MARKET CONCENTRATION AND PRICING BEHAVIOR IN THE FERTILIZER INDUSTRY: A GLOBAL APPROACH

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INTRODUCTION

- The fertilizer industry is a global market with high and increasing levels of concentration and trade.
  - The top five countries control 50-80 percent of the world's production capacity for the major nitrogen, phosphate and potash fertilizer (IFDC, 2009).
  - Among the major producing countries, the top four firms generally control more than half of each country's production capacity (except in China).
- The high levels of concentration in the industry mainly result from:
  - High requirements of raw material not available worldwide.
  - Large up-front investments required & economies of scale in production.
- Yet, high levels of concentration in an industry may also result in market power exertion and tacit collusion among firms.

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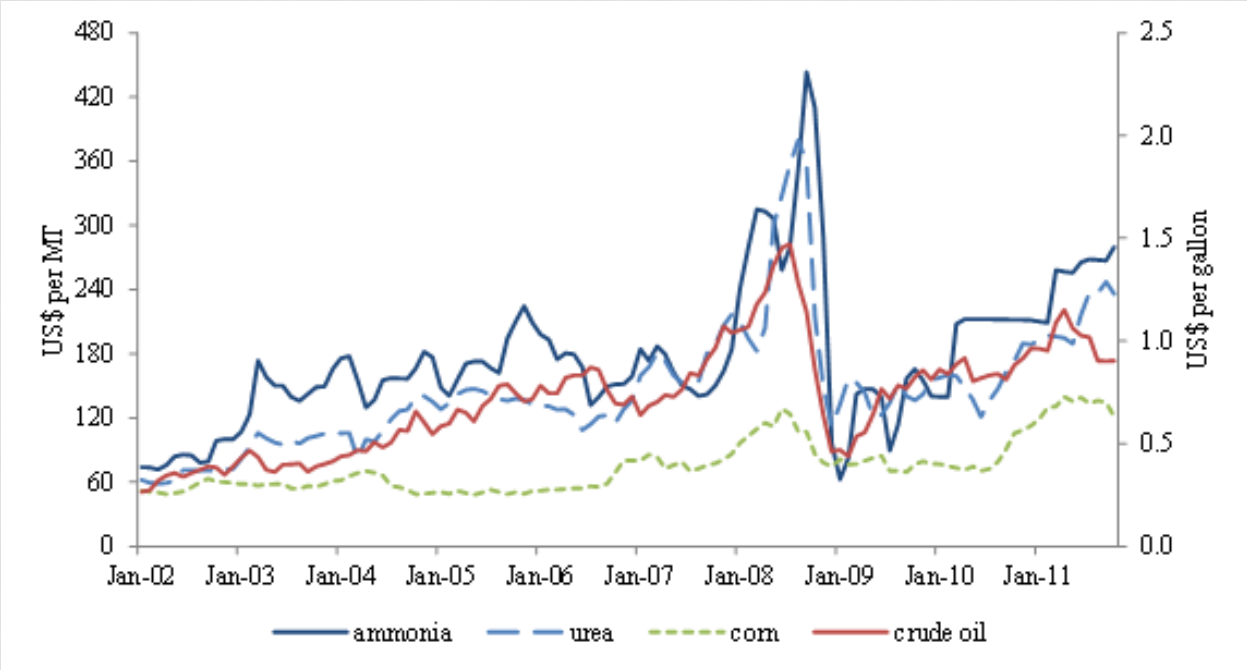
INTRODUCTION (2)

- During the food price crisis of 2007-2008, fertilizer prices exhibited higher spikes than oil and agricultural prices.

Real monthly ammonia, urea, corn and crude oil prices, 2002-2011



Note: Prices deflated by CPI, 1982-84=100. The prices correspond to Ammonia US Gulf barge and Urea US Gulf prill import from Geen Markets, No. 2 yellow corn FOB US Gulf from FAOSTAT Online database, and Oklahoma crude oil FOB spot price from the Energy Information Administration.

- Industry reports indicate that leading fertilizer producers achieved record profits in recent years (e.g., Potash Corp reported a gross margin of US$ 4.86 billion in 2008 versus US$ 474 million in 2000).

