Changing Consumer Buying Habits in Developing Countries:
A Disaggregate Demand Analysis for Fruits and Vegetables in Vietnam

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Abstract

Food systems in developing countries are currently undergoing a rapid transformation, with important implications for local farmers, wholesalers, and retailers. While supply side aspects of this transformation have been analyzed previously, issues of consumer demand have received much less attention. This paper analyzes changing consumption habits for fresh fruits and vegetables in Vietnam, using household survey data and a demand systems approach. Demand for products from modern supply chains – particularly modern retailers and non-traditional imports – is highly income elastic. Also, supermarket expansion impacts on consumer demand. This implies a continued restructuring of the food sector in the further process of economic development.

Economic growth, international market integration, urbanization, and changing lifestyles are associated with transformations in the food systems of developing countries. The increasing role of modern retail outlets, food safety and quality standards, vertical market integration, and international trade in high-value products characterize these changes (Pingali 2006). Different authors have looked into the rise of supermarkets in developing countries (e.g. Reardon et al. 2003). The growing role of private food safety and quality standards was examined by Henson and Reardon (2005) and Unnevehr (2000) highlighted the induced difficulties for devel-

oping countries in accessing export markets. Also, the analysis of contract agriculture in developing countries has received increasing attention, especially with a view to the small farm sector (e.g. Hernandez, Reardon, and Berdegue 2007; Swinnen 2007). However, in spite of the hypothesized importance of both supply and demand side factors in the food system transformation, most of the available studies concentrate primarily on aspects of supply. Relatively little empirical work so far has been dedicated to related issues of consumer demand.

Dietary changes have been observed on a global scale (Popkin 1999). Pingali (2007) describes changing demand patterns towards a "westernization of diets" in developing countries as an important driving force of the agrifood system transformation. Yet, these analyses remain at an aggregate level and do not include determinants of household demand. At the household level, changing buying patterns for broad food aggregates were explored by Huang and Bouis (2001) for example. Consumer choices between different retail outlets in Argentina have been analyzed by Rodríguez et al. (2002). We are not aware of recent demand analyses in developing countries that look specifically into household demand for food products from modern, high-value supply chains with special quality and safety attributes. This is considered a research gap, because knowledge about economic demand parameters is instructive for projections of future trends. For instance, knowing the income elasticity of demand for products purchased in supermarkets, or for foods with formal safety declarations, could help supply chain actors to better adjust to changing consumer preferences and buying habits in the process of economic development.

Here, we address this gap through empirical analyses for Vietnam. In order to estimate disaggregated demand parameters for fresh fruits and vegetables with special supply chain related attributes, we adapt an almost ideal demand system (AIDS). Traditional demand analyses gen-

erally produce demand parameters for highly aggregated food categories. Even when carried out for individual food items, supply chain related attributes – such as place of purchase – are usually not considered. Nor are standard databases suitable for such kind of disaggregation. Living standard measurement surveys, which are available for many countries nowadays, provide representative data on expenditures and other household characteristics, but the analyst has to live with predetermined product categories, which usually ignore existing product differentiation (cf. Senauer 2006). Disaggregate product or process attributes of fruits and vegetables considered in our context are (i) place of purchase, particularly considering modern retailers, (ii) food safety indications, with an emphasis on formal labels, and (iii) region of production, with a focus on non-traditional imports.

The analysis builds on a survey of 499 households that we conducted in Vietnam's major metropolitan areas in 2005. Given its rapid economic development and recent policy reforms, Vietnam is an interesting developing country to study details of the food system transformation. Changing demand patterns and fast developments in the retail sector are observed in the context of ongoing economic liberalization (Maruyama and Trung 2007). Against the background of the recent accession to the World Trade Organization (WTO), Vietnam is considered to be among the top-three most attractive destination countries for foreign direct investment in the retail sector (ATKearney 2006). Retail sales in Vietnam grew at an average annual rate of 15% between 1995 and 2005. The growth rates in the last few years reached almost 20% (GSO 2007).

The paper proceeds as follows: in section 2, the methodology and survey data used are briefly described. Then, characteristics of emerging supply chains in Vietnam are illustrated in section 3, before the estimation results are presented and discussed in section 4. In section 5, demand

elasticities are derived, which are then used for projections of likely future market developments in section 6. The last section concludes and provides policy implications.

Methodology and Data

Demand model

For the estimation of demand parameters, we employ a two-stage budgeting framework. We assume that consumers first allocate expenditures among non-food, away-from-home food, and home food commodities. For the first budgeting stage, we employ an extended Working-Leser Model to derive expenditure elasticities in the absence of price information. At the second stage, the home food budget is allocated to different fresh and processed food items using an AIDS. Our aggregate AIDS model consists of six food categories, viz. fresh fruits and vegetables, preserved fruits and vegetable products, rice, animal products, beverages and stimulants, and other foods. In three different kinds of disaggregated models, the fresh fruits and vegetables group is replaced respectively by four sub-categories representing different supply chain related attributes. Hence, each of the three disaggregated AIDS models consists of nine food categories to be estimated at the second budgeting stage (see table 1).

