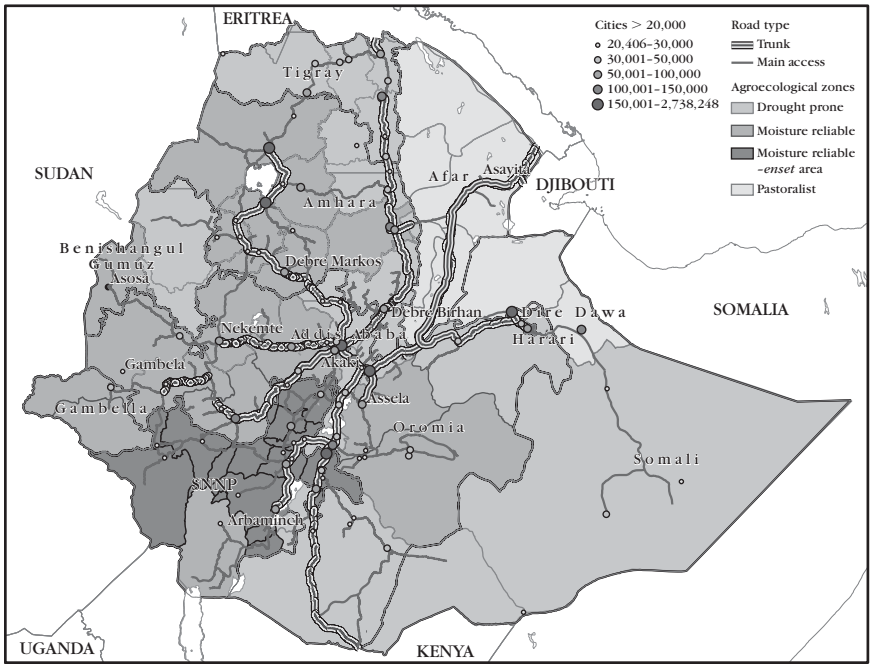
5. Other crops, including *chat* and root crops.

The model also identifies four livestock subsectors: cattle, milk, poultry, and other animal products. The two remaining agricultural subsectors are fishery and forestry. Within its general equilibrium framework, the model also contains detailed information on 44 nonagricultural sectors.

To account for geographic factors, such as agroecological conditions, population distribution, production patterns, and market locations and connections, the Ethiopian model further disaggregates each agricultural subsector into four subnational regions: Zone 1 covers the humid cereals region; Zone 2 covers the humid *enset* region; Zone 3 is the drought-prone region; and Zone 4 is the arid pastoralist region (see Figure 5.2).

Different agroecological conditions determine crop and livestock production patterns in the four zones. Zones 1 and 2 are located in the highland region, where rainfall is reliable and therefore crop growing periods are longer in these two zones

Figure 5.2—Agroecological zones of Ethiopia



Source: This figure is adapted from a map that previously appeared in EDRI (2009). The map was created by Emily Schmidt, a program coordinator for the Ethiopia Strategy Support Program II of the International Food Policy Research Institute. The map is based on Ethiopian Roads Transport Authority (2006).

than elsewhere. Because Ethiopia's agriculture is mainly rainfed, suitable rainfall conditions explain why these two zones have high agricultural potential. In fact, Zone 1 is the country's grain basket: it produces 60–70 percent of the country's cereals. Although Zone 3 is larger than Zone 1, it has less reliable rainfall and so only produces 25–30 percent of total production for most grain crops. The exceptions are sorghum and millet, which are relatively drought resistant. Hence, Zone 3 produces about 50 percent of these crops. Zone 4 is called a "pastoralist region," but only about one-fifth of national livestock is produced in this zone because of harsh agroecological conditions and low population densities. In contrast, more than 40 percent of livestock is produced in Zone 1, reflecting the close relationship between crops and livestock production among smallholders in Ethiopia.

The household structure in the DCGE model allows us to conduct growth–poverty linkage analysis. In the model, there are 12 representative household groups that are disaggregated by the four rural zones, small and large urban centers, and income level (poor or nonpoor status). "Poor" is defined as all households falling into the lowest two per capita expenditure quintiles (that is, the poorest 40 percent of the population defined at the national level). Household income elasticities are based on estimates from the 2004/05 Household Income and Expenditure Survey (HICES) (Ethiopia, CSA 2005; see Table 5A.1 in the appendix). Each household questioned in HICES 2004/05 is linked directly to the corresponding representative household in the model through a top-down consumption-based microsimulation model (see Chapter 2). In this formulation of the model, changes in representative households' consumption and prices in the DCGE model are passed down to the survey, where total real consumption for each survey household is recalculated. This new level of per capita total consumption for each survey household is compared to a poverty line, so that poverty headcount can be recalculated.

Both total and sector GDPs are endogenous variables, and their growth comes from three major dynamic factors incorporated in the model: (1) growth in factor supply, (2) change in total factor productivity (TFP), and (3) accumulation of capital through investment. By design, the supplies of skilled and unskilled labor, agricultural land, and livestock stocks are fixed in each time period, and annual growth rates are exogenously imposed. In contrast, the supply of agriculture-specific labor (that is, family workers) and workers with elementary occupations are flexible (that is, they are endogenous) and depend on supply elasticities with respect to wage rates, which endogenously change over time. Changes in TFP at the subsector level are exogenous, whereas capital accumulation as an endogenous variable is the outcome of past investment, which is financed by private, public, and foreign savings. Foreign savings is an exogenous variable chosen as a macroclosure to balance the foreign account in the model. Public savings is a residual term between government

revenue (which is an endogenous variable) and government expenditure (which is an exogenous variable chosen as the second macroclosure to balance the government account in the model). Finally, private savings is an endogenous variable, although the saving rate is exogenous.

Baseline Growth Scenario

The DCGE model for Ethiopia is first used to design a baseline scenario, against which a series of accelerated growth scenarios are compared later in the chapter. Although economic growth rates in Ethiopia were extremely high during 2004–08, the recent global financial crisis is expected to have dampened the country's growth performance during 2009–10. Given this possibility and frequent weather shocks on agricultural production, we adopt a conservative annual growth rate as a target for the baseline scenario. Specifically, the average growth rate during 1997–2007 is chosen to calibrate the baseline, during which time total GDP grew at 6.1 percent and agricultural GDP at 4.1 percent per year on average (World Bank 2011).

We choose growth rate in labor supply (except for the supply of agricultural family workers and unskilled labor) consistent with population growth of 2.7 percent per year. The same growth rate is also chosen for the supply of livestock capital. The agricultural land expansion rate varies between 2.3 and 3.3 percent for the four zones (with lower growth in the two highland zones and a higher growth rate in the other two zones). TFP growth in each agricultural subsector is chosen so that the subsector's growth rate tracks production trends in recent years. Overall, agricultural GDP grows 4.2 percent in the baseline.