INTRODUCTION (3)

- Market power effects could be outweighing cost-efficiency effects in this highly concentrated market.
- In this study we formally examine the relationship between market concentration and fertilizer prices from a global perspective.
  - We follow a dynamic panel approach using annual data on urea for a panel of countries.
- We also simulate the potential impact of increasing competition at the global/regional level on low-income agriculture (use some countries in sub-Saharan Africa and South Asia as examples).
- Our results point the necessity to further examine potential market power exertion among major producers, which can help to better understand the industry supply chain and provide additional insights for the design of policies that promote sustainable fertilizer use.

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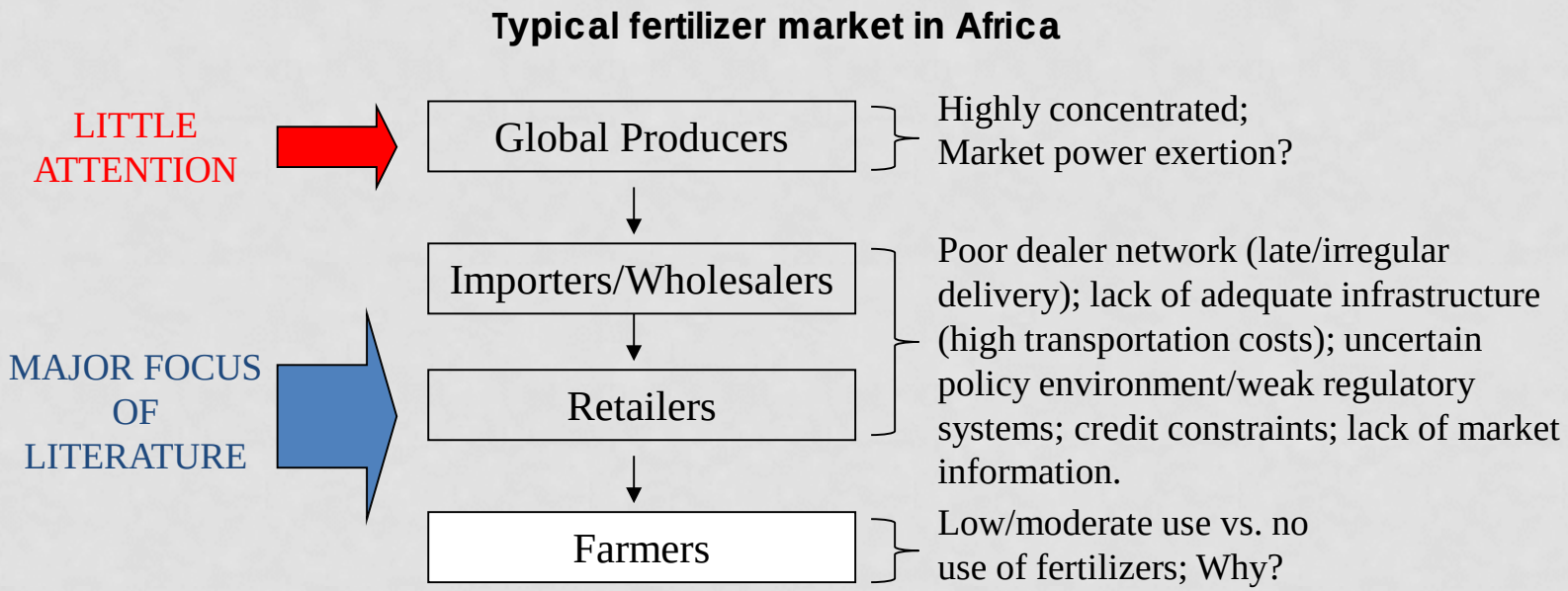
INTRODUCTION (4)



