The Economic Importance of Agriculture for Sustainable Development and Poverty Reduction in Ethiopia

Findings of an OECD Research Project
"The Economic Importance of Agriculture for Sustainable Development and Poverty Reduction"

Addis Ababa, Ethiopia
July 20, 2010

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

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Plan of Presentation

* **Approach and Findings - Summary**

* Approach and Findings - the SIO model

* Approach and Findings – the Dynamic CGE model

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Development Issues and Challenges

- Ethiopia is a poor country;

- Ethiopia is an agricultural country but agriculture has been challenged by—

  - Large and growing population;
  - Limited and deteriorating land resources;
  - Highly fluctuating growth;

- Doubt about Ethiopia's agricultural potential

  - Can agriculture lead the process of industrialization and economic transformation?
  - Can agricultural growth lead to further and significant poverty reduction?

- Debate about what kind of agricultural growth

  - More policy support to the large-scale commercial agriculture
  - More policy support to export-led agriculture

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Research Questions and Approaches

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hy agriculture?

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ow to grow?

pproaches

inking agriculture to the rest of economy;

inking growth to poverty reduction;

easuring contribution of agriculture to economy-wide growth and poverty reduction at subsector level

Key Research Findings (1)

- **Why agriculture?**
  - **Development stage matters**
    - Size of the sector
    - Strong linkages to the rest of economy
      - Consumption linkages are most important, explaining 80-90 percent of indirect growth gains due to agricultural growth
- **Why smallholder agriculture-led?**
  - Smallholder-led growth creates more consumption linkages
  - More effective in poverty reduction

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Key Research Findings (2)

Linkages differ across agricultural subsectors

- **Staple-led growth**
  - Advantage in strong linkage effect (with highest growth multiplier)
  - Advantage in effective poverty reduction (with highest poverty-reduction-growth elasticity)
  - **Weakness in job creation**
    - Mainly for domestic demand, which has limits in growth
    - Requires job creation outside cereal sector to absorb more rural labor released from high productivity in cereals;

- **Staple-led growth (*continued*)**
  - **Prices may fall too much if growth coming from few crops/products**
    - Again, domestic market demand constraint
    - Important for concurrent growth of both agriculture and non-agriculture for stabilizing agricultural prices

- **Export-agriculture-led growth**
  - Relative smaller growth multiplier (than either cereal-led or livestock-led growth)
    - But, has the advantage of linking with non-agriculture
  - Advantage for job creation
  - Minimum price effect
  - But, requires more investment led by the private sector

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Key Research Findings (4)

Measured growth multipliers differ between the two methods

- **Both in literature and our Ethiopian models, multipliers are larger in SIO models than in CGE models, due to:**

  - Fixed price assumption in SIO vs. endogenous prices in CGE
  - Flexible factor supply assumption in SIO vs. resource constraint assumption in CGE

- **In our Ethiopian models, the SIO model shows that multiplier is larger in agriculture than in non-agriculture; while the CGE model shows that multiplier of non-agriculture-led growth is slightly larger than the agriculture-led growth, due to:**

  - Land constraint in agriculture
  - Higher capital intensity in non-agriculture and corresponding growth in capital

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Key Research Findings (5)

Growth led by:	Cereals	Export agriculture	Livestock	All agriculture	Non agriculture
Total labor-GDP growth elasticity	-0.02	0.15	0.11	0.06	0.10
Poverty-growth elasticity	-1.40	-1.16	-1.16	-1.41	-1.05
Growth multipliers	1.13	1.04	1.06	1.03	1.06
% Contribution to growth multipliers					
Own sector	88.3	96.5	94.0		
Agriculture	10.3	0.3	2.6		
Nonagriculture	1.4	3.2	3.4		

Source: The dynamic CGE model for Ethiopia

- **Nonagriculture-led growth may increase urban poor**
  - **Possibly to cause food price rising**
    - Has been seen in some developing countries
    - Has shown such possibility in Ethiopia
    - Important to pay attention when non-traded nonagricultural sector (e.g. construction and housing) grows too fast

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Conclusions

- It is not the intention of the report to identify which sectors that should be picked by the government in growth strategy;

- The report reveals differential roles of different economic sectors in growth and poverty reduction and such roles may change in development process;

- Emphasizes their interdependence in development process;

- Creating synergy among sector growth will be a key.