To understand how the choice of exogenous growth rates affects the baseline, we present some aggregate results in Table 5.3 to explain the relationship between factor growth and TFP change (mostly exogenous) on the one side, and resultant economic growth (endogenous) on the other. The first row of the table reports annual growth rates for total GDP, agricultural GDP, total value-added for cereal production, total value-added for export crop production, and nonagricultural GDP. These are all endogenous results from the baseline scenarios.

Under the heading "Role of labor," the table presents the share of labor in value terms in five types of GDP and sector value-added. For example, labor accounts for 30.4 percent of GDP (column 1), 34.2 percent of agricultural GDP (column 2), and 26.7 percent of nonagricultural GDP (column 5). Thus, the agricultural sector is more labor-intensive than the nonagricultural sector. The table also presents labor's annual growth rate. Total labor at the national level grows at 2.7 percent in the baseline (column 1), which is consistent with recent population growth rates. However, labor employed in the agricultural sector grows at 2.3 percent (column 2)

Table 5.3—Decomposition of growth in baseline scenario (percent)

Category	Total national GDP (1)	Agricultural GDP (2)	Cereal value-added (3)	Export crop value-added (4)	Nonagricultural GDP (5)
Annual GDP growth rate	6.1	4.2	4.8	5.0	7.5
Role of labor					
Share of value-added	30.4	34.2	51.2	51.2	26.7
Annual growth rate	2.7	2.3	2.2	2.2	3.1
Contribution to growth[a]	13.8	18.7	23.3	22.5	11.3
Role of land					
Share of value-added	18.2	37.2	48.8	48.8	
Annual growth rate	3.4	3.4	2.6	2.6	
Contribution to growth[a]	10.7	30.5	26.9	26.0	
Role of capital					
Share of value-added	51.4	28.6			73.3
Annual growth rate	5.0	2.8			5.7
Contribution to growth[a]	47.3	19.1			63.6
Total factor productivity (TFP)					
Annual growth rate[b]	1.6	1.3	2.3	2.5	1.7
Contribution to growth	28.1	31.6	49.8	51.5	25.1

Source: Ethiopia dynamic computable general equilibrium model results.

Note: GDP = gross domestic product. TFP = total factor productivity. Blank cells = not applicable.

[a]Contribution of a factor to growth is the ratio of the factor's growth to economic growth (either growth of total GDP or a particular sector's GDP, for example, agricultural GDP) weighted by the share of the factor in an economic sector or in the whole economy.

[b]TFP growth rate is derived from $g_{TFP} = g - \sum_t w_t \cdot g_t$, where g_{TFP} is TFP annual growth rate; g is economic growth rate for GDP or agricultural GDP; w_f is the share of factor f in GDP or sector GDP; and g_f is this factor's annual growth rate. Growth in TFP is the difference between economic growth and summation of growth rates for all factors ($\sum_t$) employed in the economy.

and 3.1 percent in the nonagricultural sector (column 5). It should be noted that sector-level labor growth is an endogenous result of the model, because most categories of workers are able to migrate between farm and nonfarm activities.

Although the nonagricultural sector is less labor intensive, more rapid growth in this sector (7.5 percent) requires that more labor be employed in nonagricultural production. The last row under "Role of labor" presents the contribution of labor to growth. Labor accounts for 13.8 percent of total GDP's annual growth (column 1) and 18.7 percent of agricultural GDP's growth (column 2). Labor has a much smaller contribution to nonagricultural GDP growth (11.3 percent), because this sector is less labor intensive.

The last component of Table 5.3 (final two rows) presents TFP growth rates and the contribution of TFP to economic growth. Although subsector-level TFP growth rates are exogenously chosen in the model, calculated total TFP is actually

a residual term, and hence its growth is affected by a series of endogenous variables in the decomposition process. As shown in the final row of the table, TFP contributes 28.1 percent to overall economic growth in the baseline (column 1) and 49.8 percent to cereal growth (column 3). This result is consistent with the observation made earlier in this chapter that yield improvements accounted for half of additional cereal production in recent years. Even though yield measures the productivity of land, this comparison is still meaningful, because yield increases are closely related to the improvement in labor efficiency in labor-intensive agriculture.

One of the main objectives of this chapter is to quantitatively measure the relationship between economic growth and poverty reduction in a general equilibrium setting. Therefore, it is necessary to further evaluate whether the poverty results in the baseline scenario are consistent with historical trends. National poverty rates are available from the three most recent HICES. Table 5.4 first presents these poverty estimates and then calculates annual changes (in the final three columns). Poverty reduction between the two most recent surveys (between 1996/2000 and 2000/05) is more rapid than that between the first two surveys. The table reports the annual growth in per capita GDP for the same periods. Using the historical data, Ethiopia's poverty–growth elasticity is calculated as the ratio of the annual poverty reduction rate to the annual growth rate of per capita GDP. The elasticity of –0.35 in the final row of the table indicates that during 1996–2000, 1 percent annual growth in per capita GDP led to a 0.35 percent decline in the national poverty headcount rate. The elasticity was higher during the second period (–0.71). Assessing the differential growth rates between agricultural and nonagricultural GDP indicates that when agriculture grows slowly (for example, it is 0.03 percent

Table 5.4—Relationship between poverty and growth in Ethiopia's history

	Value			Annual change (percent)		
Measure	**1995/96**	**1999/2000**	**2004/05**	**1996–2000**	**2000–05**	**1996–2005**
National poverty rate	45.5	44.2	38.7	–0.58	–2.62	–1.61
Per capita GDP	937	1,017	1,219	1.66	3.69	2.67
Per capita agricultural GDP	474	474	532	0.03	2.33	1.17
Per capita nonagricultural GDP	463	543	687	3.24	4.83	4.03
Poverty–growth elasticity				–0.35	–0.71	–0.60

Source: Authors' calculations using poverty data (Ethiopia, CSA 2005) and GDP data (World Bank 2011).
Notes: The national poverty rate is the proportion of the nation's population with per capita consumption below the poverty line. It is measured in percent. Per capita GDP and per capita sector GDP are measured in constant birr. GDP = gross domestic product. Blank cells = not applicable.

per year in the first period), the value of the poverty–growth elasticity is also low. Thus, generally speaking, the size of the poverty–growth elasticity appears to be related to agricultural growth rates. Later in this chapter we more rigorously examine the relationship between agriculture- and nonagriculture-led growth and poverty reduction.

The same method of calculating poverty–growth elasticities is used for the baseline scenario and for other simulations discussed later in the chapter. Although per capita GDP growth rates can be directly obtained from the DCGE model, this is not the case for poverty headcounts, whose calculation requires the detailed information in the household survey. As discussed above, the representative household groups in the DCGE model are aggregates of the households appearing in the 2004/05 HICES. The simulated changes in these household groups' consumption of each commodity in the DCGE model are used to adjust the consumption of individual households in the 2004/05 HICEs. We then recalculate poverty headcounts and obtain a new poverty rate for each year in the simulation period. An important caveat of this process is that the model captures differential changes in income and consumption across, but not within, the 12 household groups. Bearing this caveat in mind, the baseline produces a poverty–growth elasticity of –1.13. Thus, a 1 percent growth rate in per capita GDP reduces the poverty rate by 1.13 percent. Although this elasticity is higher than historical trends, it is fairly consistent with results from other African countries reported in this volume and elsewhere.

