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Food demand in Vietnam: structural changes and projections to 2030

Hoa K. Hoang

Post-doctoral Fellow,
Food and Agricultural Policy Research Institute (FAPRI),
Department of Agricultural and Applied Economics,
University of Missouri-Columbia
Email: hoangh@missouri.edu

William H. Meyers

Professor, Department of Agricultural and Applied Economics,
University of Missouri-Columbia
Email: meyersw@missouri.edu

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Abstract.

Rank three demand systems have been recognized to be best-suited for long-term demand projections due to their Engel flexibility. Using a fitted QUAIDS model, food demand in Vietnam is projected under scenarios that account for alternative growth rates in food expenditures, food prices and urbanization. Results indicate that at higher levels of expenditure growth, budget share of rice declines while budget shares of high-valued foods such as meat and drinks increase. Demand for rice is projected to decline in 2020 and further in 2030 both on a per capita basis and in total while demand for other foods increases. The projections also show that the effect of urbanization is more remarkable for rice while it is modest for non-rice food groups. Results of this study highlight the importance of considering the effect of income distribution and urbanization in long-term food demand projections.

Keywords: QUAIDS, Vietnam, Southeast Asia, Diet transition, Rice consumption, Household demand.

JEL codes: D12, R20, O12, C52, C31

1. Introduction

After more than 20 years of economic reform and openness, Vietnam reached its $1,000 GDP per capita threshold in 2008 and joined the group of lower-middle income countries for the first time (Ohno, 2009). Rapid economic growth has led to dramatic changes in the economic and socio-demographic structures of the population. According to General Statistics Office (GSO), real total expenditures doubled from $226.2 (3,459,000 VND) to $402.1 (7,304,000 VND) between 2002 and 2010[1]. The proportion of food expenditure in total expenditures, however, remained around 40% during this period (GSO, 2011b), indicating the importance of food in the consumption basket of Vietnamese consumers. In a recent study, Nguyen & Winters (2011) also found that cereals remain the food group that provides the majority of calories in the diets of the Vietnamese. Cereals, in which rice makes up the largest share, account for about 30% of expenditure but contribute more than 65% of calorie per capita on a daily basis.

In a country that is undergoing significant structural economic transition like Vietnam, predicting changes in food demand becomes even more challenging. Demand for food is known to be influenced by a vast array of intertwining factors. Those include consumers' income levels, dietary habits, whether the person resides in rural or urban areas, the availability of supermarkets, restaurants and fast-food vendors etc. At the country level, the trends and patterns of food demand, especially basic staples such as rice, also depend largely on stages of economic development. As Huang & David (1993) indicated, per capita rice consumption across Asian countries tends to increase in low-income countries while it decreases in higher-income ones as people of these countries have higher incomes. Their study also found that urbanization had negative effects on rice consumption, meaning that people eat less rice as they are more urbanized. In this regard, Pingali (2007) asserted that the patterns of food demand in Asian countries tend to follow these paths : (1) lower consumption of rice and increases in the consumption of wheat and wheat-based products on a per capita basis, (2) increases in per capita consumption of high-calorie foods such as meat, fish, and dairy products, and (3) increases in the consumption of fast foods and beverages. These structural shifts are mainly induced by two major factors: (1) increased incomes, and (2) urbanization. The latter is often associated with a more westernized life style and dietary habits (Huang & Bouis, 1996; Huang & David, 1993; P. Pingali, 2007).

[1] At exchange rates of 15,297VND/$ for 2002 and 18,162VND/$ for 2010.

Food demand patterns of urban people differ from those in rural areas, as urban people are exposed to more food availability, ready-to-eat foods, fast-food restaurants and street vendors. The emergence of supermarkets, which have grown rapidly in Vietnam's urban centers in recent years (Cadilhon, Moustier, Poole, Tam, & Fearne, 2006; Mergenthaler, Weinberger, & Qaim, 2009; Moustier, Tam, Anh, Binh, & Loc, 2010), is believed to have greatly affected traditional food supply systems and the consumption patterns of urban consumers. In addition, urban people have different calorie requirements as they tend to be more sedentary (Huang & Bouis, 1996). Urban people also have better assess to media outlets and thus, become more influenced by advertisements and promotions of western cultures, which are often stylized by the consumption of fast-foods (P. Pingali, 2007). It should be noted that per capita consumption of rice is expected to decline as consumers get richer and more urbanized but demand for high quality rice may rise (P. L. Pingali, Hossain, & Gerpacio, 1997). In addition, meat and dairy products are expected to continue to be the major source of growth in food consumption, especially in the developing world (Delgado, 2003; Keyzer, Merbis, Pavel, & van Wesenbeeck, 2005).

