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ABSTRACT

Drawing upon a series of cross-country demand analyses conducted using International Comparison Program (ICP) data from 1980, 1996 and 2005, this paper highlights how consumer preferences for food evolve over time. Income and price elasticities were estimated for an increasing number of countries, reaching 144 in the 2005 ICP analysis. Consumers in lower income countries spend a higher share of income on food, are most responsive to income and price changes, and are increasingly diversifying their diets toward more protein and fat containing foods such as meats and fish. Consumers, in general, also make larger adjustments to non-food expenditures when food prices change than they do to food expenditures when the price of non-food items change.

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1. Introduction

The challenge of feeding the world's population, estimated to exceed 9 billion by 2050 (United Nations, 2011), in the face of changing diets, increasing non-food demand for agricultural products, declining growth in agricultural productivity, and uncertainties stemming from changing weather patterns has received a lot of attention lately. Much of the discourse has focused on supply-side issues of declining productivity growth and sustainably increasing agricultural productivity. Understanding those factors that govern future food supply capacity is an important component of strategic planning to reduce food insecurity. However, it is equally important to improve our collective understanding of the demand-side drivers. Examination of food demand patterns over time and how these patterns adjust to rising incomes and changing prices enables better projection of food needs, provides an insight into the kinds of food consumers are likely to seek in the future, allows identification of at-risk populations, and improves predictions about how the food industry may be structured to meet the evolving trends in global demand.

Food demand research has traditionally occurred at the country or regional level where comparable food expenditure data are readily available (Zheng and Henneberry, 2009; Abdulai and Aubert, 2004). The availability of consistent and comprehensive data sets across countries, however, has enabled cross-country

demand analysis which allows the examination of food demand trends at the global level. Drawing upon a series of cross-country demand analyses conducted using data from 1980, 1996 and 2005 this paper highlights how consumer preferences for food evolve over time. The paper starts with a brief snapshot of the prevailing food consumption patterns across countries at different levels of economic development. This is followed by a description of the data and the models used for demand analysis. Next, a discussion of key results is provided. We conclude by highlighting some implications for global food security and strategic planning.

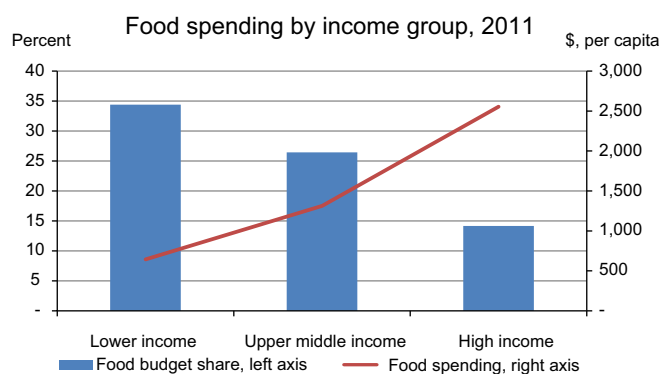
2. Food consumption patterns vary by income group

The share of income or private consumption expenditure (PCE) spent on food is often used as an indicator for the relative well-being of a country. The difference between income and PCE is that income includes household savings. Over time, PCE is more stable than income. In many demand analyses, PCE is used as a proxy for household income. Household spending on food tends to increase as income levels increase, but the proportion of total income devoted to food declines (Fig. 1). This phenomenon is known as Engel's Law, after the 19th century German statistician Ernst Engel. The intuition behind Engel's Law might be described as a "food first" budget allocation. Even low-income households must devote at least a minimum amount to meet the basic need for food. As income increases, households may spend some of that additional income on food, but will allocate proportionately more than before on other, nonfood items. For a given gain in income, the increase in food spending is larger at lower income levels than at higher income levels. This explains why, as incomes rise in lower income countries, their food expenditures grow and consumption patterns

^{*}The views expressed here are those of the authors, and may not be attributed to the Economic Research Service or the US Department of Agriculture.