Accelerated Growth Scenarios

The DCGE model is now used to assess the role of agriculture in economic growth and poverty reduction. We conduct six counterfactual simulations that differ according to the sectors driving an accelerated growth process. The first scenario is the "cereal-led growth," in which additional TFP growth is assumed for the five cereal subsectors. The assumptions on TFP growth in the other subsectors remain unchanged from the baseline, as do the exogenous growth assumptions for labor and land. The second scenario is "export crop–led growth," in which TFP growth is accelerated only in the seven agricultural subsectors that are export oriented. Similarly, the third scenario is "livestock-led growth." The fourth scenario combines the first three into an overall "agriculture-led growth" scenario. Conversely, the fifth scenario focuses on "nonagriculture-led growth," and the final scenario accelerates growth in all economic subsectors. The results and major conclusions from these six scenarios are presented below, with our discussion focusing on four of them: cereal-led growth, export crop–led growth, agriculture-led growth, and nonagriculture-led growth.

Subsector (Crop-Level) Growth, Employment and Poverty Impacts

We first discuss the scenario results of the model and analyze growth linkage effects in a general equilibrium setting. In a static CGE model, productivity growth in a shocked sector affects other sectors via various channels—the most important of which is resource reallocation. Resource allocation effects can be further enhanced if supply of some factors is flexible (for example, the existence of unemployed labor). In our dynamic model, capital accumulation may also be affected by sectoral productivity growth when this growth causes income and savings to change, resulting in changes in investment and new capital stocks. For this reason, when we discuss growth-linkage effects, we analyze not only the growth multiplier but also employment creation effects. This is important, because Ethiopia is a labor-abundant economy, and so released farm labor must find employment outside of agriculture.

As mentioned above, there are two types of labor with endogenous labor supply in our model: agricultural family labor and unskilled labor. Table 5.5 therefore pays particular attention to these two labor categories. We note that, cereal-led growth lowers demand for the farm labor within agriculture but does not change demand for unskilled labor in the economy as a whole. When labor and land become more productive in cereal production, then to produce the same amount of cereals requires fewer of these resources. Without demand and land constraints, cereal production could continue to increase and hence possibly create additional demand for labor. However, cereals are produced mainly for domestic markets in Ethiopia, and import substitution is only possible for wheat (that is, there are currently no teff or sorghum imports, and maize imports are minimal). Thus, it is impossible for cereal production to grow beyond the growth in domestic demand. Moreover, land supply is fixed, and when land is released from cereal production, it is reallocated to other crops, which creates growth-multiplier effects in the process. However, if other crop production is less intensive in the use of family or unskilled labor, then overall demand for these labor groups may decline. As shown in the second part of Table 5.5, the annual growth rate of cereal value-added increases to 6.6 percent in the cereal-led growth scenario—up from 4.8 percent in the baseline. Similarly, the growth rate of agricultural GDP rises to 4.8 percent from 4.2 percent in the baseline. However, there is only a modest acceleration in nonagricultural growth, which explains why total unskilled labor demand did not rise when demand for agricultural labor fell.

The final panel of Table 5.5 presents the growth multipliers for each scenario. Our second major finding from the cereal-led growth scenario is that cereals generate strong growth-multiplier effects. A one unit increase in real cereal value-added in 2015 causes a 1.14 unit of increase in total GDP in the same year, 0.14 of which is the multiplier effect. However, our third major finding that most of this multiplier effect is from increased production in other agricultural subsectors, which, as a

Table 5.5—Annual factor growth rates and simulated GDP growth elasticities and multipliers

Category	GDP share in 2005/06 (percent)	Accelerated economic growth led by						
		Baseline scenario	Cereals	Export crops	Livestock	All agriculture	Nonagriculture	Combined scenario
Labor supply growth rate (percent)								
Agricultural family labor		2.31	2.30	2.33	2.33	2.35	2.40	2.45
Unskilled labor		3.53	3.53	3.54	3.57	3.59	3.72	3.78
Capital		5.32	5.32	5.32	5.32	5.32	5.57	5.57
Total GDP growth rate (percent)	100.0	6.1	6.3	6.2	6.3	6.8	7.2	7.8
Agricultural GDP	45.2	4.2	4.8	4.5	4.7	5.9	4.4	6.0
Cereals	13.2	4.8	6.6	4.8	4.8	6.7	4.8	6.7
Export crops	4.5	5.0	5.0	7.6	5.0	7.6	5.0	7.6
Livestock	13.3	3.9	4.0	3.9	5.6	5.7	4.0	5.8
Nonagricultural GDP	54.8	7.5	7.5	7.5	7.5	7.5	7.6	9.2
Manufacturing	5.3	7.7	7.6	7.7	7.8	7.7	9.7	10.0
Agroprocessing	2.4	6.9	6.9	7.0	6.9	7.1	8.4	8.7
Private services	32.8	8.0	8.0	8.0	8.0	8.1	10.0	10.0
Elasticity of labor supply–GDP[a] growth			–0.02	0.15	0.11	0.06	0.10	0.09
Growth multiplier by 2015			1.13	1.04	1.06	1.03	1.06	
Contribution to total GDP increase by 2015 (percent)								
Shocked sectors[b]			88.34	96.50	94.04	96.77	93.92	
Agriculture rather than shocked sector			10.29	0.33	2.53		6.08	
Nonagricultural sectors			1.37	3.17	3.42	3.23		

Source: Ethiopian dynamic computable general equilibrium model results.

Note: GDP = gross domestic product. Blank cells = not applicable.

[a]Labor supply–GDP elasticity is defined as percentage change in baseline total labor supply over the baseline GDP growth rate, both for 2015.

[b]Shocked sectors are those labeled as column heads in the corresponding scenarios. For example, in the "Cereals" column, shocked sectors are cereals.

whole, explains 10.3 percent of total GDP increase of 1.14 in that year (see the second-to-last row of Table 5.5). Insignificant growth-multiplier effects on nonagricultural sectors are due to difficulty in labor mobility between the agricultural and nonagricultural sectors. To create more employment opportunities in nonagricultural sectors at a given wage rate requires improving productivity in these nonagricultural sectors, which was not considered in this scenario.

We turn next to the second scenario, in which export crops are the driving force behind accelerated economic growth. The first finding is that the small size of this subsector in the economy (4.5 percent of total GDP in the base year) implies that even high growth rates in export crop value-added have only modest impacts on national GDP. The growth rate of agricultural GDP rises from 4.2 to 4.5 percent per year, and that for total GDP increases from 6.1 to 6.2 percent. These modest effects on the overall economy indicate that, although there is considerable potential to expand some export-oriented crops, its expected impact on the overall economy would be rather limited.