With regard to food demand projections, Cirera & Masset (2010) argued that the structural changes in income distribution vary across households and through time but most existing food demand models failed to account for this change, leading to possible biased projections, especially in the long run. In light of this, projections based on household data could provide a cure. However, those kinds of projections are limited in the literature compared to those based on time-series. One of the major reasons might be that household data are more difficult and expensive to collect. Surveys are often conducted in 2 or 4 year intervals, which prevents researchers from getting up-to-date data.

In the literature, rank three models such as the Quadratic Almost Ideal Demand System (QUAIDS) have been recognized to outperform other complete demand systems for projections owing to their Engel flexibility, i.e. the relationship between budget shares and total expenditure is non-linear (Cirera & Masset, 2010; Cranfield, Eales, Hertel, & Preckel, 2003; Yu, Hertel, Preckel, & Eales, 2004). Recently, a growing number of studies has attempted to use high-ordered demand systems to provide medium and longer term projections for cereal consumption in developing countries such as India, Bangladesh, Ethiopia, Pakistan and Nepal (Ganesh-Kumar, Mehta, et al., 2012; Ganesh-Kumar, Prasad, & Pullabhotla, 2012; Nazli, Haider, & Sheikh, 2012; Prasad, Pullabhotla, & Ganesh-Kumar, 2011; Tafere, Taffesse, Tamiru, Tefera, & Paulos, 2011). In these studies, the projection of per capita food consumption was based on the assumption that prices and urbanization rates are held constant. Per capita demand for major food groups was estimated using

budget shares projected directly by QUAIDS or linear approximated AIDS (LA/AIDS) under different income growth scenarios. Although the accuracy of these projections has not yet been assessed, using household data for food demand projections appeared to be useful as researchers can examine the structural changes in food demand at a more disaggregate level.

To contribute to that line of literature, this study projects the patterns of at-home food demand in Vietnam through the years 2020 and 2030 using the QUAIDS model estimated by Hoang & Meyers (2015) and adding the effects of urbanization and shifting of income groups. In particular, the model is used to predict per capita consumption of six major food groups including (1) rice, (2) pork, (3) meat and fish, (4) vegetables and fruits, (5) sugar and (6) drinks under 6 different scenarios concerning the impacts of food expenditures, food prices and the changing structure of urban population. To account for demographic and income differences, the sample is divided into 5 income quintiles. Rural and urban households are separated within each quintile, making a total of 10 demographic groups. Although the projections are provided for at-home food consumption only, the results are useful, as they account for changes in the distribution of expenditures at the household level and the impacts of urbanization at the national level over time. Both of these factors are vital to our understanding of possible structural changes of food demand in the long run. Conclusions from the projections will be drawn accordingly.

2. Past trends and patterns of food demand

To assess the trends and patterns of food demand in the past, data from the Vietnam Living Standard Survey (VHLSS) 2002 were used to compare with results from VHLSS 2010 in terms of group-wise budget shares and prices. VHLSS 2002 was chosen because it is the first survey available from the improved household survey round to which VHLSS 2010 belongs. Though not ideal, the similarity and consistency in the survey methods used in these surveys allow the data to be more comparable. Furthermore, the 8-year difference between 2002 and 2010 is reasonably long enough for us to assess the structural changes in food demand in the medium term and provides us insights on the possible changes, at least, for the next 10 years.

From 2002 to 2010, real food expenditures increased at an annual compound rate of 9.8%, from $226.2 (3,459,000 VND) to $402.1 (7,304,000 VND)[2] in 2010 prices. As shown in Table 1, budget shares changed most significantly for rice and miscellaneous food group from 2002 and

[2] Using exchange rates of 15,297VND/$ for 2002 and 18,162VND/$ for 2010.

2010. Rice budget shares declined from 30.7% to 20.4% and per capita consumption also declined significantly from 143.4 kg to 124.5 kg, or by about 19 kg. Budget shares of the miscellaneous food group, of which food away from home (FAFH) accounts for about a half, increased considerably from 26.2% in 2002 to 32.1% in 2010. Other groups that had declining budget shares, although just slightly, include pork (11.4% to 11%), and sugar (2.3% to 2.2%).

In terms of per capita consumption, the consumption of pork increased but at a slower rate than meat and fish food group (4.9% vs. 5.2%). This trend indicates a shift in demand for non-pork meats and seafood as consumers' incomes increase. The fastest growth came from the consumption of drinks, 8.4% per annum, which is consistent with observations that the consumption of beverages increased significantly with incomes in Asian countries (Fan, Wailes, & Cramer, 1995; Huang & Bouis, 1996; P. Pingali, 2007). Interestingly, per capita consumption of vegetables increased much faster than most other foods (7.4%) while their budget shares did not increase very much from 2002 to 2010 (10.1% to 11%).