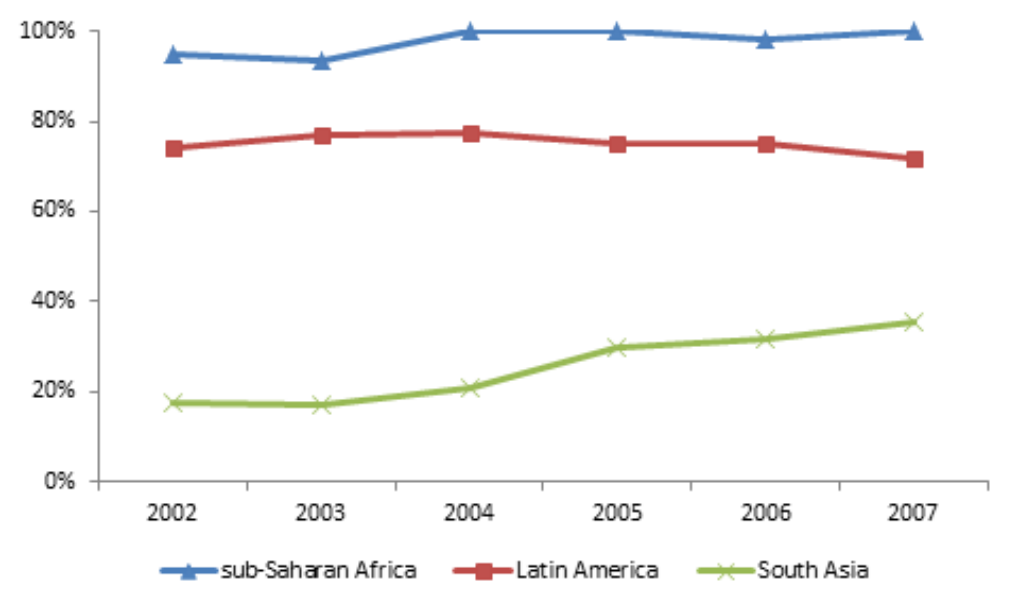
- High prices may not only be the result of several supply- and demand-side constraints at the regional and local level.
- Low-income regions are highly dependent on imported fertilizer and import (international) prices still represent a large fraction of the final price paid by farmers.

GLOBAL PATTERNS

HIGH DEPENDENCE OF DEVELOPING REGIONS ON IMPORTED FERTILIZER

- Despite their different production and consumption levels, sub-Saharan Africa and Latin America rely heavily on imported fertilizer, and South Asia is becoming more dependent on foreign suppliers.

Imports of fertilizer as a percentage of consumption in sub-Saharan Africa, Latin America and South Asia, 2002-2007



Note: Data on fertilizer nutrient consumption and imports obtained from the FAOSTAT Online database.

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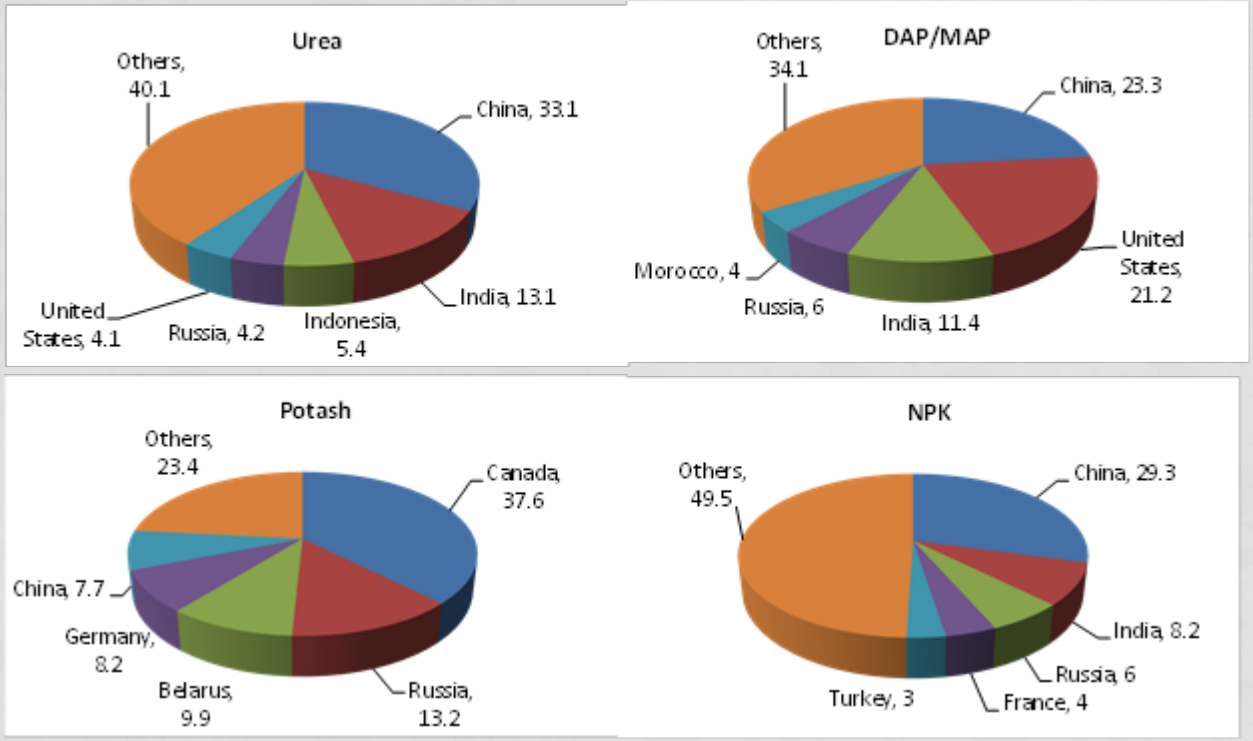
GLOBAL PATTERNS