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Source: Authors' calculations based on data from Euromonitor International, 2012.

Fig. 1. While small in value, consumers in low-income countries spend a larger share of their total budget on food.

appear to seek to catch up to the levels and composition of those of higher income countries (Regmi et al., 2008).

Most high-income countries are approaching a food consumption level close to saturation, with average daily per capita consumption around 3500 kcal (Food and Agriculture Organization, 2013). With consumption at such high levels, additional income does not result in further increases in calories consumed, but may rather result in additional spending going toward diet diversification, improved quality, convenience, or for food which satisfies consumer values such as organic, fair trade, and animal welfare.

Consumption in low-income countries, on the other hand, is about 2400 kcal per capita per day and consists predominantly of cereals, roots and tubers, although protein and fat containing food products such as meats, dairy products and vegetable oils are becoming more important. Low-income consumers spend a large share of their PCE on food, leaving less income for other essential items such as health care, housing, education, and fuel. In contrast, households in high-income countries have relatively small food budget shares, leaving sufficient income for other essentials, as well as recreational and cultural activities. In the US, for example, at-home food spending accounts for less than 10% of PCE, compared with Cameroon, where it accounts for 47% (ERS, 2012). Cameroon's food spending share has not changed much over the last 10 years, but absolute food spending has almost doubled (Euromonitor International, 2012) and per capita food consumption as measured in calories per capita per day has increased 15% between 2000 and 2009 (Food and Agriculture Organization, 2013).

While examination of consumption patterns provides a snapshot for a given point in time, estimation of demand elasticities (consumer responsiveness to income and price changes) enables projections of how demand patterns are likely to change in the future as incomes change. The income elasticity at the household level of a given consumption item measures the percent change in its demand with a 1% change in household income. Over time, as countries and households generally become more affluent, the income elasticity measure becomes a valuable tool which can provide some insight regarding the likely future demand for different consumption items. Similar to the income elasticity of demand, consumer reaction to price fluctuations is measured by price elasticities. The own-price elasticity of a good is the percent change in demand for that good with a 1% change in its price. Likewise, a cross-price elasticity measures the change in demand of a good when there is a 1% change in the price of another good.

3. Data needs for cross-country demand analysis

Data requirements for analyzing international consumption patterns for a large number of countries and commodities are demanding

and stringent (Seale and Regmi, 2006). The data need to be transitive, that is, they must allow consistent comparison across countries. Data have to be additive which means that the lower levels of aggregation for expenditure categories (such as meat, dairy and others food groups) must sum to the broad consumption category (such as food). Finally, data have to be measured in a single unit, a particular challenge since expenditures for countries are generally available in local currency units. Using exchange rates to convert expenditures into a single currency is not desirable as they do not take into consideration non-traded goods and services, leading to an understatement of purchasing power and thus an overstatement of poverty of low-income countries.

The International Comparison Program (ICP), which implements expenditure surveys using a special methodology that maintains transitivity and additivity at various levels of aggregation, provides data suitable for cross-country demand analyses. The data available from ICP can be considered as being representative for an average household for a given country. ICP uses the purchasing power parity (PPP) approach to calculate and express expenditures in a single currency, international dollars. PPP is the number of national currency units required to buy equivalent goods as purchased with one unit of base-country currency. For example, if the United States is the base country, the estimated PPP for a country would reflect the number of its national currency units required to purchase the same amount of a given good (say food) as purchased with \$1 (or a given amount) in the United States.