(Table 1 here)

The AIDS was developed by Deaton and Muellbauer (1980) to estimate a complete set of demand parameters. Pollak and Wales (1992) extended the AIDS demand functions by demographic translation to include socio-demographic variables. We apply the method proposed by Cox and Wohlgenant (1986) to eliminate demand related price variation in the data, since only supply related variation should be used for estimation. Furthermore, we use a two-stage

Heckman procedure to account for censoring and a potential sample selection bias.[1] In the first step, we model the decision to buy food of a certain category employing probit models. The results are then used to calculate the inverse Mills' ratio, which is included as an additional explanatory variable in the second-step AIDS estimation.

Data

Between August and October 2005, we conducted an interview-based survey in Vietnam's two major cities, Hanoi and Ho Chi Minh City (HCMC). These two cities represent more than one-third of all retail sales in Vietnam, which is three times higher than the corresponding population shares. Also in other countries, urban centers are the places where the food system transformation has been most rapid and visible in the recent past. The survey covered 499 households in almost all administrative districts of both cities, including urban and peri-urban areas. The sample is a random sub-sample of the nationally representative Vietnam Living Standard Survey 2002 (VLSS2002) for Hanoi and HCMC. Therefore, the sample does also cover households located in the suburbs and villages surrounding the inner city districts. These peri-urban districts are characterized as more rural and thereby the sample represents a broad picture of different types of consumers. Per capita expenditure levels for households in peri-urban districts are around 40% lower, and the mean distance to the next supermarket is more than six times higher than for households in urban districts.

The interviews were carried out with the primary food purchasers in the household. A standardized questionnaire was used that covered all consumption expenditures and other household characteristics. For fruits and vegetables consumed, detailed information about quantity, price, safety declarations, place of purchase, and region of production was collected. The focus on fresh fruits and vegetables was chosen, as they constitute high-value products for which food

safety and quality aspects receive increasing consumer attention (Figuié 2003). Furthermore, they are characterized by limited economies of scale in production, so that they can potentially play an important role in rural poverty reduction strategies (Weinberger and Lumpkin 2005). At the wholesale and retail level, they are considered a strategic marketing instrument for modern retailers. Competition between the traditional and the modern retail sector is fierce, as the market share for fresh fruits and vegetables of modern retailers is often still lower than for other product categories (Reardon et al. 2003).

Selected household characteristics, which are included in the regression models later on, are shown in table 2. A comparison of some variables of our sample with the full sample of the VLSS2002 for Hanoi and HCMC reveals that households in our sub-sample are slightly richer and better educated; but otherwise, the values are very similar, which confirms the representativeness of our sample for the regions surveyed. Average annual per capita household expenditures, which we use as a reliable measure of permanent incomes, amount to around 9.8 million Vietnamese Dong (VND). This corresponds to 615 US Dollars, based on official exchange rates and 2,960 US Dollars based on purchasing power parity in 2005. Education in years of schooling of the respondent is included to take account of knowledge and awareness. Structural differences between the two cities are indicated by the Hanoi dummy. Supermarket penetration is captured by considering households' distance to the nearest supermarket. Inclusion of an urban dummy in estimation can help to analyze the influence of urbanization trends on household demand patterns. While there is correlation between the urban and distance-to-supermarket variables, this does not cause a serious collinearity problem. Having both variables in the models is instructive to disentangle the urbanization and supermarket penetration effects, which are related but not identical.

In addition to these socio-economic variables used in the AIDS estimation, additional variables are included in the probit models. They are hypothesized to impact on the purchase decisions but not on conditional demand. Hence, they function as exclusion restrictions. Female labor force participation, often referred to as an important demand side driver of the food system transformation, is included as a dummy. It takes the value of one if the respondent is female and if she is employed. Finally, car ownership could have an impact on consumers' buying decisions for products from modern supply chains. This variable gives an indication of transportation costs associated with purchases from different supply chains.

(Table 2 here)

Emerging Supply Chains in Vietnam

In metropolitan areas of Vietnam, annual per capita consumption of fresh fruits and vegetables amounts to 149.7 kg on average. Consumed quantities are 23% lower in the poorest and 31% higher in the richest expenditure quartile. Table 3 shows consumption and buying patterns and the role of different supply chains. As outlined above, we use three examples of supply chain related attributes to analyze changing buying habits in the food system transformation. These are (i) place of purchase, particularly considering modern retailers, (ii) food safety indications, with an emphasis on formal labels, and (iii) region of production, with a focus on imports.

(Table 3 here)

Modern retailers

Similar as in other developing countries, in Vietnam modern retailers, particularly supermarkets, are in a process of developing more specialized, more integrated, and shorter supply

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chains for efficiency gains as well as improved food safety assurance (cf. Balsevich et al. 2003; Cadilhon et al. 2006). This development is embedded in the government strategy to modernize the country's food system. Consequently, the number of supermarkets has been growing rapidly in metropolitan areas, and modern retailers are starting to extend their scope to smaller cities and towns. From the first supermarket that opened in 1993, the number grew to 104 in 2005 (ACNielsen 2007). This growth further continues: city administrations have already approved licensing applications for further supermarket establishments of different formats (Moustier et al. 2006a). In the development of the national retail market, local investors are increasingly joined by multinational chains. Until 2007, foreign investors had to establish a joint venture with a Vietnamese company if they wanted to be active in the country. As a result of the recent accession to the WTO, capital limitations will be loosened in 2008, and market access will be completely opened up in 2009. Despite the investments in modern retail formats, fresh horticultural produce is still mainly bought in traditional retail outlets (Maruyama and Trung 2007). According to our sample, modern retail outlets, including supermarkets and specialized vegetable shops particularly catering for upscale consumers, have currently a market share of 5.6% for fresh fruits and vegetables.