Disaggregated by income quintile and rural and urban groups (within each quintile), food consumption showed consistent patterns (Table 3). In general, richer consumers spent larger budget shares for non-pork meats, drinks, and miscellaneous foods including FAFH than poorer consumers while the reverse trend applied for rice and pork. Within the same income class, urban consumers spent a smaller share of expenditure on rice and more on other food groups than those living in rural areas. In terms of per capita consumption, urban consumers consumed much less rice, slightly less drinks and pork, and more of other foods than rural consumers. Consistent with findings from Huang & David (1993), richer and more urbanized consumers ate less rice. For example, the difference between urban and rural consumers of the first quintile was about 20 kg, but that of the fifth quintile was nearly 33 kg. The differences in other food groups were not as proportionate as for rice, but for all other food groups except rice per capita consumption increased with income in both rural and urban areas.

From 2002 to 2010, the share of urban people within each income quintile also increased at an average rate of about 5% per annum. Notably, urbanization rates are highest for the three middle quintiles, ranging from 4.6% to 6%, while lowest for both income ends, which have a same rate of 3.8% (Table 4). This ndicates a faster growth of the middle class in the country during these years.

3. Method

The QUAIDS model estimated by Hoang & Meyers (2015) is used to project demand for 6 major food groups through the years 2020 and 2030. QUAIDS (Banks, Blundell, & Lewbel, 1997)

is among very few rank three[3] demand systems extended from the Almost Ideal Demand System (AIDS) (Deaton & Muellbauer, 1980).

The QUAIDS model has a form as follows:

$$w_i = a_i + \sum_{j=1}^{n} \gamma_{ij}\, lnp_j + \beta_j ln\left[\frac{m}{\alpha(\boldsymbol{p})}\right] + \frac{\lambda_i}{b(\boldsymbol{p})}\left\{ln\left[\frac{m}{\alpha(\boldsymbol{p})}\right]\right\}^2 \quad (1)$$

where w_i is the budget share of household i derived from price, quantity and total expenditure, $w_i = p_i q_i / m$, and satisfies the constraint $\sum_{i=1}^{n} w_i = 1$, n is the number of goods in the system, p_j is the price of good j, m is per capita total food expenditure, $\alpha(\boldsymbol{p})$ and $b(\boldsymbol{p})$ are the price indices, p is the vector of prices and α, β, γ, and λ are parameters to be estimated. Price indices are defined below:

$$lna(\boldsymbol{p}) = a_0 + \sum_{n=1}^{n} \alpha_i lnp_i + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} lnp_i lnp_j \quad (2)$$

$$b(\boldsymbol{p}) = \prod_{i=1}^{n} p_i^{\beta_i} \quad (3)$$

All parameters need to satisfy the adding-up condition, homogeneity condition, and Slutsky symmetry restriction:

Adding-up: $\sum_{i=1}^{n} \alpha_i = 1, \sum_{i=1}^{n} \beta_i = \sum_{i=1}^{n} \gamma_{ij} = 0,$

Homogeneity: $\sum_{i=1}^{n} \gamma_{ij} = 0 \; \forall \, j$

Symmetry: $\gamma_{ij} = \gamma_{ji}$

Expenditure elasticities are obtained from

$$\eta_i = {}^{\mu_i}/_{w_i} + 1 \quad (4)$$

where $\mu_i = \beta_i + \frac{2\lambda_i}{b(p)}\left\{ln\left[\frac{m}{\alpha(p)}\right]\right\}$

Uncompensated price elasticities are given by $e_{ij}^{u} = {}^{\mu_{ij}}/_{w_i} - \delta_{ij}$ (5)

where $\mu_{ij} = \gamma_{ij} - \mu_i\left(\alpha_j + \sum_k \gamma_{jk} lnp_k\right) - \frac{\lambda_i \beta_i}{b(p)}\left\{ln\left[\frac{m}{\alpha(p)}\right]\right\}^2$

Compensated price elasticities are derived from the Slutsky equation:

[3] "The rank of a demand system is the maximum dimension of the function space contained by the Engel curve", Cirera and Masset, 2014, pg. 2824.