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Outline

- Background
  - Government policy
  - Recent economic performance
- Methodology – SIO Model
- Key Findings - **how powerful growth linkages are in Ethiopia**

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Background - Government Policy

- Liberalization and structural adjustment;

- Agriculture Development Led Industrialization (ADLI) adopted as development strategy in 1994;

  - broad-based development within the agricultural sector;

  - agricultural development power broad economic growth/development;

- The Poverty Reduction/Development Plans

  - Sustainable Development and Poverty Reduction Program (SDPRP) – 2002/03-2004/05

  - Plan for Accelerated and Sustained Development to End Poverty (PASDEP) - 2005/06-2009/10

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Background - Government Policy

- PASDEP focuses on a number of **areas/issues** in setting targets and designing interventions

  - a geographically differentiated strategy,

  - addressing the population challenge,

  - unleashing the potential of Ethiopia's women,

  - strengthening the infrastructure backbone ,

  - managing risk and volatility,

  - scaling up to reach the MDGs, and

  - creating jobs (particularly in urban areas);

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Background - Government Policy

- The **agricultural growth agenda** set by PASDEP consists of the following elements:

  - shift to higher-valued crops;

  - promote niche high-value export crops;

  - a focus on selected high-potential areas;

  - facilitate the commercialization of agriculture;

  - support the development of large-scale commercial agriculture where it is feasible; and

  - better integrating farmers with markets – both locally and globally.

Background - Government Policy

- The **instruments** to achieve the agriculture agenda in the context of PASDEP include:

  - constructing farm-to-market roads;

  - development of agricultural credit markets;

  - specialized extension services for differentiated agricultural zones and types of commercial agriculture;

  - development of national business plans and tailored packages for specialized export crops (such as spices, cut flowers, fruits and vegetables);

  - area irrigation through multi-purpose dams;

  - measures to improve land tenure security, and to make land available where feasible for large-scale commercial farming; and

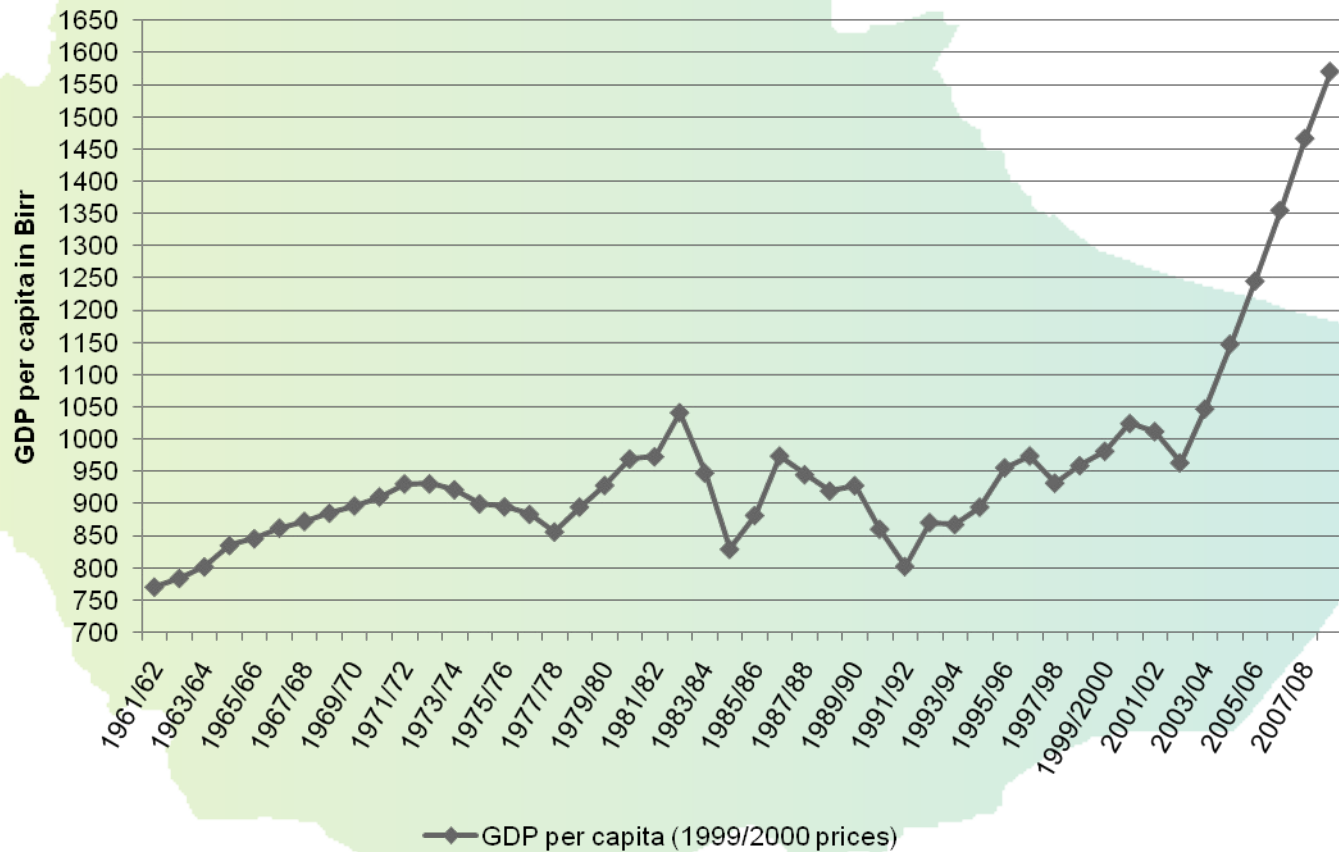 - reforms to improve the availability of fertilizer and seeds.