Food safety

Due to the complexity and diversity of traditional supply chains, food safety monitoring has become a challenging task in Vietnam. Problem awareness is high in the public. More than 90% of all households are conscious of reports on spoiled or contaminated fruits and vegetables in the media, particularly television. A high percentage of more than 93% of consumers are concerned about the safety of fresh fruits and vegetables. To minimize risk of exposure, consumers mostly employ informal safety assurance measures for their supply of fresh fruits and

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vegetables. This includes a thorough visual and olfactory inspection of the product at the place of purchase or consumers' trust to sellers. Nonetheless, there are also consumers that do not utilize any indications of safety for a considerable amount of their fresh fruits and vegetable purchases (18.3% of total quantities).

Slowly, formal safety assurance mechanisms have gained in importance. Already in 1995, the Vietnamese government launched a 'safe vegetables' program ('*rau sach*' or '*rau an toan*') to counteract food safety problems in horticultural produce. In this context, the Ministry of Agriculture and Rural Development issued a temporary regulation on the production of 'safe vegetables', which adopted maximum residue levels from Codex Alimentarius as benchmark in 1998. Since then, the government has fostered the development of vegetable production with improved food safety through the agricultural and rural development service. In cooperation with local authorities, the 'safe vegetable' label is promoted in annual fairs for farmers and in advertising programs for retailers and consumers.

Within the program, training and technical support is given to farmers to improve management of irrigation water, fertilization, and application of pesticides. Produce is marketed through specialized supply chains in a limited number of 'safe vegetable' shops and supermarkets. The municipal health care service is meant to work closely with responsible agencies to regularly control the quality and hygienic conditions in vegetable production and marketing. However, quality controls are mostly organized internally in the cooperatives. Furthermore, awarding the 'safe vegetable' label is not authenticated by a standardized certification process, and no formalized sanction mechanisms exist in case of non-compliance (Moustier et al. 2006b). Laboratory analyses are hardly conducted or can detect only few types of pesticides (Tam 2005). A lack of standard enforcement mechanisms enhances asymmetric information and distrust be-

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tween producers and consumers (Hoan, Mergenthaler, and Breisinger 2005). Only 33% of the respondents in our survey confirmed that they would trust the claims made by the 'safe vegetable' label. For privately labeled products, producers often cultivate under contract schemes and follow tight technical specifications, or they receive other incentives to secure food safety. So far, fruits and vegetables with formal food safety assurance are still a niche market in Vietnam. Their current market share is 3.8% in metropolitan areas. Growth seems to be mainly hampered by lax control, lack of sanction mechanisms, and a still limited supply at few retail outlets (Hoang and Nakayasu 2006).

Imports

Imports occur for products which cannot be sourced at competitive prices, in required qualities, or due to limited availability. Horticultural imports from China occur mainly in the off-season. These imports are generally perceived as low quality by consumers in metropolitan Vietnam. Imports from non-neighboring countries have started more recently through new, high-value supply chains. These mostly involve temperate fruits not grown in Vietnam such as apples or grapes, originating partly in industrialized countries like the US and New Zealand. The market share of such non-traditional imports amounts to 1%. As table 3 indicates, the bulk of fresh fruits and vegetables originate from domestic growing areas.

Estimation Results

For the estimation of demand parameters, a two-step procedure is employed, as described above: in the first step, probit models on the decision to purchase are estimated, before the AIDS models are run in the second step. As we are mainly interested in demand for fruits and

vegetables with different supply chain related attributes, only these results are reported here.[2] The probit models are significant in most cases according to the Chi-square test (table 4), and the conditional demand equations according to an F-test for the system estimation (table 5). The goodness-of-fit measures are fairly high in most cases, especially for the equations involving modern supply chains, indicating that the models have relatively good explanatory power. The inverse Mills' ratio is significant in all AIDS equations, confirming that a sample selection bias would have been an issue without the Heckman procedure.

Expenditure and distance to the nearest supermarket are mostly significant in the probit and AIDS models for modern supply chains. Own-prices are significant to a lesser degree. Urbanization influences the shift from own production to purchases in traditional markets, but has no significant impact on the decision to buy from modern supply chains. Therefore, consumer buying habits towards products from modern supply chains are – *ceteris paribus* – rather triggered by a higher supermarket penetration associated with the food system transformation than by urbanization trends per se.

Differences between the two cities regarding modern supply chains are significant for imports from non-neighboring countries. HCMC's better international market access, partly through its seaport, is probably an important factor in this connection. Education positively influences demand for products from modern supply chains, reflecting higher safety concerns among better-educated people. For non-traditional imports, education's positive impact on demand also results from a greater familiarity with 'exotic' products. Female labor force participation does not affect the decision to buy from modern supply chains, whereas car ownership increases the probability to shop in modern retail outlets.