$$e_{ij}^{c}=e_{ij}^{u}+\eta_i w_i \tag{6}$$

In addition, to account for demographic characteristics of a household, Poi (2013) extended equation 1 using the scaling technique proposed by Ray (1983). Assuming a utility maximizing household with s demographic characteristics, represented by vector **z**, the scaled expenditure function has the form:

$$m_0\,(\boldsymbol{p},\boldsymbol{z},u) = \overline{m_0}(\boldsymbol{z}).\,\theta(\boldsymbol{p},\boldsymbol{z},u) \tag{7}$$

in which $\overline{m_0}(\boldsymbol{z})$ measures the change in a household's expenditure with respect to demographic characteristics holding consumption patterns constant. The second term $\phi(\boldsymbol{p},\boldsymbol{z},u)$, on the other hand, accounts for actual prices and quantities consumed by a household and is defined by:

$$ln\phi(\boldsymbol{p},\boldsymbol{z},u)=\frac{\prod_{j=1}^{k} p_j^{\beta_j}(\prod_{j=1}^{k} p_j^{\eta'_j\mathbf{z}}-1)}{\frac{1}{u}-\sum_{j=1}^{k}\lambda_j lnp_j} \tag{8}$$

QUAIDS with a vector of demographic variables **z** now has the form:

$$w_i = a_i + \sum_{j=1}^{n}\gamma_{ij}\,lnp_j + (\beta_j + \eta_i\boldsymbol{z})\,ln\left[\frac{m}{m_0\,(\boldsymbol{z})\alpha(\boldsymbol{p})}\right] + \frac{\lambda_i}{b(\boldsymbol{p})c(\boldsymbol{p},\boldsymbol{z})}\left\{ln\left[\frac{m}{m_0\,(\boldsymbol{z})\alpha(\boldsymbol{p})}\right]\right\}^2 \tag{9}$$

where $m_0\,(\boldsymbol{z})$ = 1 + ρ′ $\boldsymbol{z}$ and $c(\boldsymbol{p},\boldsymbol{z}) = \prod_{j=1}^{k} p_j^{\eta'_j\mathbf{z}}$ with $\sum_{j=1}^{k}\eta_{rj} = 0$ (r=1…s) to satisfy adding-up condition. Two additional vectors of demographic parameters ρ and η are to be estimated.

It is noted that when λ_i = 0 the equation 1 becomes the original AIDS model. With a quadratic term λ_i in the logarithm of expenditure *m*, QUAIDS allows a good to change from luxury (expenditure elasticity>1) to necessity (expenditure elasticity<1) as expenditure increases.

Using likelihood ratio and Wald tests the Hoang & Meyers (2015)'s study has shown that QUAIDS is superior to AIDS in fitting the data. The expenditure elasticity of rice demand was estimated to be very inelastic (0.05) while those of non-rice foods were more elastic, ranging from 0.65 to 1.83. Meat and fish, drinks and miscellaneous food group turned out to be luxury goods, both at the national level and for rural and urban consumers. However, rice showed a different pattern as it was estimated to be an inferior good for urban consumers and a normal good for rural consumers with expenditure elasticities being -0.18 and 0.14, respectively. The opposite patterns of demand for rice and non-rice foods has stressed the importance of using demand systems with Engel flexibility. Obviously, a demand system without appropriate Engel flexibility will not be able to capture the falling marginal budget shares at higher expenditure levels, leading to possible biases in its projections.

4. Model validation

Following Ganesh-Kumar, Prasad, et al. (2012), the prediction performance of QUAIDS is validated using two sets of data: actual data from VHLSS 2010, the base year, and VHLSS 2002. The validation procedure is described as follows. First, food budget shares, w_i as in equation 1, are predicted using the actual food expenditure m of 2010. Per capita demand for each food group is then calculated using the predicted food budget shares and actual 2010 prices. Second, a backward prediction is generated assuming food expenditure and prices of each food group decline to the 2002 actual level in real terms. The estimated 2002 per capita demand is compared with the actual 2002 data.

The results, reported at the sample mean, showed that the predicted budget shares using 2010 data are similar to the actual values and the predicted quantities are just slightly different from the actual levels (Table 5). Backward predictions for the year 2002 are quite consistent with our expectations that the budget share for rice increases while those for other food groups, except for vegetables and fruits, decrease in response to a lower expenditure level. In terms of quantities, the prediction errors are larger for vegetables and drinks compared to other food groups, mainly due to upwardly predicted budget shares coupled with comparatively low prices, especially for vegetables. Existing studies using QUAIDS and LA/AIDS for backward forecasts found even large prediction errors, ranging from 20% to more than 100%, particularly for food groups that are aggregations of different food items (Ganesh-Kumar, Prasad, et al., 2012; Prasad et al., 2011). Thus, the performance of this model seems very satisfactory.