TOP-5 COUNTRIES CONTROL MORE THAN 50% OF THE GLOBAL PRODUCTION CAPACITY

- Canada & Russia alone explain more than half of potash global capacity.
- Basically the same countries (China, US, India & Russia) control most of the production capacity of urea and DAP/MAP.

Distribution of world fertilizer production capacity by country, 2008-09



Note: Based on capacity of operative plants in 2008-09 according to IFDC Worldwide Fertilizer Capacity Listings by Plant.

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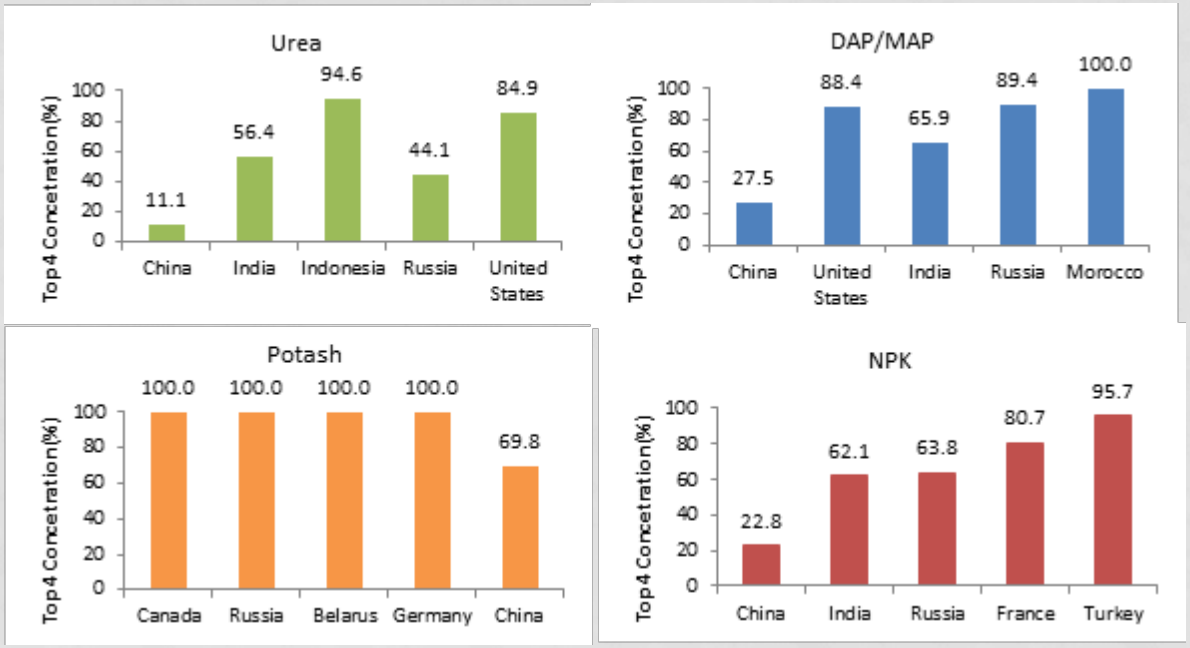
GLOBAL PATTERNS

TOP-4 FIRMS GENERALLY CONTROL MORE THAN HALF OF EACH MAJOR COUNTRY PRODUCTION CAPACITY

- In some cases, only one company operates in the country (e.g., in Belarus and Germany for potash and in Morocco for DAP/MAP).
- Figures do not include associations/partnerships between firms.