(Tables 4 and 5 here)

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Demand Elasticities

To get a better understanding of the magnitude of different factors, demand elasticities are calculated for total household expenditures, supermarket distance, and own-prices. In table 6, the expenditure elasticities of the aggregated food categories are compared with previous estimates for Vietnam and other countries in South-East Asia. Our elasticities reasonably fit into the overall picture. It should be stressed that the other estimates refer to national populations as a whole, while ours are confined to metropolitan areas, where households are somewhat richer than in remote rural areas on average. Accordingly, our expenditure elasticity for rice (the basic staple food) is lower, and those for higher-value products are somewhat higher.

(Table 6 here)

Expenditure elasticities

In growing economies, substantial future demand growth can be expected for food products with high income or expenditure elasticities. Goods with high expenditure elasticities create incentives for farmers and other supply chain actors to harness opportunities in these emerging markets. However, expenditure elasticities for aggregated food groups can mask important heterogeneity that exists among individual food items or goods with different product and process attributes. For instance, the aggregated expenditure elasticity for fresh fruits and vegetables in metropolitan areas of Vietnam indicates a rise in consumption with increasing incomes, which however will be under-proportional. Thus, the relative importance of the sector in the overall economy is expected to shrink over time. While this might be true for the fruits and vegetable sector as a whole, it is not true for high-value supply chains, as table 7 indicates. Disaggregated

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expenditure elasticities for fresh fruits and vegetables from emerging supply chains are significantly higher than the aggregate elasticity. This applies in particular for modern retailers and non-traditional imports. Likewise, these elasticities are higher than the disaggregated elasticities for products from traditional supply chains. Expenditure elasticities of greater than one indicate that these are luxury goods, so demand is expected to rise substantially in the further process of economic development.

(Table 7 here)

Distance and price elasticities

Actors in supply chains can stimulate demand by making their products available on a broader basis. Modern retailers partially achieve this by increasing the penetration rate of their retail outlets, that is, locating supermarkets in closer consumer proximity. In this way, supermarket penetration induces local competition among retailers. As a consequence, not only supermarkets offer products from modern supply chains such as products with formal safety assurance. Specialized vegetable shops have emerged that sell horticultural produce with the 'safe vegetable' label. Even in market stalls in the inner city districts, some retailers can be found that offer fresh fruits and vegetables with formal labels. The same holds for non-traditional imports. The fact that the modern supply chain categories in our context are neither identical nor mutually exclusive is further highlighted by supermarkets' procurement strategies due to their still limited supplier base: At times, they get their supply through similar supply chains as traditional retailers (cf. Hoang and Nakayasu 2006).

The low distance elasticity for the aggregate fresh fruits and vegetables category shows that supermarket penetration has hardly any impact on aggregate demand for fruits and vegetables

(table 7). In contrast, the impact is considerable for all three types of modern supply chains. Distance elasticities indicate that a 10% reduction of supermarket distance to a household increases consumer demand by 3% to almost 7%.

Table 7 also shows own-price elasticities. Absolute price elasticities for fruits and vegetables from modern supply chains are higher than the aggregate and the disaggregated price elasticities for products from traditional sectors. Consumers therefore react more sensitive to price changes for products from these supply chains. A high price responsiveness indicates that efficiency gains in modern supply chains, leading to lower prices, will increase demand over-proportionally.

Projections

To illustrate supply chain implications, we project demand patterns over a period of 10 years (2005-2015). Growth in expenditure levels, a reduction in the distance to supermarkets through higher penetration rates, and changes in prices are considered in the projections. For expenditure growth, we take a conservative annual growth rate of 10%,[3] which corresponds to an increase from 9.8 million VND in 2005 to a mean expenditure level of around 25 million VND in 2015. Based on past trends in the growth of supermarket numbers, we presume that the distance to the next supermarket would decrease by 10% per year. According to this assumption, the mean distance would be reduced from 4.8 km in 2005 to 1.7 km in 2015. This corresponds to a reduction from 2.0 km to 0.7 km in urban and from 12.2 km to 4.3 km in peri-urban districts. For prices, we assume that real prices remain constant, except in modern supply chains. As it

has been observed in other countries, it is expected that, due to efficiency gains, prices will be reduced; we assume a 3% reduction per annum.

Figure 1 shows that purchased quantities of fresh fruits and vegetables from modern supply chains are projected to grow rapidly over the coming years. Growth is particularly high for products from modern retailers, but also for imports from non-neighboring countries where the starting base is very low. Purchased quantities are expected to grow by a factor of more than 10 until 2015, to reach more than 90 kg for modern retailers and 15 kg for non-traditional imports. Fruits and vegetables with formal safety assurance are also projected to grow, though less rapidly to reach 23 kg within 10 years. Market shares are likely to quintuple to reach almost 30% for modern retailers, and more than 5% for non-neighboring imports. For products with formal safety assurance, market shares are expected to double until 2015.

(Figure 1 here)

Figure 2 shows a decomposition of growth effects for modern retailers. The expenditure effect is clearly dominating. Around 81% of growth can be attributed to this factor. The supermarket penetration effect is responsible for about 9% of growth, while own-price effects accounts for the remainder. This clearly highlights the importance of considering demand aspects, when projecting future trends in the food system transformation.