5. Scenarios and projection results

As already mentioned, this study will not only use the QUAIDS model to project future consumption patterns. It will also conduct scenario analysis to estimate the effects of continuing urbanization and of differing real price and expenditure growth paths. Thus, two major sets of assumptions are laid out concerning (1) the status of the economy, represented by alternative changes in real food expenditures and prices, and (2) urbanization growth. During the 2002-2010 period, the shares of food expenditures in total expenditures declined slightly but steadily from 43% in 2002 to 37.5% in 2008, but bounced back to 43% in 2010 (Figure 1), possibly due to high food price inflation as Vietnam faced stiff inflation in the years 2008 and late 2010 (Bhattacharya, 2013). In this study, we made an assumption that food expenditures will grow at the same rate with income in the projection periods.

Since 2008, the economic growth of Vietnam has slowed down significantly (Cuong, Hung, & Tung, 2010). In 2015, Vietnam is projected to grow at a rate of 5.4-5.6% in GDP (ADB, 2014; IMF, 2014). Thus, in this study we assume an expenditure growth rate of 6% per annum as the base. Two scenarios expanding from this base assumption include (1) an optimistic scenario where food expenditure grows at 8% and real price grows at 1% per annum, and (2) a pessimistic scenario where food expenditure grows at 4% and real price grows at 2% per annum. The former mirrors the economy in good times when real incomes grow fast and real prices of foods increase slowly while the latter imitates the opposite outlook (Table 6).

The urbanization rate in Vietnam is projected to be nearly 40% in 2020 and between 40% to 45% in 2030 according to United Nations and the General Statistics Office of Vietnam (GSO, 2011a; United Nations, 2014). In this study, there are three scenarios of urbanization growth for each projection year. In the base cases of the years 2020 and 2030, the urbanization rate for each demographic group is held fixed as in 2010. This no-urbanization-effect scenario is to replicate how most studies of this kind have been conducted without considering continued urbanization. Two other urbanization scenarios in addition to the base scenario for the year 2020 assume (1) high urbanization rate in which the share of urban population accounts for 38% of the total population, equivalent to United Nations' current projections, and (2) low urbanization rate in which the urban share accounts for 33% of the total population. Similarly, two other scenarios for the year 2030 include (1) high urbanization rate in which the urban share accounts for 45% of the population, and (2) low urbanization rate in which the rural share accounts for 40% of the population. The detailed decomposition of the share for each demographic group is presented in Table 7. Following the past trend, the middle-income groups are projected to grow at a slightly faster rate, up by 1%, compared with those at the two income extremes.

The projection procedures take the following steps: (1) Budget shares are predicted by QUAIDS under different food expenditure growth assumptions, (2) Per capita consumption of each food group is then estimated at the household level using the predicted budget shares and assumed price growth rates, (3) The national average per capita consumption is derived from the mean per capita consumption of each demographic group using the shares of population as weights.

Table 8 presents projected budget shares under two different food expenditure growth scenarios. Consistent with our past observations, consumers' demand for rice and the miscellaneous food group, which is mainly driven FAFH consumption, is more responsive to food expenditure increases than other food groups. Rice budget shares keep declining at higher levels of food expenditures, from 20.4% in 2010 to 15.4% in 2020 and to 11.2% in 2030 assuming food

expenditures grow at an annual rate of 4%. In contrast, budget shares of the miscellaneous group are projected to increase from 36.9% to 41.7% in 2020 and 2030, respectively. Budget shares for pork, vegetables and fruits, and sugar are projected to decline while those for meat and fish and drinks increase. Changes in the projected budget shares of these food groups across different food expenditure growth scenarios are modest.

The consistent trends in the projected food budget shares reinforce our confidence in the capacity and flexibility of the QUAIDS model in capturing the structural changes in food demand with respect to changes in incomes (or more directly, food expenditures). In addition, it also suggests an obvious trend in food consumption patterns of Vietnamese consumers that the two most popular table foods, rice and pork, will become less important in the food basket while higher-valued foods such as meats and seafood, and very likely, FAFH, will be more preferred as consumers' incomes increase. On a per capita basis, the consumption of all food groups except for rice is projected to increase in 2020 from the 2010 level and continue to increase in 2030 (Table 9).