  A new poverty reduction/development plan is currently in preparation.

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Background – Economic Performance

- Overall – GDP growth

Ethiopia - GDP per capita (1999/2000 prices)

Background – Economic Performance

- Agriculture – Crop production growth

  - **Data show large increases in production in the last decade** – acreage expansion main source overall

Crop	Growth (1997/98-2007/08) - (%)		
	Production	Acreage	Yield
Sorghum	149	61	55
Teff	129	47	56
Wheat	109	81	16
Maize	94	61	21
Barley	72	44	19
All Cereals	111	57	

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Background – Economic Performance

- Agriculture – Crop production growth

  - **Yield increases became more important in recent years;**

Crop	Average Annual growth rate - 2004/05-2007/08 (1997-2000 E.C.) (%)		
	Production (quintals)	Area Cultivated (hectares)	Yield (quintals per hectare)
All Cereals	12.2	4.8	6.2
Teff	15.9	6.7	7.7
Barley	0.7	-3.4	4.5
Wheat	2.1	0.6	1.5
Maize	18.9	9.0	7.8
Sorghum	18.3	7.4	8.9

Note: Cereal yield is calculated as acreage-share weighted average of the yields of the five major cereals listed in the table – they account for more than 95 percent of cereal acreage and cereal output.

The central questions are – what are the sources of this growth? And is it sustainable?

Research Question

- What are the size of linkages that alternative growth patterns can generate?

Approaches

- SAM-based fixed-price models (IO, SIO);

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Types of growth linkages

- **Production linkages**
  - Backward - input demands
  - Forward – output supply
- **Consumption linkages –** spending on consumer goods
- **Labor market linkages –** employment, wage rates
- **Investment linkages –** source of capital

Methodology - Model

Fixed-price Semi-Input-Output (SIO) model

- ▪ fixed-coefficient Leontief technology,

- ▪ assume constant prices.

- ▪ classify sectors into two groups:

- constrained supply response – net-exports (imports) adjust; and

- supply perfectly elastic supply response – domestic output adjusts;

Choice ideally reflects tradability, technological/resource constraints, capacity utilization rates

an important determinant of results

Methodology - Social Accounting Matrix (SAM)

- **Ethiopian SAM 2006/07 developed by EDRI**
- **24 agricultural sectors and their production disaggregated into 4 agro-ecological zones**
- **44 non-agricultural sectors:**
  - 16 agro-processing and agriculture-related manufacturing sectors
  - 11 other manufacturing sectors
  - 6 other industrial sectors
  - 8 private service sectors
  - 3 public service sectors
- **12 representative households:**
  - 8 rural poor and non-poor households defined by zones
  - 4 urban poor and non-poor households defined by large cities and small/medium towns
- **5 types of labour**