(Figure 2 here)

Reardon et al. (2003) estimate that the share of supermarkets in fresh foods is roughly 15-20% already today in Southeast Asian countries like Indonesia, Malaysia, and Thailand.[4] In this context, our projections appear reasonable. Still, exact future growth rates are hard to predict, as they depend on policy measures, too: further restriction of street vending and informal markets,

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increasing food safety requirements in traditional markets, licensing new supermarkets, and liberalizing foreign direct investment for multinational retailers can change supply side conditions considerably. On the demand side, income and expenditure growth is volatile and depends on future economic development. Nonetheless, it can be expected that in the medium and long run, high-value fruits and vegetables with quality and safety attributes are likely to leave the niches that they currently occupy to become the default choice of larger population segments in metropolitan Vietnam. Similar trends are likely also for smaller cities and towns, probably with a certain time lag.

Conclusions

In spite of the stated importance of supply and demand side factors in the food system transformation, most of the studies available until now have concentrated primarily on supply side aspects. Addressing this unbalanced focus, we have analyzed changing consumer buying habits and the underlying determinants based on household survey data from Vietnam. We have estimated demand parameters for fresh fruits and vegetables in the two metropolitan areas, Hanoi and Ho Chi Minh City. The focus has been on purchases from modern, high-value supply chains. Supply chain related attributes specifically considered are place of purchase, food safety indications, and region of production. The estimation results demonstrate that consumers' decisions to buy fresh fruits and vegetables from emerging modern supply chains are heavily driven by total household expenditures. Expenditure elasticities range between 1.2 and 2.6. Price elasticities were found to be between -1.5 and -1.1, and distance-to-supermarket elasticities between -0.6 and -0.3. The impact of prices and supermarket penetration on demand form modern

retailers is lower than the expenditure effect. This clearly highlights the importance of considering demand aspects, when projecting future trends in the food system transformation.

Given that Vietnam is currently undergoing a rapid economic development – with incomes growing fast and supermarkets reaching higher penetration rates – high-value supply chains will rapidly gain market shares at the expense of more traditional sub-sectors. Though traditional horticultural and agricultural sectors are also projected to expand, growth rates will be lower than for modern supply chains. The food and retail industry needs to adapt accordingly. Traditional retailers could benefit by offering additional services to consumers. Safety labeled fruits and vegetables could be an option. This will critically depend on improved command and control systems to counteract consumers' low levels of trust in these labels. As an alternative, retailers could develop contract arrangements with preferred farmers, or farmers may possibly establish special high-quality farmer markets. In both cases quality and safety standards can be communicated face to face to consumers. Within such more direct links between producers and final buyers, consumers' trust to their preferred retailer can be substantiated. Traditional retailers also could try to diversify their supply to include new products, like non-traditional imports. Modern retailers, on the other hand, will further build on their high-quality reputation. In order to meet high consumer expectations, they have to extend their dedicated supplier basis and create integrated supply chains on a wider scale. If this continues to prove difficult in the domestic market, horticultural produce will be increasingly sourced from abroad, which would further fuel domestic competition with possible hardships for local agricultural producers.

Rising competition is a challenge, especially for the millions of small-scale farmers in Vietnam. Although traditionally produced and marketed fruits and vegetables are also projected to grow in absolute terms and will therefore continue to constitute a substantial market share, their rela-

tive importance will nevertheless shrink in the coming years. Farmers should actively try to get involved in modern supply chains to profit from emerging market opportunities. This will likely require new institutional mechanisms such as farmer groups or cooperatives to reduce transaction costs and facilitate access to necessary knowledge and production technology. Horizontal cooperation could also help farmers emerge as stronger and more attractive partners in public or private sector out-grower schemes.

More research on changing demand patterns and buying habits in developing countries is necessary to supplement the growing body of literature on analysis of supply side issues in the rapid transformation of food systems. Only when both supply and demand side aspects are well understood, can policies be designed to manage the transformation efficiently and equitably. Our study is only an initial step in this direction.

[1] Though this approach was put into question by Shonkwiler and Yen (1999), Tauchmann (2005) has more recently shown that Heckman procedures are a good choice for practical applications.

[2] The other estimation results can be made available upon request.

[3] Based on the two rounds of the Vietnam Living Standard Survey in 2002 and 2004, average annual income growth rates reached almost 14% in the two cities.

[4] The current share of supermarkets in fresh products is 25-35% in South America, and around 10% in Central America (Berdegue et al. 2005), while it is still quite low in Sub-Saharan Africa. In general, the share of supermarkets in developing countries is lower in fresh than in processed foods (Reardon et al. 2003).