If the urbanization structure remains the same as in 2010, per capita rice consumption is projected to decline from its 2010 level. In the optimistic scenario, which assumes real food expenditures grow at 8% and real prices grow at 1%, per capita rice consumption is projected to decline from 124 kg in 2010 to 121 kg in 2020 and to 102 kg in 2030, or at an annual rate of 0.3% and 0.9%, respectively. In the pessimistic case, which assumes real food expenditures grow at 4% and real prices grow at 2%, per capita rice consumption continues to decline to 109 kg in 2020 and to 90 kg in 2030, or at an annual rate of 1.3% and 1.4%, respectively. These growth rates are slightly lower than the 2002-2010 level, which was 1.7% (see Table 1).

In contrast, without urbanization effects, the per capita consumption of all other non-rice foods is projected to increase from the 2010 level. Consumption increases significantly in the optimistic scenario while modestly in the pessimistic scenario. The consumption of meat and fish and drinks appear to grow faster than other food groups. For example, per capita consumption of meat and fish is projected to increase from 27 kg in 2010 to 50.8 kg in the optimistic scenario but just 32.6 kg in the pessimistic scenario of 2020, equivalent to an annual growth rate of 8.9% and 2.1% respectively. Per capita consumption of pork is projected to grow as well, but at growth rates of 6% and 1.2% for both scenarios of 2020, which are slightly lower than those of meat and fish. In 2030, the growth rates of per capita consumption is slightly higher for meat and fish, vegetables and drinks compared to the corresponding 2020 levels. It is noted that the 2002-2010 actual growth rates of per capita consumption of non-rice food groups are within the range of the growth rates projected in the optimistic and pessimistic scenarios.

Interestingly, the effects of urbanization appear to be very modest for the consumption of non-rice foods, about less than 1 unit of measurement. The difference is most remarkable for rice, about 3-5 kg among three urbanization scenarios. For example, in the optimistic scenario of 2020, per capita consumption of rice is projected to be 117 kg under high urbanization assumption, which is about 4 kg lower than without urbanization effects. Similarly, in the pessimistic scenario of 2030, per capita consumption of rice is projected to be 84.9 kg under high urbanization assumption, which is about 3.5 kg lower than without urbanization effects. While changes in food expenditures and prices ultimately affect the consumption at the household level as well as at the food-group level, the differences in the effect of urbanization structure on food demand emphasize the fact that the changes across different demographic groups are less proportionate for rice than non-rice foods, leading to a significant change in the nationally weighted level of per capita consumption of rice.

According to United Nations (2014), Vietnam's population in 2002 and 2010 were 82.5 and 89 million people, respectively. Population is projected to reach 97 million people in 2020 and about 101.8 million people in 2030, which are equivalent to annual growth rates of 0.9% and 0.7%, respectively. Total household demand is derived using these population projections (Table 10).

Two extreme scenario combinations, optimistic (economy) –low (urbanization) and pessimistic (economy) –high (urbanization), are selected to present in comparison for brevity. Total household demand for rice is projected to vary from 10.3 to 11.6 million tonnes in 2020 and 8.6 to 10 million tonnes in 2030. Except for the optimistic-low scenario of 2020, other scenarios show that rice demand is projected to decline from the 2010 level despite of population growth, which is consistent with a declining trend observed in the 2002-2010 period. The declining rates, however, are modest, ranging from 0.5% to 1.1% per annum. Demand for non-rice food groups is projected to increase but at more varying degrees. For example, demand for meat and fish is projected to be in between 3.1 to 4.9 million tonnes in 2020, or grow at an annual rate of 3.1% to 10.5%. Similarly, demand for vegetables and fruits is projected to vary from 8.1 to 12 million tonnes in 2020, or at an annual growth rate of 2.4% and 8.5%. Projected demand in 2030 shows a similar pattern for respective food groups and scenarios.

6. Conclusion

This study employs QUAIDS model to generate projections of demand for 6 major food groups: rice, pork, meat and fish, vegetables and fruits, sugar, and drinks under different scenarios concerning changes in food expenditures, prices and urbanization. The results have confirmed the flexibility of QUAIDS in allowing food budget shares to change, even in an opposite direction, at

different expenditure levels. As expected, budget shares of rice decline significantly while those for meat and fish, drinks and most notably, miscellaneous food group, increase at higher levels of food expenditures.

On a per capita basis, the consumption of rice also shows a fall in 2020 from the 2010 level and continues to decline in 2030. Per capita consumption of pork continues to increase at higher levels of food expenditures but its growth rate is slower than that of meat and fish, suggesting consumers' high preference for non-pork meats and seafood as their incomes grow. Similarly, the consumption of drinks and miscellaneous food group, of which FAFH accounts for a large share, increases as consumers' incomes increase.