The second major finding from this scenario is that the growth multipliers for export crops are smaller than for cereals. An additional 0.04 units of GDP are created by a one unit increase in export-crop production. Moreover, the impact channels are quite different. Unlike in cereal-led growth, the nonagricultural sector is positively affected by export crop–led growth, but the effect on other agricultural sectors is insignificant. Results indicate that 96.5 percent of increased GDP is a direct result of export-crop growth. Of the remaining impact channels, only 0.33 percent is attributable to nonexport agriculture, whereas 3.17 percent is due to nonagriculture.

The third finding is that export crop–led growth creates more employment opportunities, as growth rates in both family farm and unskilled labor increase from baseline levels. The reason is that export crops are produced for foreign markets, and demand in such markets is not constrained by domestic income. Without considering other constraints, such as increased trade barriers from importing countries and physical and institutional difficulties in accessing markets, productivity growth in export crops leads to increased demand for family and unskilled labor. Measured as a labor-supply–GDP elasticity, a 1 percent increase in GDP led by growth in export crops is associated with a 0.15 percent increase in total labor supply (in Table 5.5 in the fourth column in the row for "Elasticity of labor supply–GDP growth"). This is the highest elasticity in all of the scenarios we consider.

A comparison of the results from the first two scenarios indicates that the contribution of an agricultural subsector's growth to overall economic growth is mainly determined by the size of the subsector. Small subsectors may have high growth potentials but can only generate modest increases in overall economic growth. Furthermore, although the economywide multiplier effect of a subsector is important, it should

not be the only indicator used to explain growth linkages between agriculture and nonagriculture, as well as within agriculture. Given that the Ethiopian government has accorded a high priority to generating employment, promoting growth in some sectors can create more employment opportunities, even though they may not generate as much economywide growth. Those subsectors that face fewer demand constraints from domestic markets and that use unskilled labor more intensively will have greater potential to create jobs at the given level of growth.

Comparing Agriculture-Led and Nonagriculture-Led Growth

The fourth and fifth scenarios compare agricultural and nonagricultural growth. In reality it is impossible to have either the agricultural or nonagricultural sectors grow independently of each other. However, these two scenarios are designed to assess possible differential effects on the overall economic growth and poverty reduction. As shown in the first two rows of Table 5.5, growth in the aggregate agricultural and nonagricultural sectors creates more employment opportunities both for family farm labor and unskilled labor, whereas nonagricultural growth leads to a greater increase in labor demand and therefore more employment opportunities than does growth in the agricultural sector alone. Measured by the labor-supply–GDP elasticity, a 1 percent increase in total GDP led by nonagricultural growth is associated with a 0.10 percent increase in labor supply, and the elasticity is 0.06 when agricultural growth is the leading force. Moreover, the growth multiplier in the case of nonagriculture-led growth is higher than that of agriculture-led growth (1.06 versus 1.03). Stronger growth-multiplier effects from nonagriculture-led growth are related to additional capital accumulation. Nonagriculture is more capital intensive than agriculture. Increases in nonagricultural productivity leads to faster investment growth, which generates additional demand for capital goods production. Faster capital accumulation creates more demand for labor that can be employed by both agricultural and nonagricultural sectors. This demand leads to higher growth-multiplier effects in this scenario. Decomposition of the multiplier effect shows that, in the agricultural growth scenario, only 3.24 percent of increased GDP (1.03 units) occurs in the nonagricultural sector, whereas in the nonagricultural growth scenario, 6.08 percent of the increase in GDP (1.06 units) comes from increased agricultural GDP.

Demand-side linkages are examined in Table 5.6. The first panel in the table presents annual consumption growth rates in the various scenarios. The commodity groups shown in the table are aggregations from the 62 groups used in the DCGE model, with base year prices for each individual commodity used as weights. As shown in the table, the growth rate in real consumption is lower than the total GDP growth rate. This is because the change in relative prices and different income elasticities across commodities cause demand growth to vary across commodities.

Table 5.6—Consumption linkages in the simulation scenarios

Category	Baseline scenario	Accelerated economic growth led by					
		Cereals	Export crops	Livestock	All agriculture	Nonagriculture	Combined scenario
Growth in GDP (percent)	6.1	6.3	6.2	6.3	6.8	7.2	7.8
Growth in consumption, measured by real expenditure (percent)							
Total	5.1	5.4	5.3	5.4	6.0	5.6	6.5
Cereals	4.7	6.0	4.8	4.8	6.2	4.9	6.3
Export crops	4.4	4.5	4.8	4.5	5.1	4.7	5.2
Livestock	3.8	3.9	3.9	5.3	5.5	3.5	5.2
Other foods	3.7	3.8	3.8	3.7	5.0	3.9	4.9
Nonfood	6.3	6.3	6.5	6.4	6.7	7.2	7.6
Share in increased total consumption, 2015 (percent)							
Cereals		76.4	10.2	3.9	29.4	5.2	21.4
Export crops		1.5	20.5	1.6	6.0	4.6	4.8
Livestock		3.0	7.8	73.1	25.2	-6.8	13.8
Other foods		7.4	7.8	1.8	19.7	5.3	13.0
Nonfood		11.7	53.8	19.5	19.6	91.7	47.0
Change from baseline in 2015 (percent)							
Total		2.1	1.2	1.9	6.3	3.4	9.3
Cereals		9.0	0.7	0.4	10.2	1.0	11.1
Export crops		0.4	2.8	0.4	4.3	1.8	5.2
Livestock		0.5	0.7	10.6	12.1	-1.8	9.8
Other foods		1.1	0.7	0.3	9.0	1.3	8.9
Nonfood		0.5	1.3	0.8	2.6	6.6	9.4
Elasticity of consumption–GDP,[a] 2015							
Total		1.2	1.4	1.3	1.3	0.5	0.8
Cereals		5.3	0.8	0.3	2.1	0.1	0.9
Export crops		0.2	3.2	0.2	0.9	0.3	0.4
Livestock		0.3	0.8	7.2	2.5	–0.3	0.8
Other foods		0.7	0.8	0.2	1.8	0.2	0.8
Nonfood		0.3	1.6	0.5	0.5	0.9	0.8

Source: Ethiopian dynamic computable general equilibrium model results.

Note: GDP = gross domestic product.

[a]Elasticity of consumption–GDP is defined as the ratio of the percentage increase in consumption from baseline to percentage increase in GDP from baseline, both for 2015.

Comparing consumption growth rates for the first two scenarios reveals that consumption for a group of commodities grows more rapidly when the group is targeted in the scenario. For example, the growth rate of cereal consumption increases from 4.7 to 6.0 percent in the cereal-led growth scenario. However, in the same scenario, livestock consumption growth only increases slightly. In contrast, when growth is led by additional livestock productivity, livestock consumption grows more rapidly, while cereal consumption growth rate rises only slightly. This differential demand effect by commodity groups is due to relative prices. Accelerating growth in a particular group of commodities causes its prices to fall relative to other commodity groups. This growth generates additional incomes for the farmers engaged in these subsectors, but increased consumption stemming from direct income effects is not limited to those products for which supply increases. On the contrary, lower prices induce more across-the-board consumption by both rural and urban households. When accelerated growth occurs across the whole economy, relative price movements become smaller, and growth in consumption is dominated by income effects. Thus, growth differences across commodity groups also decrease.