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Tables and Figures

Table 1. Expenditure Categories With Their Respective Budget Shares

Basic categories	Budget share	Supply chain related attributes in the disaggregated models replacing the aggregate:		Abbreviation	Budget share
First budgeting stage			Own production	(Own)	0.7%
Non-food	41.5%	Place of	Traditional retailing	(Trad)	8.4%
Away-from-home food	12.9%	purchase	Modern retail outlets	(Mod)	0.5%
Home food	45.7%		Other sources	(Other)	0.4%
					10.1%
Second budgeting stage					
Other food	5.0%	**or**			
Beverages and stimulants	3.3%		No concerns or no measures	(No)	1.9%
Animal products	21.3%	Safety	Inspection at purchase	(Insp)	6.0%
Rice	5.5%	assurance	Trust to seller	(Trust)	1.9%
Preserved fruits and vegetables	0.5%		Formal safety assurance	(Form)	0.3%
Fresh fruits and vegetables	10.1%				**10.1%**
	45.7%	**or**			
			Domestic production	(Dom)	8.9%
		Region of	Imports from China	(China)	0.6%
		production	Non-traditional imports	(Imp)	0.3%
			Not specified	(Not)	0.4%
					10.1%

Table 2. Variable Definitions and Sample Statistics Compared to VLSS2002 Data

Variable	Description	Own survey		VLSS2002	
Expenditure	Annual per capita expenditure (million VND)	9.76	*[6.43]*	9.20	*[6.08]*
Distance	Distance to the next supermarket (km)	4.77	*[7.21]*	-	
Education	Years of schooling	8.67	*[4.48]*	-	
	Household head with 12 years of schooling or more	38.5%		35.3%	
F-empl	Food purchaser is female and employed	21.1%		-	
Car	Car owning households	2.7%		1.0%	
Urban	Households in urban areas	73.0%		73.8%	
Hanoi	Households in Hanoi	36.7%		36.2%	

Notes: The table shows mean values and standard deviations in brackets. Expenditure data from the VLSS2002 was adjusted by the official consumer price index.

Table 3. Average Per Capita Consumption (kg/year) of Fresh Fruits and Vegetables by Supply Chain

Product attributes of fresh fruits and vegetables		All	Poorest quartile	Richest quartile
Place of purchase	Own production	12.9	25.8	4.6
	Traditional retailing	124.2	85.0	165.6
	Modern retail outlets	8.4	0.4	22.1
	Other sources	4.2	3.6	4.2
Safety assurance	No concerns or no measures	27.5	39.7	21.9
	Inspection at purchase	85.4	57.1	108.4
	Trust to seller	31.2	16.3	52.8
	Formal safety assurance	5.7	1.7	13.3
Region of production	Domestic production	139.4	109.2	178.4
	Imports from China	4.7	3.0	7.1
	Imports from non-neighboring countries	1.4	0.0	4.6
	Not specified	4.2	2.6	6.4
	All	149.7	114.8	196.5

Table 4. Probit Models of the Decision to Purchase Fresh Fruits and Vegetables From Different Supply Chains

| | Place of purchase | | | | Safety indicators | | | | | Region of production | | |
	Own	Trad	Mod	Other	No	Insp	Trust	Form	Dom	China	Imp	Not
Expenditure	-0.245	-0.988***	1.0188***	0.156	0.021	0.116	0.159	0.207	0.607	-0.267	0.980***	0.775***
	[0.233]	[0.325]	[0.2334]	[0.247]	[0.195]	[0.194]	[0.169]	[0.228]	[0.560]	[0.177]	[0.287]	[0.216]
O. price	-0.173	0.019	-0.240**	-0.234***	-0.442***	-0.144	0.145*	-0.067	-1.469***	0.044	-0.069	-0.295**
	[0.147]	[0.152]	[0.101]	[0.075]	[0.082]	[0.117]	[0.086]	[0.084]	[0.320]	[0.085]	[0.100]	[0.139]
Distance	0.530***	0.125	-0.2155**	0.171**	0.319***	-0.057	0.085	-0.212*	0.356*	-0.090	-0.113	-0.116
	[0.123]	[0.135]	[0.0893]	[0.081]	[0.082]	[0.074]	[0.073]	[0.118]	[0.184]	[0.080]	[0.111]	[0.091]
Urban	-0.682**	0.972***	0.324	-0.059	-0.065	0.062	0.275	0.444	-a	-0.044	0.412	-0.280
	[0.285]	[0.287]	[0.3039]	[0.207]	[0.215]	[0.205]	[0.199]	[0.347]	-	[0.238]	[0.478]	[0.285]
Hanoi	1.152***	0.451	0.3900*	0.717***	1.124***	0.245	-0.396***	-0.034	-1.171***	-0.427***	-1.161***	0.961***
	[0.217]	[0.289]	[0.2161]	[0.175]	[0.162]	[0.162]	[0.148]	[0.210]	[0.393]	[0.157]	[0.261]	[0.194]
Education	-0.063	-0.007	0.152	0.099	-0.182	0.045	0.239**	0.229	-0.123	0.173	0.390*	-0.392***
	[0.132]	[0.155]	[0.150]	[0.129]	[0.120]	[0.113]	[0.108]	[0.143]	[0.221]	[0.117]	[0.233]	[0.137]
F-empl	-0.617**	-0.206	0.097	-0.718***	-0.178	0.014	-0.069	0.254	-0.669	-0.010	0.129	0.782***
	[0.289]	[0.3103]	[0.216]	[0.255]	[0.186]	[0.184]	[0.159]	[0.198]	[0.471]	[0.176]	[0.270]	[0.203]
Car	-0.634	-0.680	0.842**	0.143	-1.108*	0.379	0.011	0.338	-a	0.091	0.701	-0.645
	[0.469]	[0.6316]	[0.423]	[0.541]	[0.613]	[0.561]	[0.373]	[0.416]	-	[0.432]	[0.502]	[0.640]
Constant	0.311	10.5980**	-13.485***	-4.236**	0.312	-1.188	-2.633	-3.530	15.410***	0.723	-11.846***	-7.196***
	[2.258]	[4.1471]	[2.534]	[2.158]	[1.949]	[1.928]	[1.715]	[2.285]	[5.433]	[1.785]	[2.839]	[2.372]
Regression statistics:												
Log l:	-128.55	-52.29	-124.03	-133.05	-221.17	-247.67	-302.99	-133.58	-9.59	-271.81	-98.52	-132.15
Chi2:	143.77	78.49	83.03	67.81	148.09	14.76	34.4	34.23	46.69	22.99	62.07	85.86
Pseudo R2:	0.42	0.18	0.27	0.16	0.28	0.04	0.06	0.14	0.34	0.05	0.26	0.21