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Key Findings - SIO Model

	Teff	Maize	Coffee	Livestock (Cattle)	Thread and Yarn	Constru-ction
Shock: Output	1	1	1	1	1	1
Change in Incomes						
Rural poor	0.40	0.38	0.20	0.51	0.20	0.21
Rural non-poor	0.76	0.82	1.02	0.78	0.36	0.39
Urban poor	0.04	0.04	0.05	0.04	0.11	0.08
Urban non-poor	0.17	0.17	0.21	0.18	0.29	0.31
Change in GDP - total	1.42	1.47	1.54	1.56	1.01	1.08
Change in GDP – ind.	0.59	0.60	0.72	0.62	0.58	0.83
% due to consumption linkages	88	90	79	92	66	47
% due to indirect production linkages	12	10	21	18	34	53

Key Findings – SIO Model

- Agricultural growth linkages significant in Ethiopia;
- Given low intermediate input use, consumption linkages dominate;
- Require agricultural growth to occur;

MM and/or CGE models provide more interesting results:
- **price effects**
- **poverty impact**

2. Agriculture and its sub-sectors (such as staples) are relatively large;
   i. Share in GDP, consumption;
   ii. Share in employment - incomes;
3. Value-added share (particularly labour value-added) in output of agriculture and its sub-sectors are relatively large (77-98% of value of output);
4. Share of imports in intermediate consumption of non-agriculture (particularly in industry) is large;

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Conclusions

- Agricultural growth linkages are significant in Ethiopia;

- Consumption linkages dominate indirect effects;

- Non-agricultural sectors have to grow in order to match growing supply of agricultural products and increasing demand for non-agricultural products – *case of private services*.

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Why a CGE Model?

- **Price matters**
  - Producers and consumers respond to prices
  - Price affects resource allocation
  - Price affects household incomes and welfare
  - Existence of cross-sector price interactions
  - ***Flexible (endogenous) price model necessary***
- **Resource constraint matters**
  - Land resource
  - Skilled labor
  - Capital
  - ***A full General equilibrium model necessary***
- **Income source and distribution matter**
- **Agro-ecological conditions matter**

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Social Accounting Matrix (SAM)

- **National SAM developed by EDRI and the same SAM used in the SIO model analysis**
- **24 agricultural sectors and their production disaggregated into 4 agro-ecological zones**
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- **5 types of labor**

Ethiopia: Agricultural Suitability and Market Access

Cities > 10,000
- 10,037 – 50,000
- 50,000 – 100,000
- 100,000 – 150,000
- 150,000 – 500,000
- > 500,000