The second panel in Table 5.6 reports the contribution of each commodity group to the increase in total consumption. It shows that when accelerated growth is led by cereals, then 76.4 percent of increased total consumption is from cereal consumption itself. When growth is led by the livestock subsectors, then livestock consumption explains 73.1 percent of total consumption increases. More importantly, when growth is led by export crops then 53.8 percent of consumption increases are from nonagricultural goods. Such differential consumption outcomes will have effects on poverty reduction. For a low-income country like Ethiopia, most of the poor population lives in rural areas, where food consumption, particularly staple foods, is the most important component of household total expenditure baskets (including expenditure in kind). When economic growth increases income among rural low-income households, then staple consumption grows more rapidly than consumption of other commodities. This differential occurs because rural poor households have higher income elasticities for food demand than do urban and nonpoor rural households. In the poverty–growth linkage analysis below, we show that agriculture-led growth is more pro-poor than growth led by the nonagricultural sector. One important reason for this is due to the different effects on consumption growth across different scenarios shown in Table 5.6.

The final panel of Table 5.6 shows the ratio of changes in consumption to changes in total GDP, which can be used to compare the marginal effect of growth led by different subsectors on consumption of the various commodity groups. The table shows that the consumption–growth elasticity is higher under agriculture-led growth than under nonagriculture-led growth. This trend is particularly evident for

food consumption and further emphasizes the importance of consumption linkages when growth is led by the agricultural sector.

To further examine price effects, Table 5.7 presents the change in agricultural product prices. The table shows that prices fall by 8–16 percent for the five cereal products under cereal-led growth, whereas prices fall by 9–11 percent for the livestock products under livestock-led growth. When growth accelerates in both agricultural and nonagricultural sectors, then the negative price effects on agricultural products become much smaller. In fact, prices even rise slightly for certain products. This result indicates that agricultural policy should avoid favoring only a few selected crops or livestock products, because there is potential to cause prices for these products to fall so much that farmers will benefit little in terms of income generation. The results also reveal the importance of concurrent growth in agricul-

Table 5.7—Deviation in marketed commodity prices from baseline, 2015 (baseline = 1)

Scenario	Teff	Barley	Wheat	Maize	Sorghum	Oilseeds	*Enset*
Cereals	0.92	0.87	0.84	0.85	0.90	1.00	0.97
Export crops	1.01	1.01	1.01	1.01	1.01	0.99	1.00
Livestock	1.02	1.02	1.02	1.03	1.03	1.02	1.01
All agriculture	0.96	0.91	0.88	0.89	0.95	1.00	1.00
Nonagriculture	1.06	1.06	1.06	1.07	1.07	1.05	1.05
All sectors	1.02	0.97	0.93	0.96	1.02	1.06	1.07

Scenario	Vegetable	Fruits	Sugar	Tea	Cotton	Coffee	Cut flowers
Cereals	1.01	1.01	0.98	1.01	0.99	1.00	1.00
Export crops	1.02	1.00	0.84	0.91	0.68	0.96	0.99
Livestock	1.03	1.04	0.99	1.03	0.98	1.02	1.02
All agriculture	1.04	1.04	0.79	0.95	0.67	0.97	1.01
Nonagriculture	1.08	1.21	1.61	1.15	1.60	1.05	1.03
All sectors	1.13	1.26	1.44	1.10	1.04	1.02	1.04

Scenario	Cattle	Poultry	Milk	Meat and oil products	Dairy products	Milled grains	Other foods
Cereals	1.00	1.00	1.00	1.00	1.00	0.99	1.00
Export crops	1.01	1.01	1.01	0.98	1.01	1.00	0.98
Livestock	0.90	0.91	0.89	1.03	0.90	1.02	1.03
All agriculture	0.92	0.92	0.91	1.01	0.91	1.02	1.01
Nonagriculture	1.09	1.09	1.09	0.99	1.09	1.00	0.98
All sectors	1.00	1.01	0.99	1.00	0.99	1.03	0.99

Source: Ethiopian dynamic computable general equilibrium model results.

tural and nonagricultural sectors for stabilizing agricultural prices—an important linkage effect that can only be observed in a general equilibrium analysis.

Decomposing Agricultural Growth's Impact on Poverty

Accelerating economic growth is often the primary focus of policy interventions in low-income countries like Ethiopia, because only rapid growth can enable the country to catch up with the rest of the world. The previous subsection showed the importance of agriculture in generating overall growth and demonstrated that this importance is not only because of the size of agriculture. Rather, the importance of agriculture is also due to its strong linkages to the rest of the economy, particular consumption linkages, which allow growth to directly benefit a majority of the population and increase consumption levels. In this subsection, we focus on the impact of growth on poverty reduction, one of the most important goals for all developing countries.

Although growth is generally good for the poor, opportunities for them to participate in growth varies, depending on the type of growth. The growth–poverty linkage analysis addresses this issue and measures what kind of growth creates more job opportunities for the poor. We use similar scenarios to those from the growth linkage analysis to evaluate the linkages between growth led by different subsectors and poverty reduction. Although income distribution influences the effectiveness of growth on poverty reduction, we are unable to analyze its effect in the current model structure. That is to say, we generally assume that the income distribution, particularly the distribution in each representative household group, does not change over time for different types of growth. Although this caveat of the model may lead to an overestimation of growth's contribution to poverty reduction, it will not be a problem when the focus of the analysis is to compare growth–poverty linkages across different scenarios designed in the model. We explain this argument below.

To compare the effectiveness of growth led by different subsectors on poverty reduction, it is important to make sure scenarios are comparable. Because of the different sizes of the subsectors, the same growth rate at the subsector level can have very different impacts on national economic growth and poverty reduction. It is unlikely that a small subsector will cause large reductions in poverty, even if this small sector grows rapidly. To address this comparability issue, we focus on the linkage between overall economic growth and poverty reduction. The poverty–growth elasticity is calculated using the same formula as before (the percentage change in the national poverty rate caused by 1 percent growth in per capita GDP).

According to 2004/05 HICES (Ethiopia, CSA 2005), the country's reported national poverty rate was 38.7 percent in 2005. This poverty rate is consistent with the standard US$1.25 per capita per day international measure of poverty. As

expected, the rural poverty rate is similar to the national poverty rate, because more than 80 percent of the population lives in rural areas. The rural poverty rate is 39.3 percent, and the urban rate is slightly lower (35.1 percent).

It is widely anticipated that Ethiopia is unlikely to meet the first Millennium Development Goal of halving poverty by 2015, which requires the poverty rate fall to 23 percent by 2015. We first use the Ethiopian model to simulate baseline poverty reduction, consistent with the baseline growth simulation. According to our results, the national poverty rate will fall to 28.6 percent by 2015 (Table 5.8). Obviously, Ethiopia needs to not only accelerate the level of growth but also find ways to enhance the benefits of growth for its poor. In other words, it is important to identify the composition of growth that is most effective at reducing poverty. In this regard, it is necessary to consider the relative importance of agriculture and industry in helping the country significantly reduce poverty.