Notes: All estimations based on $n = 499$ observations. The dependent variable is a dummy that equals 1 if a household purchases fresh fruits and vegetables of the respective category and 0 otherwise. For an explanation of abbreviations, refer to tables 1 and 2. All cross- prices were included as independent variables, but are not shown here. Robust standard errors are shown in brackets.

*, **, *** Estimates are significant at the 10%, 5%; and 1% level, respectively.

[a] Variable not included due to perfect collinearity with the dependent variable.

Table 5. Demand System Estimates for Fresh Fruits and Vegetables From Different Supply Chains

		Place of purchase				Safety indicators				Region of production		
	Own	Trad	Mod	Other	No	Insp	Trust	Form	Dom	China	Imp	Not
Expenditure	-0.005	-0.055***	0.022***	0.005**	-0.001	-0.040***	0.004	0.010***	-0.046***	-0.006***	0.011***	0.006**
	[0.003]	[0.009]	[0.004]	[0.002]	[0.006]	[0.010]	[0.006]	[0.002]	[0.008]	[0.002]	[0.002]	[0.003]
O. price	0.003	0.046***	0.001	-0.001	-0.001	0.026***	0.019***	0.001	0.052***	0.003***	0.000	-0.005***
	[0.002]	[0.006]	[0.002]	[0.001]	[0.003]	[0.006]	[0.003]	[0.001]	[0.005]	[0.001]	[0.001]	[0.002]
Distance	0.008***	0.004	-0.010***	0.003***	0.013***	-0.008**	-0.001	-0.002*	0.009***	-0.002***	-0.003***	0.000
	[0.001]	[0.004]	[0.002]	[0.001]	[0.003]	[0.004]	[0.003]	[0.001]	[0.004]	[0.001]	[0.001]	[0.001]
Urban	-0.022***	0.061***	-0.002	0.000	-0.006	0.031***	0.006	0.002	0.032***	-0.001	-0.002	0.001
	[0.004]	[0.012]	[0.005]	[0.003]	[0.008]	[0.012]	[0.008]	[0.003]	[0.010]	[0.002]	[0.002]	[0.003]
Hanoi	0.009***	-0.009	0.005	0.009***	0.034***	0.009	-0.033***	0.001	0.017**	-0.005***	-0.009***	0.009***
	[0.003]	[0.008]	[0.004]	[0.002]	[0.006]	[0.009]	[0.006]	[0.002]	[0.008]	[0.002]	[0.002]	[0.003]
Education	0.000	0.004	0.006**	-0.001	-0.005	0.003	0.008**	0.003**	0.005	0.002**	0.003***	-0.001
	[0.002]	[0.005]	[0.002]	[0.001]	[0.004]	[0.006]	[0.004]	[0.001]	[0.005]	[0.001]	[0.001]	[0.002]
Mills'	0.038***	0.039***	0.044***	0.040***	0.063***	0.070***	0.064***	0.039***	0.060***	0.029***	0.042***	0.034***
	[0.002]	[0.007]	[0.003]	[0.002]	[0.003]	[0.004]	[0.003]	[0.002]	[0.015]	[0.001]	[0.002]	[0.002]
Constant	0.057**	0.647***	-0.156***	-0.036**	0.097*	0.485***	-0.003	-0.070***	0.569***	0.058***	-0.081***	-0.051**
	[0.026]	[0.072]	[0.031]	[0.018]	[0.052]	[0.100]	[0.057]	[0.019]	[0.067]	[0.014]	[0.015]	[0.022]
Regression statistics:												
R2:	0.54	0.29	0.51	0.61	0.53	0.44	0.56	0.57	0.24	0.71	0.65	0.45
Chi2:	568.19	204.69	442.43	732.01	516.19	341.83	550.2	664.87	175.21	1229.4	909.73	377.38

Notes: All estimations based on *n* = 499 observations. The dependent variable is the home food budget share of each category. For an explanation of abbreviations, refer to tables 1 and 2. All cross prices were included as independent variables, but are not shown here. Standard errors are shown in brackets.

*, **, *** Estimates are significant at the 10%, 5%; and 1% level, respectively.