The ICP started as a joint venture between the United Nations and the University of Pennsylvania, with the overall purpose of providing comparable Gross Domestic Product (GDP) data for a large number of consumption items across countries (Diewert, 2010; Kravis et al., 1975). It is currently maintained by the International Comparison Program Development Data Group of the World Bank. Over the years, data collected by the ICP increased from 10 countries in Phase I (1970), 60 countries in Phase IV (1980), 115 countries in 1996, to 146 in 2005 (Table 1). These 146 economies in 2005 account for more than 95% of the world's population and 98% of the world's nominal GDP (World Bank, 2008). As part of its improved survey methodology, the 2005 ICP divided the world into five geographic regions (i.e., Africa (48 countries); Asia Pacific (24 countries); West Asia (10 countries); South America (10 countries); and the Commonwealth of Independent States (CIS) (10 countries)) and the OECD, other European countries, Israel and Russia (46 countries). Israel was included in both the West Asia and the OECD surveys and Russia was included in both the CIS and OECD surveys, giving a total of 146 countries. Of the 146 countries, information was missing for Greece and Comoros leaving data of 144 countries available for demand analysis.

4. Methodology used in demand analysis

This paper draws on several studies which use the same model (Florida model, Theil et al., 1989) and three sets of ICP data collected during three different periods (1980, 1996 and 2005). Fitting a cross-country demand system to a large number of goods is made possible via multistage budgeting (Barten, 1977). This strategy categorizes goods into a manageable number of groupings so that econometric estimation is feasible. In the first stage, all consumers in each country are postulated to allocate their total expenditures among broadly defined categories of goods such as food and transportation. In the second stage, consumers allocate each group's expenditure among categories of goods within each group. For example, consumers allocate total food expenditure among categories such as meat, dairy, vegetables and others. The cross country demand analyses conducted with the ICP data have all divided total consumer expenditures into nine consumption

Table 1
Countries in 2005 ICP, 146.

Latin America (10)	Asia (24)	Africa (48)	West Asia (10)	Commonwealth of Independent States (10)	Eurostat/OECD (44)		
Countries since 1980 ICP							
Argentina	Hong Kong	Botswana	Senegal	Syria	Austria	Italy	
Bolivia	India	Madagascar	Tanzania		Belgium	Japan	
Brazil	Indonesia	Malawi	Tunisia		Canada	Luxembourg	
Chile	Pakistan	Morocco	Zambia		Denmark	Netherlands	
Ecuador	Philippines	Nigeria	Zimbabwe		Finland	Norway	
Paraguay	South Korea				France	Poland	
Peru	Sri Lanka				Germany	Portugal	
Uruguay	Thailand				Greece	Romania	
Venezuela					Hungary	Spain	
					Ireland	United Kingdom	
					Israel	United States	
Countries added in 1996 ICP							
	Bangladesh	Benin	Guinea	Bahrain	Armenia	Albania	Macedonia
	Fiji	Cameroon	Kenya	Jordan	Azerbaijan	Australia	Mexico
	Iran	Congo, Rep.	Mali	Lebanon	Belarus	Bulgaria	New Zealand
	Mongolia	Côte d'Ivoire	Mauritius	Oman	Georgia	Czech Rep.	Slovakia
	Nepal	Egypt	Sierra Leone	Qatar	Kazakhstan	Estonia	Slovenia
	Singapore	Gabon	Swaziland	Yemen	Kyrgyz Rep.	Iceland	Sweden
	Vietnam				Moldova	Latvia	Switzerland
					Russia	Lithuania	Turkey
					Tajikistan		
					Ukraine		
Countries added in 2005 ICP							
Colombia	Bhutan	Angola	Guinea-Bissau	Iraq		Bosnia, Herzegovina	
	Brunei	Burkina Faso	Lesotho	Kuwait		Montenegro	
	Cambodia	Burundi	Liberia	Saudi Arabia		Serbia	
	China	Cape Verde	Mauritania			Cyprus	
	Lao PDR	Central African Rep.	Mozambique			Malta	
	Macao	Chad	Namibia			Croatia	
	Malaysia	Comoros	Niger				
	Maldives	Congo, Dem. Rep.	Rwanda				
	Taiwan	Djibouti	São Tomé & Príncipe				
		Equatorial Guinea	South Africa				
		Ethiopia	Sudan				
		Gambia	Togo				
		Ghana	Uganda				