Concentration of fertilizer production capacity in main producing countries, 2008-09



Note: Based on capacity of operative plants in 2008-09 according to IFDC Worldwide Fertilizer Capacity Listings by Plant.

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EMPIRICAL MODEL

- We estimate the following dynamic price model.

$$\ln p_{ijt} = \alpha \ln p_{ijt-1} + \beta mktstructure_{ijt} + X_{ijt}\delta + \varepsilon_{ijt}$$

$$\varepsilon_{ijt} = c_i + u_{ijt}$$

where p_{ijt} is the price of urea in country i from region j at year t; $mktstructure_{ijt}$ is a measure of market concentration; X_{ijt} is a vector of controls; c_i is a country specific effect and u_{ijt} is an idiosyncratic shock.

- We use annual data on urea for 38 countries during1970-2002.
  - The panel nature of our data permits us to exploit differences in market structure across countries and time.

- Estimate model following Arellano & Bond (1991) GMM procedure to account for the potential correlation of c_i with some of the X_{ijt}, and the potential endogeneity of market structure and the lag of price.

EMPIRICAL MODEL (2)

- We consider two measures of market concentration:
  - top-4 concentration ratio (CR4);
  - Herfindahl-Hirschman index (HHI).

- To measure market share we consider both production capacity (*q*) and number of plants (*pl*).

- We take into account that countries import part or most of their urea.

$$mktstructure_{ijt} = w_{it} \text{ x } mktstructure_{it} + (1 - w_{it}) \text{ x } mktstructure_{j \neq it} \quad \text{(Measure 1)}$$

$$mktstructure_{ijt} = \mathrm{I}(w_{it} \geq 0.5) \text{ x } mktstructure_{it} + (1 - \mathrm{I}(w_{it} \geq 0.5)) \text{ x } mktstructure_{j \neq it} \quad \text{(Measure 2)}$$

where *i* represents the country, *j* the region the country belongs to, and w_{it} is the share of total consumption from local production.

- Control variables include share of imported urea over total consumption; whether the country is a top producer; regional and time dummies.

RESULTS

EFFECT OF MARKET CONCENTRATION ON UREA PRICES

- Positive correlation between concentration and prices (when significant).
- Elasticities range between 0.82 and 1.65.

Concentration measure	Arellano-Bond difference GMM	
	Model 1	Model 2
Top-4 ratio on production capacity		
Measure 1	0.032	0.316
Measure 2	0.718	0.817*
Top-4 ratio on number of plants		
Measure 1	-1.013	-0.858
Measure 2	0.976**	1.155**
HHI on production capacity		
Measure 1	0.979	1.058
Measure 2	0.672	0.558
HHI on number of plants		
Measure 1	1.642*	1.654*
Measure 2	0.998**	0.921**
Main producer & share imports/consumption	Yes	No
Among top-4 producers & share imports/consumption	No	Yes
Regional fixed effects	Yes	Yes
Year fixed effects	Yes	Yes

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Measure 1 corresponds to the weighted average of the measure of market concentration at the country and regional levels; Measure 2 is the measure of market concentration at either the country or regional level, depending on whether most of the urea consumed is from local production or imports.