At the national level, the projections have shown that the effect of urbanization is more remarkable for rice while it is quite modest for the remaining food groups, mainly due to the fact that changes in per capita consumption of rice are much less proportionate across different demographic groups. This finding is consistent with observations across countries that demand for basic staples is one of the most sensitive to income change and varies greatly between rural and urban consumers. Over time, it is projected that demand for rice in Vietnam will decline both on a per capita basis and in total. In addition, consumers will consume more higher-valued foods, particularly more other types of meats in place of pork, as their incomes increase. Although this study concerns for at-home consumption only, the projections have shed some light on our understandings of the possible changes in the patterns and trends of food demand in the medium and long term. Similar approaches using household data can be replicated for other countries to examine the effects of income distribution, urbanization and changes in consumers' preferences on demand for food over time, which would help us to provide better long-run projections.

Tables and Figures

Table 1: Budget share and quantity consumed, 2002 and 2010

Food group	Budget share			Per capita consumption		
	2002	2010	Annual growth rate	2002	2010	Annual growth rate
Rice	30.7%	20.4%	-4.2%	143.4	124.5	-1.7%
Pork	11.4%	11.0%	-0.4%	10.0	13.9	4.9%
M&F	16.6%	18.8%	1.7%	19.0	26.9	5.2%
V&F	10.1%	11.0%	1.1%	45.7	72.7	7.4%
Sugar	2.3%	2.2%	-0.4%	4.0	5.5	4.7%
Drinks	2.7%	4.4%	8.1%	7.2	12.0	8.5%
Misc.	26.2%	32.1%	2.8%	-	-	-

Source: VHLSS 2010.

Note: * in percentage point. #Per capita consumption and price growth rate of the miscellaneous group are not reported as this group comprises of disparate food items. Per capita consumption for rice, pork, meat and fish (M&F), vegetables and fruits (V&F), and sugar are in kilograms except for drinks, which is in liters.

Table 2: Food unit price and expenditure growth rates

Food group	Unit	Unit price (1000VND)		Real price growth rate*	Real expenditure growth rate*
		2002	2010		
Rice	Kg	3.0	9.5	5.7%	3.8%
Pork	Kg	20.7	54.2	3.4%	7.9%
Meat and fish	Kg	16.6	54.7	6.4%	11.2%
Vegetables and fruits	Kg	3.9	11.1	4.4%	10.7%
Sugar	Kg	10.5	30.6	4.8%	8.4%
Drinks	Liter	7.8	42.0	13.1%	15.5%
Misc.	Index	-	-	-	12.5%

Source: VHLSS 2010 and 2002.

Note: * Calculated as annual compound growth rates.

Table 3: Budget share and quantity consumed in 2010 by demographic group

	Rice	Pork	M&F	V&F	Sugar	Drinks	Misc.
Budget share							
Urban -Quintile 1	25.7%	12.1%	16.9%	11.7%	2.6%	3.1%	27.8%
Quintile 2	19.4%	11.5%	18.2%	11.2%	2.3%	3.6%	33.8%
Quintile 3	15.9%	10.7%	18.5%	11.7%	2.1%	4.0%	37.1%
Quintile 4	13.2%	9.9%	19.5%	11.4%	1.9%	4.3%	39.8%
Quintile 5	9.2%	8.4%	19.9%	11.4%	1.8%	5.1%	44.3%
Rural- Quintile 1	32.7%	11.2%	16.1%	10.7%	2.2%	3.7%	23.5%
Quintile 2	24.7%	12.0%	18.6%	10.9%	2.4%	4.1%	27.1%
Quintile 3	20.3%	11.7%	19.6%	10.8%	2.5%	4.6%	30.6%
Quintile 4	16.9%	11.5%	20.0%	10.9%	2.3%	5.0%	33.4%
Quintile 5	13.8%	10.7%	20.4%	10.8%	2.3%	5.8%	36.3%
Quantity consumed							
Urban- Quintile 1	115.3	10.6	16.2	51.2	4.1	5.7	
Quintile 2	108.2	11.9	19.9	59.0	4.6	7.6	
Quintile 3	102.7	13.0	23.8	72.5	4.8	10.9	
Quintile 4	99.9	15.1	29.1	83.3	5.0	13.4	
Quintile 5	95.4	18.1	40.5	113.7	6.3	21.5	
Rural- Quintile 1	135.9	8.7	15.1	45.4	3.6	6.4	
Quintile 2	136.1	12.0	21.7	58.7	5.1	8.4	
Quintile 3	134.0	14.2	27.4	68.3	6.1	10.4	
Quintile 4	131.7	16.8	32.3	80.1	6.5	14.2	
Quintile 5	127.9	19.0	40.0	101.9	7.9	20.6	

Source: VHLSS 2010.