categories: food, clothing and footwear, education, housing, house furnishings and operations, medical care, transport and communications, recreation, and other expenditures. The food category, which only included food consumed at home (including beverages and tobacco) in the earlier ICP surveys, also includes food consumed away from home in the 2005 ICP. Using the 1996 and the 2005 ICP data, two of the studies (Seale et al., 2003; Muhammad et al., 2011) conduct the second stage analysis as well, focusing on the eight food subgroups: cereals (including bread), meat, fish, dairy products, fruits and vegetables, oils and fats, beverages and tobacco, and other food products.

To facilitate the analysis the countries covered by the ICP are divided into low-, middle-, and high-income countries, based on their income relative to that of the United States. Low-income countries represent those with real per capita income less than 15% of the US level, middle-income countries are those with income between 15% and 45% of the US level, and high-income countries have per capita income equal to or greater than 45% of the US level.

The same model (Florida model, Theil et al. 1989) and the same maximum likelihood estimation procedure is used to estimate the first stage demand analysis, covering the broad consumption categories, with the 1980, 1996 and the 2005 ICP data. The second stage analysis of food sub-groups is conducted with the 1996 and 2005 ICP data, using the Florida–Slutsky model—an extension of the Florida model—and the same estimation procedure (Seale et al., 2003). A difference, however, does exist in that in 2005 the food category

includes food consumed away from home while it is part of the 'recreation' sub-group in 1996. Demand analysis conducted by Theil et al. (1989) with the 1980 data does not cover the second stage analysis of the food sub-groups.

5. Major demand analysis findings

Many of the results of these studies align well with conventional wisdom and traditional economic thinking. However, by producing very specific and detailed measures of food demand behavior they offer superior forecasting potential. The elasticity estimates obtained from the analysis of ICP data indicate how average consumers across different countries tend to respond to income and price changes. Given the spectrum of average income levels in the surveyed countries which, in 2005, range from the Democratic Republic of Congo (with per capita income less than 1% of the US level) to the United States, the findings from these studies provide an indication of how demand for different goods and services may change when a consumer moves from one level of income to the next. For example, the results obtained for the United States may hold true for the highest income consumer in Sub-Saharan Africa, while the results obtained for Mexico may hold true for lower income consumers in the United States. In any case, these results enable better projection of food needs and provide an insight into the kinds of food consumers are likely to seek in the future as their levels of income change.

5.1. Food share of additional unit of disposable income declines with affluence

In general, the studies based on three sets of ICP data indicate similar findings: poorer households (countries) make bigger changes in their budget allocations when price and income levels change, and consumers tend to upgrade their diets when income levels rise by substituting cheaper sources of calories with more expensive sources of calories. An average household in the poorest country in the 2005 ICP, the Democratic Republic of Congo, for example, will spend over 60 cents of an additional dollar of income on food, but a household in Ghana will spend only about 42 cents, a household in Brazil 26 cents and one in the United States only 6 cents (Muhammad et al., 2011). The household response to a marginal increase in disposable income therefore declines with income growth.

5.2. Food consumed away from home increases with affluence

As countries generally experienced income growth over the 25-year period, 1980–2005, we expect the marginal expenditure estimates to decline over the three points in time. As anticipated, the marginal expenditure estimates decline from 1980 to 1996 (Table 2), but they increase from 1996 to 2005. This increase in the estimates is likely due to the fact that the food category in 2005 also includes food consumed away from home. Without the inclusion of this food group the estimated increase in food spending with an additional \$1 income would be smaller for 2005 than for 1996, continuing the downward trend seen earlier. Therefore, we could consider the difference between the two estimates to be a “lower bound” for marginal expenditures on food consumed away from home. Using this approach, consumers in Malawi spent about 3 cents of an additional dollar allocated to household expenditure on food away from home (FAFH) (Fig. 2). In Nepal, it was also about 3 cents and about 5 cents in Bangladesh. Expenditures on FAFH were fairly consistent across countries with high-income countries spending a similar share of an additional dollar, 5 cents for Japan and Australia and 4 cents for Germany and the United States.