Road Type
- Trunk
- Main Access
- International Corridors

AgroEcological Zones
- Drought prone
- Humid lowland moisture reliable
- Other moisture reliable - Cereals
- Other moisture reliable - Enset
- Pastoralist
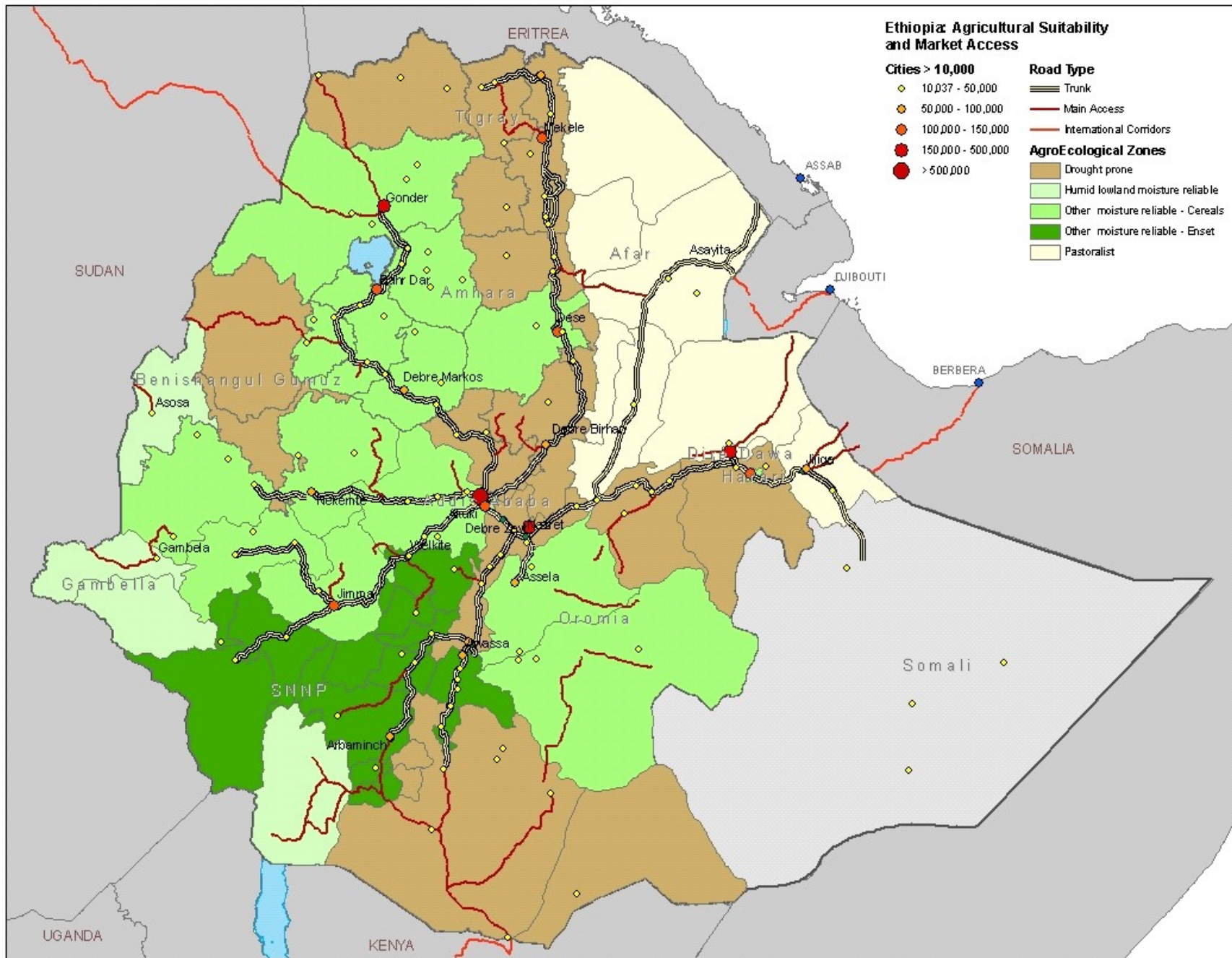
A Dynamic CGE Model for Ethiopia

- **General equilibrium component**
  - **Commodity market equilibrium**
    - Imperfect substitution in the sectors with trade activity; endogenously determined prices for the part of the goods domestically produced and consumed and such prices are affected by the world prices for the other part of the same goods exported and imported
    - Endogenously determined commodity prices for non-traded sectors (i.e. domestic supply = demand, e.g. teff, enset, construction and some private services)
  - **Factor market equilibrium**
    - Endogenously determined factor returns to land, skilled labor and capital
    - Demand driven (flexible supply) for agricultural and other types of unskilled labor, and their returns are endogenously linked to the wage rate for the skilled labor
- **Dynamic component**
  - Population growth
  - Productivity change
  - Capital accumulation

A Dynamic and Regionalized Economywide Model (DREM)

A Microsimulation Model and Micro-Macro Link

- **The microsimulation model defined for all sample households in HICE 2005 and it captures only demand and expenditure by commodities and total income (measured by total expenditure)**

- **Micro (microsimulation model) and macro (DREM) link**
  - Sample households in the microsimulation model link to their representative households in DREM by zone, rural and urban, poor and non-poor
  - Top-down linkages through consumption/demand
  - Headcount poverty assessment through this link

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Relationship between Poverty and Growth

	1995/96	1999/00	2004/05	Annual change (%)		
				96-00	00-05	96-05
GDP pc	937	1,017	1,219	1.66	3.69	2.67
Agricultural GDP pc	474	474	532	0.03	2.33	1.17
Nonagricultural GDP pc	463	543	687	3.24	4.83	4.03
National poverty rate (%)	45.5	44.2	38.5	-0.58	-2.62	-1.61
Poverty-growth elasticity				-0.35	-0.71	-0.60

Note: Income is measured in constant birr
Sources: Authors' calculation using data from MOFED for poverty and World Bank for income