Using the same six scenarios discussed above, the growth–poverty linkages are used to compare the effectiveness of additional growth in reducing poverty under different growth assumptions. The poverty–growth elasticity is calculated for each scenario based on growth in total GDP rather than on the sector's GDP. Table 5.8 shows the poverty rate by 2015 in each scenario. For example, the national rate falls to 28.6 percent in 2015 in the model's baseline, and the rural and urban poverty rates fall to 29.6 and 23.5 percent, respectively. With one exception, all poverty rates fall more in the six accelerated growth scenarios. The national poverty rate falls to 23.9 percent in 2015 in the sixth growth scenario (all sectors combined)—a poverty rate that nearly achieves the country's first Millennium Development Goal.

The second panel of Table 5.8 reports the additional number of people lifted above the poverty line by 2015 in each growth scenario. About 25 million people were living below the poverty line in 2005. The baseline scenario lowers this number to 24 million. Considering that the population will grow by 19.5 to 20 million over the 10-year simulation period (with a 2.7 percent population growth rate), the decline in the absolute number of poor under the baseline seems to be an optimistic scenario. The model results also indicate that about 60 percent of the reduction in the number of poor occurs in rural areas (not shown in the table). The model therefore reports more optimistic poverty reduction in urban areas, where the poverty rate falls to 23.5 percent by 2015—an 11.6 percentage point reduction from its level in 2005. The final row of the table reports poverty–growth elasticity, which was 1.13 in the baseline. We have mentioned in previous subsections that this elasticity is higher than that calculated using historical data, but it is comparable to those of other countries derived using similar methods.

We now assess how different sources of growth affect poverty reduction rates differentially. We start with the agriculture-led and nonagriculture-led scenarios. As discussed above, the annual GDP growth rate is 6.8 and 7.2 percent in the agriculture-led

Table 5.8—Changes in poverty rates and poverty–growth elasticities

Category	Base year value	Baseline scenario	Cereals	Export crops	Livestock	All agriculture	Nonagriculture	Combined scenario
Poverty rate by 2015 (percent)								
National	38.7	28.6	26.1	28.1	27.9	24.8	27.0	23.9
Rural	39.3	29.6	27.0	29.2	29.0	25.6	27.5	24.4
Urban	35.1	23.5	22.1	22.9	22.5	20.7	24.5	21.5
Additional people lifted out of poverty by 2015 relative to baseline (thousand)								
National			2,075	422	600	3,194	1,357	3,922
Rural			1,871	328	460	2,799	1,502	3,629
Urban			204	94	140	395	–145	294
Share of reduction in absolute numbers of the poor by 2015 (percent)								
Rural			90.2	77.8	76.6	87.6	110.6	92.5
Urban			9.8	22.2	23.4	12.4	–10.6	7.5
Poverty–growth elasticity	–1.13	–1.40	–1.16	–1.16	–1.41	–1.05	–1.24	

Source: Ethiopian dynamic computable general equilibrium model results.

Notes: The poverty rate is the proportion of the population with per capita consumption below the poverty line. Blank cells = not applicable.

and nonagriculture-led scenarios, respectively (see Table 5.6). Although overall economic growth is higher in the nonagriculture-led scenario, more poverty reduction occurs in the agriculture-led scenario. As indicated in the first row of Table 5.8, the national poverty rate falls to 24.8 percent by 2015 in the agriculture-led scenario, but it remains at 27 percent in the nonagriculture-led one. A different way to present these differential effects of growth on poverty is to calculate the number of additional poor people lifted above the poverty line. The comparison shows that the agriculture-led scenario lifts 1.8 million more people out of poverty than does the nonagriculture-led scenario. A more accurate comparison is to compare poverty–growth elasticities. The elasticity is –1.41 and –1.05 in the agriculture-led and nonagriculture-led growth scenarios, respectively. Economic growth driven by agriculture is therefore far more pro-poor than nonagricultural growth.

For nonagriculture-led growth, the poverty rate in urban areas rises by 2015 from its baseline level in the same year. To understand this counterintuitive result, we compare changes in real disposable income, measured by total expenditure in real terms (that is, at the same level as base-year prices), for poor and nonpoor households in rural and urban areas. Table 5.9 shows that for nonagriculture-led growth, real incomes for poor urban households fall from their baseline levels in 2015, while those of rural poor households increase. Without simultaneous growth in the agricultural sector, agricultural product prices rise in this scenario (fourth row in Table 5.7). If the increase in nominal incomes for some poorer urban households does not keep up with rising food prices, then their real incomes will fall. This reduction leads to declining real consumption and causes some poor urban households, which were lifted out of poverty in the baseline, to now fall back into poverty.

This result has important policy implications for the promotion of nonagricultural growth. Ensuring the participation of the poor is important for any growth strategy, but it is equally important to pay attention to possible food price increases during the growth process. This perverse growth outcome has been recently observed in many developing countries where high nonagricultural growth has

Table 5.9—Change in total real expenditure from baseline, 2015 (percent)

Category	Cereals	Export crops	Livestock	All agriculture	Nonagriculture	Combined scenario
Total	2.11	1.16	1.90	6.26	3.38	9.32
Rural poor	2.97	0.81	1.85	6.90	4.05	10.67
Rural nonpoor	2.17	1.47	1.73	6.95	4.60	11.21
Urban poor	1.89	1.03	2.81	6.34	–1.38	5.15
Urban nonpoor	0.90	0.76	2.18	3.41	0.49	3.46

Source: Ethiopian dynamic computable general equilibrium model results.

been accompanied by food price inflation. Ethiopia appears to have shown this same outcome during its recent growth period, which may partly explain why rapid growth has not significantly reduced poverty in urban areas.

Conclusions

Ethiopia has embarked on an agriculture-led growth strategy to meet the challenges of accelerating national growth and poverty reduction. Three sets of questions around the importance of the agricultural sector were highlighted as being relevant to the implementation of this strategy. Which sectors have large prospective linkages? What are the growth and poverty-reduction potential of these sectors? What policy interventions are needed to unlock their growth potential? We have applied the DCGE model described in Chapter 2 to address these three policy questions for Ethiopia. Several key messages can be drawn from our analysis.

First, the importance of agriculture relates to its size in the economy. Although the agricultural sector is unlikely to grow faster than many nonagricultural subsectors, due in part to its greater dependency on nature, its size is much larger than the nonagricultural sector in Ethiopia. The country's economic history shows that GDP growth is strongly correlated with agricultural growth. The DCGE model showed that agricultural growth, even when it is slower than nonagricultural growth, directly contributes more to overall economic growth. Moreover, certain large staple subsectors drive the agricultural sector as a whole. In contrast, some nontraditional export crop sectors may be able to grow very rapidly, but this growth will be from a small base and so is unlikely to translate into significant sectorwide growth. For this reason, overall agricultural growth must primarily come from growth in the staple subsectors.