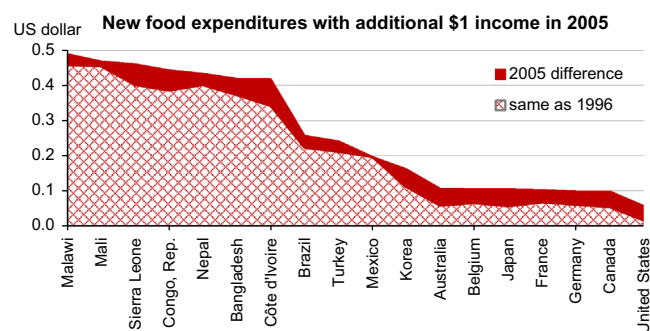
Table 2

Key shifts in consumer preferences over 1980–2005.
Source: 1980 calculated from Theil et al. (1989) Table 5.5 pages 106 and 107; 1996 from Seale et al. (2003) and 2005 from Muhammad et al. (2011).

	Budget change with 1% change in house hold income					
	Food			Education		
	1980	1996	2005	1980	1996	2005
Low-income countries	0.76	0.73	0.78	1.10	1.08	0.93
Middle-income countries	0.65	0.60	0.66	1.08	1.07	0.92
High-income countries	0.48	0.34	0.49	1.08	1.07	0.91

	Budget change with 1% change in food expenditures ^a					
	Meat			Fish		
	1980	1996	2005	1980	1996	2005
Low-income countries	NA	1.07	0.99	NA	1.25	0.84
Middle-income countries	NA	1.06	0.99	NA	1.20	0.79
High-income countries	NA	1.07	0.99	NA	1.17	0.77

^a Author calculations using Appendix Table 1 (pp. 22–24) and Appendix Table 5 (pp. 38–40) of Muhammad et al. (2011), and Table 7 (pp. 26–28) and Table 11 (pp. 40–42) of Seale et al. (2003).



Note: Unlike 1996, 2005 data includes food consumed away from home.

Source: Regmi, Seale 2010; and Mohammed et al. 2011.

Fig. 2. Food budget is more responsive to income changes with the inclusion of expenditures on food consumed away from home.

While the marginal expenditure from an additional dollar income is similar, the percentage increase (elasticity) varies significantly across the countries. As the actual size of the FAFH budget is larger in the developed countries, these countries have smaller elasticities of demand than the developing countries. For example, the income elasticity of demand calculated with the 2005 ICP data for the category ‘other food,’ which includes processed food and FAFH, is 1.4 for low-income countries, .88 for middle-income countries and .64 for high-income countries (Muhammad et al., 2011, Appendix Table 5.)

Across most countries, spending on FAFH has been growing very rapidly in recent years. It comprised 32% of US household food expenditures in 1980 and over 41% of total household food expenditures in 2005 (Lin and Guthrie, 2012). Globally, Euromonitor International, 2012 data indicate almost 56% growth in Asian and Latin American full-service and fast-food outlet sales over the period 1999 and 2005. As FAFH becomes an important component of household food expenditures, we anticipate that food budgets will become more sensitive to fluctuations in income and price changes.

5.3. Income and own-price change responses vary across different food groups

Income and own-price changes generate budget responses which not only vary among consumers at different income levels, but also vary across different types of food products (Seale et al., 2003; Muhammad et al., 2011). Studies have indicated that consumer expenditures on fresh fruits and vegetables tend to rise when income levels rise (Huang, 2004). Fruits and vegetables are typically considered high-value products. However, the ICP data, unfortunately, includes roots and tubers in the vegetable subgroup which are low-cost staples and of great importance to several low-income countries. The inclusion of roots and tubers could have caused a downward bias of the income and price elasticity estimates for the fruits and vegetable sub-group. Nevertheless, the results from the 2005 ICP indicate that a 10% growth in disposable income raises the demand for fruit and vegetables ranging from 7% in Ethiopia, 6% in Nepal to an average of about 3% in the OECD countries. Similarly, demand responses of fruit and vegetables to a 10% own price change ranges from about –5% for low-income countries to about –2% for high-income countries (Muhammad et al., 2011.)