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Base-Run Result of DREM

	National economy	Agriculture	Cereals	Export crops	Non-agriculture
Annual growth rate, 2009-2015 (%)					
GDP	6.1	4.2	4.8	5.0	7.5
Total labor	2.7	2.3	2.2	1.8	3.1
Land	3.4	3.4	2.6	4.7	
Capital	5.0	2.8			5.7
TFP	1.6	1.3	2.3	0.0	1.7
Contribution to growth, 2009-2015 average (%)					
Total labor	13.8	18.7	23.3	5.6	11.3
Land	10.7	30.6	26.9	95.4	
Capital	47.3	19.1			63.6
TFP	28.2	31.6	49.8		25.1

Six Growth Scenarios of DREM

1. **Cereal-led growth:**
   - Additional TFP growth in 5 cereals only (1.2% for teff - 3.0% for wheat)

2. **Export-led growth:**
   - Additional TFP growth in 7 export crops only (0.5% for oilseeds - 3.0% for coffee)
   - Additional land expansion

3. **Livestock-led growth:**
   - Additional TFP growth in 4 livestock sectors only (0.8% for cattle - 1.5% for poultry)

* **Agriculture-led growth:** Combination of 1-3

* **Nonagriculture-led growth**
   - Additional TFP growth in the private nonagricultural sectors by 2%

* **Combined growth:** combination of 4 and 5

Growth Rate of DREM Scenario Result

	Growth led by						
	Base-run	Cereals	Export agriculture	Livestock	All agriculture	Non agriculture	Combined
GDP	6.1	6.3	6.2	6.3	6.8	7.2	7.8
AgGDP	4.2	4.8	4.5	4.7	5.9	4.4	6.0
Cereals	4.8	6.6	4.8	4.8	6.7	4.8	6.7
Export crops	5.0	5.0	7.6	5.0	7.6	5.0	7.6
Livestock	3.9	4.0	3.9	5.6	5.7	4.0	5.8
NonagGDP	7.5	7.5	7.5	7.5	7.5	7.6	9.2
Manufacturing	7.7	7.6	7.7	7.8	7.7	9.7	10.0
Agro-processing	6.9	6.9	7.0	6.9	7.1	8.4	8.7
Private services	8.0	8.0	8.0	8.0	8.1	10.0	10.0

Linkage Results in DREM

Growth led by:	Cereals	Export agriculture	Livestock	All agriculture	Non agriculture
Total labor-GDP growth elasticity	-0.02	0.15	0.11	0.06	0.10
Poverty-growth elasticity	-1.40	-1.16	-1.16	-1.41	-1.05
Growth multipliers	1.13	1.04	1.06	1.03	1.06
Contribution to growth multipliers (%)					
Own sector	88.3	96.5	94.0	96.8	93.9
Agriculture other than own sector	10.3	0.3	2.6		6.1
Non-agriculture	1.4	3.2	3.4	3.2	

- Cereal-led growth has the highest poverty-growth elasticity and growth multiplier, but it lowers economy-wide labor demand;
- Export-agriculture-led growth has the lowest growth multiplier but increases total labor demand;
- Cereal-led growth stimulates more growth within agriculture, while export-agriculture-led growth creates more growth outside agriculture;
- Livestock-led growth has relatively high elasticity and multiplier for all the three indicators, and stimulates growth both within and outside agriculture;
- Agriculture-led growth is more pro-poor, while non-agriculture-led growth creates more jobs;

Price Effect in DREM – Positive Side

Shares of increased total consumption (%), 2015

Growth led by:	Cereals	Export agriculture	Livestock	All agriculture	Non agriculture
Cereals & related	76.4	10.2	3.9	29.5	5.2
AgExports & related	1.5	20.6	1.6	6.0	4.6
Livestock products	3.0	7.8	73.2	25.2	-6.8
Other foods	7.4	7.8	1.8	19.7	5.3
Nonfoods	11.7	53.8	19.5	19.6	91.7

- Increased consumption mainly stays in the shocked sector – price effect
- Staple-led growth (cereals and livestock) increases food consumption more
- Export-agriculture-led growth creates more demand for non-foods
- Non-agriculture-led growth causes modest increases in food demand and consumption of livestock products falls due to price hike
- Agriculture-led growth creates balanced growth for all food and non-food products