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SIMULATION ANALYSIS
INCREASING COMPETITION

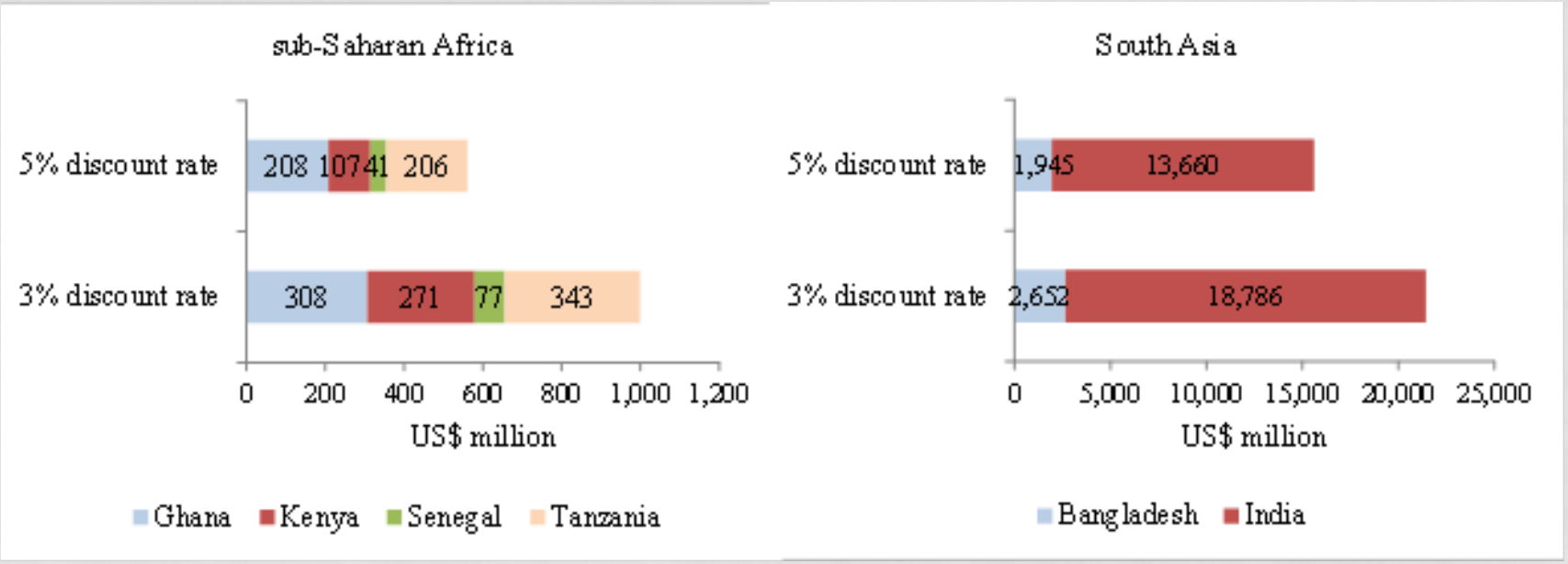
- It is worth further evaluating the potential impact that increased competition in the industry could have on low-income countries.
- We conduct a basic simulation analysis.
  - First simulate the general impact of increased competition on prices, fertilizer intake, crop production and rural income.
    (use elasticities derived above and from other related studies)
  - Then perform a cost-benefit analysis for selected countries.
    (Ghana, Kenya, Senegal and Tanzania in SSA; Bangladesh and India in SA)
- Based on the top-4 concentration ratio results, a10% increase in competition leads to:
  - Conservative scenario: 8.2% decrease in prices.
  - Optimistic scenario: 11.6% decrease in prices.

SIMULATION ANALYSIS (2)
INCREASING COMPETITION

- To decrease the top-4 concentration ratio by 10%, build nitrogen plant with:
  - Africa: annual production capacity of 0.7 million MT.
  - South Asia: annual production capacity of 1.2 million MT.
- New plant will absorb the share-reduction of the top-4 firms in the market, and not large enough to be among the top-4 producers in each region.
- Building costs in area with sufficient natural gas deposits: US$700 million in Africa; US$1.2 billion in SA (reference plant built in Delta & Lagos States, Nigeria).
  - Building costs shared based on fertilizer consumption by each corresponding country.
- Production cost per MT of US$130 (Fertilizer Institute); bagging & inland transportation costs of US$45 per MT (Chemonics & IFDC, 2007).
- Only 20% of rural population will effectively increase their income.
  - Some farmers already using optimal amount; others still will not reach optimal level.