Second, the importance of cereal production in overall economic growth is due not only to its size but also to its strong multiplier effects. The model shows that cereal-led growth has the largest multiplier effect and is a driver of growth in other agricultural subsectors.

Third, there exists a certain limitation to cereal-led growth for job creation. In fact, productivity-led growth in the cereal sector will release labor from agriculture, which requires that other sectors of the economy absorb more labor. Because Ethiopia is a labor-abundant economy with rapid population growth, it is necessary to pay attention to limited job creation potential when promoting cereal production. Export crops, in contrast, may have smaller growth multipliers, but they create more employment opportunities, because they face less stringent demand constraints and relatively stronger linkages with market activities (including trade and transport).

Fourth, the growth multiplier effect is higher in the nonagricultural sector than it is in the agricultural sector as a whole. These enhanced multiplier effects are related to the current structure of Ethiopia's nonagricultural sector and the growth assump-

tions of the model. In the model's simulation, additional nonagricultural growth mainly comes from manufacturing and private services. Agroprocessing is one of the most important components of manufacturing in Ethiopia, and private services are primarily for meeting domestic demand. Thus, accelerated growth in these nonagricultural subsectors is expected to create demand for agricultural goods, both through production and consumption linkages. Moreover, such nonagricultural growth is good for job creation, because it increases labor demand in both agricultural and nonagricultural sectors. However, more private investments and higher growth rates in capital accumulation are the preconditions for greater multiplier effects and job creation in the nonagricultural sector. Incentives for the private sector to invest can be discouraged in a business environment that has institutional barriers. These will constrain nonagricultural growth led by the private sector and hence limit job creation. The model did not consider these constraints, which should ideally be taken into consideration for Ethiopia.

Fifth, real prices for staple crops and livestock products are expected to fall when growth in these agricultural subsectors is faster than growth in other sectors of the economy. Urban consumers as well as farmers who are net buyers of foodcrops and livestock products will benefit from such declines in prices. Conversely, farmers who are net sellers of these products will be hurt by lower incomes. Thus, it is essential to pay close attention to any potential negative effects on famer income induced by falling prices when agricultural policies favor only a few crops or livestock products. The simulation results also reveal the importance of concurrent growth of agricultural and nonagricultural sectors for stabilizing agricultural prices—an important linkage effect that can only be observed though general equilibrium analysis.

Sixth, the impact of growth on poverty is larger when economywide growth is driven by agriculture rather than by nonagriculture. Agriculture-led growth can lift 1.4 times more people out of poverty than the same amount of nonagriculture-led growth.

Finally, nonagriculture-led growth can become less pro-poor even in urban areas when such growth causes domestic food prices to rise. This result has important policy implications when promoting nonagricultural growth. Although the participation of the poor in the growth process is important for promoting any form of growth, it is equally important to pay attention to possible food price increases from neglecting agriculture. This kind of growth outcome has recently been observed in many developing countries where high nonagricultural growth has been accompanied by food price inflation. It may also explain the slowdown in poverty reduction in Ethiopia's urban areas.

This chapter quantitatively measured growth linkages and growth–poverty relationships by assuming that economywide growth is driven by accelerated growth in different sectors or subsectors of agriculture. Nevertheless, it is not the intention of this analysis to prioritize particular sectors for Ethiopia's growth strategy. Rather,

our analysis reveals differential roles for economic sectors in generating both growth and poverty reduction and hence displays their interdependence during the development process.

Government policies and public investments are important conditions for productivity-led growth in the economy. However, they are not assessed in this chapter. Moreover, to stimulate the same level of economic growth across different subsectors may require different levels of public investment. We did not use the Ethiopian DCGE model for cost–benefit assessment. Moreover, growth at the subsector level is not necessarily the result of public investment. Investment by the private sector is often the dominant force in generating growth in the nonagricultural sector and in export-oriented high-value agriculture. In this case, the existence of a dynamic private sector requires policy supports and appropriate institutional environments. These factors are often more important for capital accumulation than public sector direct intervention.

In the agricultural sector, both better incentives and improved production conditions are needed to provide farmers with more opportunities to diversify and consequently to transition many crops currently grown for subsistence into marketable commodities and cash income opportunities. Policies and public investments that will help improve agricultural production and market conditions and encourage farmers to improve land and labor productivity are also necessary. The main elements of the Ethiopian government's approach to improving market connectivity have focused on the crucial areas of liberalizing markets and improving roads, especially major highways. Liberalization has improved the functioning of grain markets after the interventionist policies of the Derg, particularly in regions that produce surplus grain (World Bank 2006). The government has recognized that a dramatically improved road network is a prerequisite for enhanced growth in agriculture and for fostering urban–rural linkages. However, transport costs for farmers and traders remain high, despite a significant effort over the past decade on road construction. This is in part because most farmers lack feeder roads to the main networks, and roads are long-term and costly investments that do not improve yields or generate positive returns quickly. However, it is broadly accepted that growth in the agricultural sector is constrained by the service sector, including trade, transport, and financial and business services. Improvements in these market-related services will strengthen intersectoral linkages and increase growth-multiplier effects. Moreover, reducing marketing costs benefits smallholders by increasing the net prices they receive for their goods, thereby raising incomes. Improving market conditions also creates a more efficient trading sector, which itself can increase nonagricultural incomes without necessarily raising costs.

Looking beyond road investments, supportive policy measures are also needed to develop functioning markets. Institution building and attention to risk, information, and distortions related to food aid are also critical (Gabre-Madhin 2001). The

government's recent emerging-market strategy has resulted in a central commodity exchange to address problems of market information and transaction costs and risks and to exploit scale economies through cooperatives (Gabre-Madhin and Goggin 2006). However, the outcome has so far not been as positive as expected, because other policy and institutional barriers have constrained market participation in the private sector. Many policy measures in other sectors, such as extending mobile phone coverage to rural villages or subsidizing the purchase of radios, could also have substantial impacts on market responsiveness and connectivity. Similarly, innovative approaches are needed to help farmers meet the new challenges of participating in global markets—particularly meeting quality and safety standards.

In conclusion, exploiting potential growth linkages and fostering greater poverty reduction and structural transformation require a diversified or balanced growth strategy that encompasses agricultural staples and export crops. The findings in this chapter imply that the current emphasis on ADLI is, in principle, warranted. However, our results also show that an exclusive focus on agriculture, and particularly on a few selected agricultural subsectors, is often counterproductive. Such focus would at best lead to suboptimal outcomes in growth and poverty reduction. The greater comprehensiveness of the new PASDEP strategy suggests that policymakers may have learned that lesson.