Table 6. Comparison of Income (Expenditure) Elasticities for Major Food Groups

	Indonesia	Philippines	Thailand	Vietnam	Hanoi & HCMC	
Beverages & tobacco	0.91	0.89	0.92	1.10	1.15	Beverages & stimulants
Breads & cereals	0.38	0.39	0.43	0.51	0.28	Rice
Fish	0.81	0.78	0.79	0.90	0.93	Animal products
Meat	0.73	0.70	0.70	0.78		
Dairy	0.78	0.75	0.75	0.86		
Fats& oils	0.42	0.42	0.45	0.53		
Fruits& vegetables	0.58	0.56	0.56	0.64	0.61	Fresh fruits & vegetables
					1.27	Preserved fruits & vegetables
Other foods	0.73	0.70	0.69	0.78	0.67	Other foods

Source: Figures for Indonesia, the Philippines, Thailand and Vietnam are taken from Seale, Regmi and Bernstein (2003). Figures for Hanoi & HCMC are from own calculations.

Table 7. Expenditure, Own-Price, and Distance Elasticities of Fresh Fruits and Vegetables From Different Supply Chains

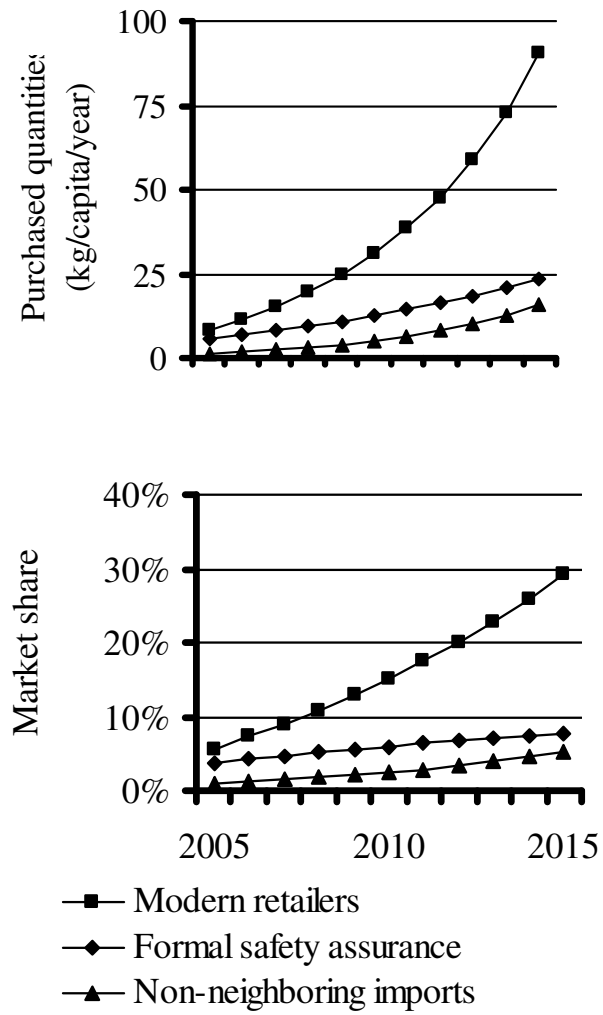|	Fresh fruits & vegetables	Place of purchase				Safety indicators				Region of production			
		Own	Trad	**Mod**	Other	No	Insp	Trust	**Form**	Dom	China	**Imp**	Not
Expenditure	**0.61**	0.27	0.52	**2.50**	1.04	0.67	0.61	0.91	**1.16**	0.59	0.41	**2.59**	2.02
Distance	**0.02**	1.47	0.02	**-0.65**	0.40	0.54	-0.07	0.03	**-0.55**	0.05	-0.16	**-0.29**	-0.24
Own price	**-0.64**	-1.34	-0.67	**-1.48**	-1.48	-1.51	-0.83	-0.68	**-1.12**	-0.65	-0.87	**-1.17**	-1.66

Figure 1. Projected purchase quantities and market shares of modern supply chains for fresh fruits and vegetables
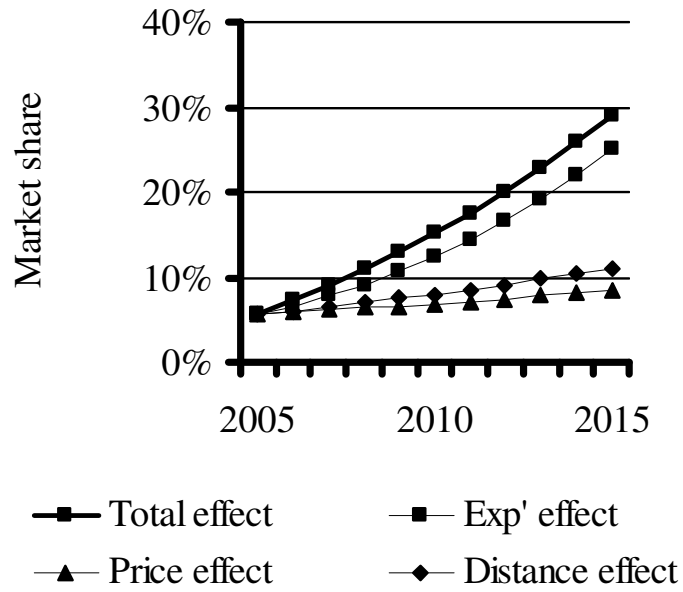
Figure 2. Projected market shares from modern retailers differentiated by expenditure, price and distance effect