These studies provide a clear indication of how income and price changes affect consumer demand for staple food items such as cereals (including breads) compared with higher valued food containing animal proteins such as meat and dairy products. The 2005 ICP data analysis indicated that expenditures on cereals among wealthy consumers, such as the average inhabitant of Spain or the United States, actually decline when income levels rise (Fig. 3). Goods for which expenditure levels decline with income

growth are known as inferior goods. Past studies have indicated that rice has become an inferior good in several Asian countries (Huang and David, 1993; Senauer et al., 1986). However, no other study to date (including that with 1996 ICP) has noted that cereals as a sub-group of food consumed at home have become an inferior good.

A 10% income increase leads to larger percentage adjustments in food budgets in poorer countries than in wealthier ones, across all groups of food. These changes tend to be larger for higher valued foods (such as meat, dairy and the 'other' category which includes processed food and food consumed away from home) than for staple foods such as cereals. For example, a 10% increase in household disposable income results in over an 8% increase in meat and dairy expenditures in Sub-Saharan Africa and South Asia, but the same level of income change only results in an increase of about 3.5% in meat and dairy expenses in the United States. In contrast, a similar change in income levels generates only about a 5–6% increase in cereals expenditure in Sub-Saharan Africa and Asia, while the income growth actually leads to a reduction in cereals expenditures in the United States. Similarly, price responses are similarly bigger in magnitude for meat and dairy than for cereals across all countries, with poorer countries making larger adjustments than wealthier ones.

5.4. Animal protein and education are no longer luxury consumer expenditures

As incomes change, consumers' ideas about what is a luxury or necessity change. Goods are considered to be luxury items when a 1% change in income results in demand change greater than 1%. Comparing the estimated income elasticities across the 25-year period (1980–2005), a few key shifts in consumer preferences are evident (Table 2). With FAFH gaining a share of household budgets, meat and fish consumed at home are no longer considered as much of a luxury item (conditionally) as in the past. The term 'conditionally' indicates that this response is only with respect to a change in total food budget and not with respect to total household disposable income. Based on the conditional elasticities obtained with the 1996 data, when total food expenditures increased by 1%, consumer expenditures on meat and fish increased by more than 1%. The change of meat and fish (conditionally) to a 'necessary' food item (expenditure elasticity less than one) in 2005 may be indicative of the fact that animal protein has become more of an everyday food item globally.

Another significant change in the results obtained from the three sets of ICP data concern expenditures on education. The income elasticity for education was greater than 1 both in 1996 and 1980, indicating that households tended to consider education as a luxury consumption item (Table 2). However, in 2005, the estimated income elasticity is less than 1 for all country groupings.

For the first time, education appears to be transitioning away from being considered a luxury service to being a necessary expense for households. This finding is supported by the fact that in some of the poorest countries covered by the 2005 ICP, school enrollments have grown significantly in recent years. For example, between 1980 and 2005, secondary school enrollments went up from about 5–19% in Uganda and from 16% to 33% in Zambia (World Development Indicators, 2011).