Appendix

Table 5A.1—Income elasticities of demand used in the Ethiopian dynamic computable general equilibrium model

Category	Rural	Urban	Category	Rural	Urban
Maize	0.70	0.50	Cattle meat	0.80	0.80
Wheat	1.00	0.66	Poultry	0.75	1.15
Teff	1.10	0.70	Milk	0.75	0.75
Other cereals	0.70	0.50	Other meats	0.50	0.50
Root crops	0.50	0.70	Fish	0.70	0.70
Pulses	0.75	0.60	Processed foods	0.80	0.90
Oilseeds	0.80	0.50	Beverages	0.50	0.80
Enset	0.70	0.50	Textiles	1.20	1.00
Vegetables	0.50	0.75	Other manufactures	1.20	1.00
Fruits	0.50	0.75	Construction	0.90	0.50
Sugarcane	0.75	0.60	Utilities	1.00	0.80
Chat	0.70	0.50	Trade and transport	1.00	0.80
Coffee	0.60	0.60	Restaurants	0.80	0.50
Tobacco	0.70	0.50	Other private services	1.10	1.10
			Public services	1.20	0.90

Source: Authors' estimates based on data from the 2004/05 Household Income, Consumption and Expenditure Survey (Ethiopia, CSA 2005).

Table 5A.2—Structure of the Ethiopian social accounting matrix

Agricultural sectors	Teff; barley; maize; sorghum; wheat; pulses; *enset;* oilseeds; vegetables; fruit crops; sugarcane and sugar beets; cotton; tea; *chat;* coffee; tobacco; cut flowers; other crops; cattle; poultry; other small livestock; raw milk; forestry; fishing
Industrial sectors	Coal; natural gas; other mining; meat and oilseed products; dairy products; grain mill products; grain mill services; sugar and sugar confectionary; tobacco products; manufacturing of tea; beverages; other processed food products; cotton lint; thread and yarns; fiber; other textiles; wearing apparel; leather products; wood products; paper products; publishing; petroleum; fertilizer; chemicals, rubber, and plastic products; nonmetal products; metal products; motor vehicles and parts; other transport equipment; electronic equipment; machinery and equipment; other manufactures; electricity; water; construction
Service sectors	Trade and repair services; hotels and restaurants; transport services; communication; financial services; business services; real estate and renting services; recreation and other private services; public administration and defense; education; health
Factors	Professional workers; technicians and sales workers; unskilled workers; elementary occupation workers; agricultural family workers; agricultural land; livestock stocks; physical capital
Households	Poor and nonpoor households separated into four rural agroecological zones and small and large urban centers
Regions	Zone 1 (moisture-reliable region); Zone 2 (moisture-unreliable *enset* region); Zone 3 (drought-prone region); Zone 4 (pastoralist region)

Source: Authors.

Note

1. It is worth noting that maize yields in Ethiopia are higher than that in many other African countries. According to World Bank (2007), the average maize yield rose from 1.0 to 1.8 mt/ha during 1986–2000 as the result of National Maize Research Programs.

References

Ahmed, H., A. Amogne, T. Tebekew, B. Teferra, E. Tsehaye, P. Dorosh, S. Robinson, and D. Willenbockel. 2009. *A Regionalized Social Accounting Matrix for Ethiopia, 2005/06: Data Sources and Compilation Process.* Addis Ababa, Ethiopia: Ethiopian Development Research Institute.

Diao, X., and A. Nin Pratt. 2007. "Growth Options and Poverty Reduction in Ethiopia: An Economy-Wide Model Analysis." *Food Policy* 32: 205–228.

Dorosh, P., and J. Thurlow. 2009. *Implications of Accelerated Agricultural Growth on Household Incomes and Poverty in Ethiopia: A General Equilibrium Analysis*. Ethiopia Strategy Support Program 2 Discussion Paper 2. Washington, DC: International Food Policy Research Institute.

EDRI (Ethiopian Development Research Institute). 2009. *Ethiopia: Input–Output Table and Social Accounting Matrix.* Addis Ababa, Ethiopia. www.edri.org.et/Documents/SAM%20document%20with%20list%20of%20tables.pdf.

Ethiopia, CSA (Central Statistical Agency). 2004. *Report on Area and Production of Belg Season Crops for Private Peasant Holdings*. Statistical Bulletin 302. Addis Ababa, Ethiopia: Federal Democratic Republic of Ethiopia.

———. 2005. *Household Income, Consumption, and Expenditure Survey 2004/2005.* Addis Ababa, Ethiopia: Federal Democratic Republic of Ethiopia.

———. 2008a. *Agricultural Sample Survey 2007/2008 (2000 E.C.): Volume I—Report on Area and Production Crops (Private Peasant Holdings, Meher Season)*. Statistical Bulletin 417. Addis Ababa, Ethiopia: Federal Democratic Republic of Ethiopia.

———. 2008b. *Agricultural Sample Survey 2007/2008 (2000 E.C.): Volume III—Report on Farm Management Practices (Private Peasant Holdings, Meher Season).* Statistical Bulletin 417. Addis Ababa, Ethiopia: Federal Democratic Republic of Ethiopia.

Ethiopia, CSA (Central Statistical Agency), EDRI (Ethiopian Development Research Institute), and IFPRI (International Food Policy Research Institute). 2010. *The Population and Housing Census Atlas of Ethiopia 2007.* Addis Ababa, Ethiopia; Washington, DC. www.csa.gov.et/pdf/atlas%20cencus%202007.pdf.

Ethiopian Roads Transport Authority. 2006. "Ethiopian Road Network." Dataset. Addis Ababa, Ethiopia.

Gabre-Madhin, E. Z. 2001. *Market Institutions, Transaction Costs, and Social Capital in the Ethiopian Grain Market*. Research Report 124. Washington, DC: International Food Policy Research Institute.

Gabre-Madhin, E. Z., and I. Goggin. 2006. "Does Ethiopia Need a Commodity Exchange? An Integrated Approach to Market Development." Paper presented at the Ethiopia Strategy Support Program Conference, Addis Ababa, Ethiopia, June 6–8.

MOFED (Ministry of Finance and Economic Development). 2002. *Ethiopia: Sustainable Development and Poverty Reduction Program.* Addis Ababa, Ethiopia: Federal Democratic Republic of Ethiopia.

———. 2005. *Ethiopia: Building on Progress: A Plan for Accelerated and Sustained Development to End Poverty (PASDEP) (2005/06–2009/10).* Addis Ababa, Ethiopia: Federal Democratic Republic of Ethiopia.

Taffesse, A. S. 2007. "Product Flows and Growth Linkages in Ethiopia—A Note." In *Fostering New Development Pathways: Harnessing Rural-Urban Linkages* (*RUL*) *to Reduce Poverty and Improve Environment in the Highlands of Ethiopia: Proceedings of a Planning Workshop on Thematic Research Area of the Global Mountain Program* (*GMP*) *Held in Addis Ababa, Ethiopia, August 29–30, 2006,* edited by Gete Zeleke, Peter Trutmann, Aster Denekew, 141–156. Lima, Peru; Addis Ababa, Ethiopia: Global Mountain Program.

World Bank. 2006. *Ethiopia: Policies for Pro-Poor Agricultural Growth.* Washington, DC.

———. 2007. *Ethiopia: Accelerating Equitable Growth—Country Economic Memorandum.* Washington, DC.

———. 2011. *World Development Indicators.* Washington, DC.