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Price Effect in DREM – Negative Side (1)

Price indices (2015, base-run=1)

Growth led by:	Cereals	Export agriculture	Livestock	All agriculture	Non agriculture	Combined
Teff	0.92	1.01	1.02	0.96	1.06	1.02
Barley	0.87	1.01	1.02	0.91	1.06	0.97
Wheat	0.84	1.01	1.02	0.88	1.06	0.93
Maize	0.85	1.01	1.03	0.89	1.07	0.96
Sorghum	0.90	1.01	1.03	0.95	1.07	1.02
Oilseeds	1.00	0.99	1.02	1.00	1.05	1.06
Coffee	1.00	0.96	1.02	0.97	1.05	1.02
Poultry	1.00	1.01	0.91	0.92	1.09	1.01
Milk	1.00	1.01	0.89	0.91	1.09	0.99
Meat products	1.00	1.03	0.98	1.01	0.99	1.00
Dairy products	1.00	1.01	0.90	0.91	1.09	0.99
Grain milling	0.99	1.00	1.02	1.02	1.00	1.03
Other food	1.00	0.98	1.03	1.01	0.98	0.99

Price Effect in DREM – Negative Side (2)

- Cereal prices fall by 8–16% when cereals grow much faster than other sectors;

- Livestock prices fall by 9–11% when livestock grows too fast;

- Food prices rise by 6–21% when non-agriculture grows too fast;

- Urban poverty higher when non-agriculture grows too fast;

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Price Effect in DREM – Negative Side (3)

Growth led by:	Base-run	Cereals	Export agriculture	Livestock	All agriculture	Non agriculture	Combined
Poverty rate by 2015 (%)							
National	28.6	26.1	28.1	27.9	24.8	27.0	23.9
Rural	29.6	27.0	29.2	29.0	25.6	27.5	24.4
Urban	23.5	22.1	22.9	22.5	20.7	24.5	21.5
Additional number of people out of poverty (comparing 2015 with base-run)							
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
GDP growth rate (%)	6.1	6.3	6.2	6.3	6.8	7.2	7.8

Price Effect in DREM – Negative Side (4)

- Avoid to favor a few selected staple crops or livestock products only

- Importance of concurrent growth of agriculture and non-agriculture for stabilizing agricultural prices

- Pay attention to possibly rising food price accompanied by accelerated nonagricultural growth

- Pay attention to negative side of growth effect on poverty when non-agriculture grows too rapidly (particularly for such effect on the urban poor)

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Summary and Conclusion (1)

- The importance of agriculture is due to its large size in the Ethiopian economy and as a main income source for a majority of Ethiopians

- The importance of agriculture is also due to its strong linkages and consumption linkages dominate at the current development stage

  - Broad agriculture growth creates balanced demand increase for both agricultural and nonagricultural goods – less inflation pressure

- Agriculture is a large sector with various activities, and no single sector has a dominant role in all aspects along the development process.

  - Staple crops and livestock have the strongest linkage effect

    - Such growth linkages are mainly on the consumption side

Summary and Conclusion (2)

- Staple-led growth is more effective in poverty reduction (mainly through its strong consumption linkage effect)
- However, high productivity in staple production (particularly in cereal production) will release labor and has limitation in job creation
- Declines in food crop and livestock prices can be significant if growth only occurs in a few food crops and livestock sectors
- Export agriculture has rather modest linkage effect because weak in consumption linkages
- Export agriculture creates linkages effect in the nonagriucltural sector
- Export-agriculture-led growth increases labor demand

- Nonagriculture-led growth can have nice linkage effect to the agricultural sector and such linkage effect can be larger than that in agriculture

Summary and Conclusion (3)

- Nonagricultural growth creates jobs
- Fast nonagricultural growth without simultaneous growth in agriculture causes food price to rise
- Price effect of nonagricultural growth can slow down poverty reduction particularly in the urban areas

- **Avoid to favor a few selected staple crops or livestock products to mitigate price effect**

- **Importance of concurrent growth of agriculture and non-agriculture for stabilizing agricultural prices**

- **Pay attention to the rising food price accompanied by accelerated nonagricultural growth, which has become more important in these days**

- **Pay attention to urban poor, which has become increasingly important**

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