5.5. Impact of food price hikes is larger than the impact of non-food price hikes

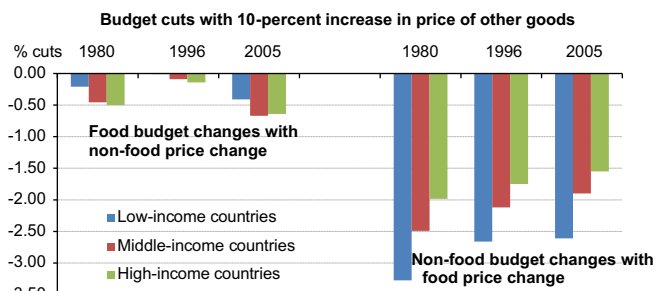
Analysis of results from the three sets of studies conducted over the 25-year period, 1980–2005, indicates that a change in the price of food would have a larger impact on non-food expenditures than an equal change in the price of non-food would have on food expenditures (Fig. 3). As discussed earlier, consumers tend to make their food allocation decision with what may be described as a "food first" rationale. Even an individual or a household with the smallest income has to devote a minimum budget to meet basic food needs. When the price of a non-food good rises (with no change in income), the food budgets are impacted minimally. These consumers are generally unable to further cut their food budgets in response to higher prices of non-foods. More affluent consumers in middle- and high-income countries, on the other hand, may cut down value-added or time-saving food items in order to accommodate higher prices of non-foods. However, as their total food budget is a small share of total expenditures, these changes are small. On average, a 10% increase in the price of non-food products results in about half-a-percent decline in food budgets of consumers in middle- and high-income countries. The response is even smaller for low-income countries.

In contrast, an increase in the price of food tends to have a more pronounced and negative impact on consumption of other goods and services. The budget reductions for non-food items are the largest for the poorest countries where food is a large share of the consumer budget. Even for affluent countries such as the United States where food is a small share of an individual's income an increase in the price of food tends to reduce consumption of other goods. A 10% rise in the food price results in a reduction of over 2.5% in non-food consumption in the low-income countries and 1.5–2% reduction in the high-income countries. Therefore, higher food prices can impact consumer welfare not only by affecting the quality and quantity of food which becomes affordable to a consumer, but also by negatively impacting the overall economy. Regmi and Seale (2010) point out that the impacts of a food price change are among the largest for expenditures on medical care. A food price change can therefore impact consumer health directly by affecting food intake and also indirectly through a decrease in the budget allocated for medical care.

6. Concluding remarks

The studies discussed in this paper point to income growth being a primary force driving changes in global food demand. Income-induced changes occur more rapidly in lower income countries than they do in more affluent countries. With expectations of continued and more rapid income growth in developing countries than in developed countries, alongside higher population growth and greater urbanization, the demand-side dynamics have significant implications for global food security.

The findings discussed point to an increasing demand for staple foods such as cereals up to a certain income level, after which further increases in income levels result in an actual decline in demand for cereals. In contrast, demand for animal protein continues to increase



Source: Theil et al. 1989, calculated from table 5.7 page 116 and 117, Regmi and Seale 2010, and Meade et al. forthcoming 2013. The elasticities are calculated with no change in nominal income.

Fig. 3. Non-food expenditures are more responsive to food price changes than food expenditures to non-food price changes.

with further income gains, across countries at all income levels. In addition, it appears that consumers globally have switched from considering animal protein a luxury food item to considering it a regular part of their diet. We therefore expect a significant increase in the demand for animal protein, which raises the question whether the world can sustainably increase livestock production to meet this demand.

The paper also provides evidence that non-food price changes tend to have minimal impact on food consumption, but food price changes tend to have larger impacts on the rest of the economy. Therefore, higher food prices can impact consumer welfare not only by affecting the quality and quantity of affordable food, but also by negatively impacting the overall economy. Particularly, higher food prices can have negative impacts on consumer health both by directly affecting food intake and also by reducing the budget allocated for medical care.

Finally, the studies also indicate that consumers globally have begun regarding education as a necessary household expenditure item. Increasing expenditures on education among households in developing countries will improve the new generation's opportunities while at the same time increasing the opportunity cost of rural labor. This could result in migration of youth to urban areas both in search of education or better jobs, in turn creating shortages of farm labor and potentially contributing to a gradual increase in farm sizes.

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