SIMULATION ANALYSIS (3)
INCREASING COMPETITION

Net present value of simulated policy in selected countries in sub-Saharan Africa and South Asia (time horizon of 40 years)



- NPV in 4 countries in SSA: US$1 billion (3% discount rate); US$561 million (5% discount rate).
- NPV in 2 countries in SA: US$21.4 billion (3% discount rate); US$15.6 billion (5% discount rate).

CONCLUDING REMARKS

- Sustainable growth in fertilizer use in regions like SSA is unlikely to happen unless new measures are implemented that address the structural problems which limit the incentives to supply and use fertilizer.
- One of the issues which has not received much attention is the potential market power exerted by major global fertilizer producers in a highly concentrated industry with increasing levels of trade.
- Our results suggest the necessity to further evaluate the extent of market power exertion in fertilizer markets, considering the high dependence of developing regions on imported fertilizer.
- Of course our simulation analysis relies on several simplifying assumptions, which could be further refined on a country-by-country basis depending on data availability.

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CONCLUDING REMARKS (2)

- A number of specific actions that could be conducted to promote competition in the industry include, but are not limited to:

- **Implementing a platform in SSA** with regional economic organizations to develop 1) pre-investment and feasibility studies; 2) provision of advisory services; and 3) facilitation of the creation of an investor consortia (public-private partnerships & foreign investment) for pilot studies to examine alternative mechanisms to increase competition in the industry in order to improve input access at competitive prices in prioritized geographical locations.

- **Formation of a Global Antitrust task force** for 1) developing and enforcing antitrust laws; 2) preventing restraining fertilizer trade between countries; and 3) promoting competition in the industry at the global level. The task force could be hosted at the International Competition Network (ICN), which now includes 100 antitrust agencies from nearly 90 jurisdictions.

- Certainly, these measures should be complemented with other supply- and demand-driven policies at the regional and local level to promote the sustainable use of fertilizer.

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THANK YOU

ARELLANO-BOND GMM METHOD

- Estimate price model in first differences to eliminate country-specific effect c_i.

$$\Delta \ln p_{ijt} = \alpha \Delta \ln p_{ijt-1} + \beta \Delta mktstructure_{ijt} + \Delta X_{ijt}\delta + \Delta u_{ijt}$$

- Arellano-Bond GMM procedure further eliminates the trade-off between lag and sample depth (compared to 2SLS), permitting to include all valid lags of the untransformed variables as instruments for the potential endogenous variables :

E.g., $mktstructure_{ijt-s}$, $\ln p_{ijt-s}$, $s > 1$

- Arellano-Bon GMM procedure also accounts for the fact that after differencing the disturbances are not i.i.d., making the estimation more efficient and better behaved.

SIMULATION ANALYSIS

INCREASING COMPETITION

Cost-benefit analysis

Variable	sub-Saharan Africa				South Asia	
	Ghana	Kenya	Senegal	Tanzania	Bangladesh	India
Rural income						
Rural per capita annual income in US$	731.6	738.4	575.2	499.3	680.1	743.8
Rural affected population (million)	2.3	4.0	1.1	4.8	21.0	154.4
Annual income of affected population in US$ million	1,712	2,939	644	2,387	14,282	114,836
Fertilizer use						
Country annual consumption of nitrogen fertilizer in '000 MT	16.2	74.9	13.1	38.3	1,034.7	12,362.9
Increase in fertilizer consumption (conservative scenario)	13.3%	13.3%	13.3%	13.3%	13.3%	13.3%
Increase in consumption of nitrogen fertilizer in '000 MT	2.2	10.0	1.7	5.1	137.6	1,644.3
Change in income						
% Increase in average rural income	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Total increase in annual income for affected population in US$ million	17.1	29.4	6.4	23.9	142.8	1,148.4
Change in costs						
Cost of building plant in region (prorated) in US$ million	79.4	367.8	64.5	188.3	92.7	1,107.3
Variable cost per MT (production, bagging, transportation) in US$	175.0	175.0	175.0	175.0	175.0	175.0
Total variable annual costs for increased fertilizer use in US$ million	0.4	2	0.3	1	24	288
Net present value at 3% discount rate (2013-2043) in US$ million	308	271	77	343	2,652	18,786
Net present value at 5% discount rate (2013-2043) in US$ million	208	107	41	206	1,945	13,660