Note: Per capita consumption for rice, pork, meat and fish (M&F), vegetables and fruits (V&F), and sugar are in kilograms except for drinks, which is in liters.

Table 4: Urban and rural population shares by income class

		Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
2002	Urban	5.1%	11.2%	17.7%	30.9%	52.1%
	Rural	94.9%	88.8%	82.3%	69.1%	47.9%
2010	Urban	8.9%	16.7%	22.3%	37.0%	55.9%
	Rural	91.1%	83.3%	77.7%	63.0%	44.1%
2010-2002 change	Urban	3.8%	5.5%	4.6%	6.0%	3.8%
	Rural	-3.8%	-5.5%	-4.6%	-6.0%	-3.8%

Source: VHLSS 2010 and 2002.

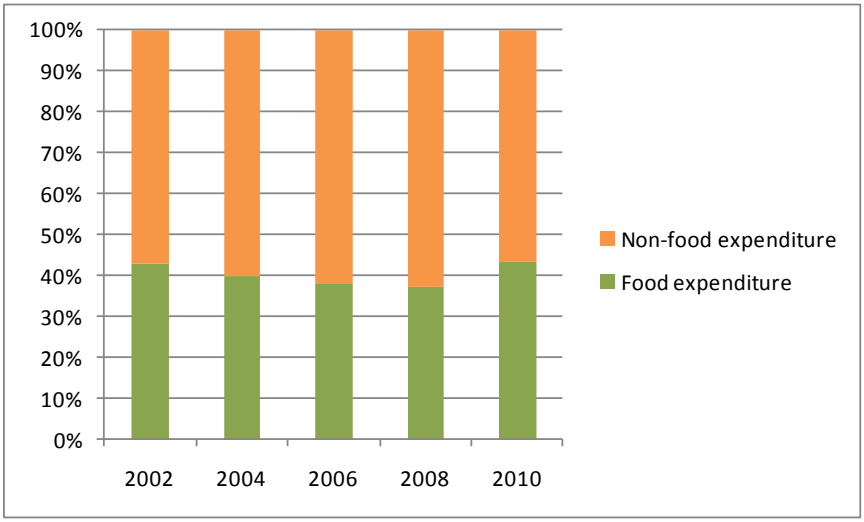
Table 5: Predicted 2010 and 2002 budget shares and quantity demanded

		Rice	Pork	M&F	V&F	Sugar	Drinks	Misc.
2010	Actual budget share	20.4%	11.0%	18.8%	11.0%	2.2%	4.4%	32.1%
	Predicted budget share	20.4%	11.0%	18.8%	11.0%	2.2%	4.4%	32.1%
	Actual quantity	124.5	13.9	26.9	72.7	5.5	12.0	-
	Predicted quantity	124.2	14.0	27.0	73.6	5.5	12.2	-
	Quantity prediction errors	-0.2%	1.0%	0.4%	1.2%	0.6%	1.6%	-
2002	Actual budget share	30.7%	11.4%	16.6%	10.1%	2.3%	2.7%	26.2%
	Predicted budget share	32.6%	11.2%	15.4%	12.0%	2.5%	3.5%	23%
	Actual quantity	143.4	10.0	19.0	45.7	4.0	7.2	-
	Predicted quantity	154.0	9.3	17.6	53.0	4.0	8.4	-
	Quantity prediction errors	7.4%	-6.6%	-7.3%	16.0%	0.9%	17.5%	-

Source: VHLSS 2010 and 2002.

Note: Per capita consumption for rice, pork, meat and fish (M&F), vegetables and fruits (V&F), and sugar are in kilograms except for drinks, which is in liters.

Figure 1: Shares of food and non-food expenditures, 2002-2010



Source: GSO, (2011)

Table 6: Scenario assumptions

Economy	Real food expenditure growth rate	Real price growth rate
Optimistic	8%	1%
Pessimistic	4%	2%
Urbanization in 2020	Urban share	Rural share
2010 level	28%	72%
High	38%	62%
Low	33%	67%
Urbanization in 2030		
2010 level	28%	72%
High	45%	55%
Low	40%	60%

Source: Calculated.

Table 7: Scenario changes in the urbanization structure by demographic group (%)

No.		Country-level		Quintile 1		Quintile 2		Quintile 3		Quintile 4		Quintile 5	
		Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
1	2010 level	28	72	9	91	17	83	22	78	37	63	56	44
	2020 scenarios												
2	High	38	62	18	82	27	73	32	68	47	53	65	35
	Change (2)-(1)			9	-9	10	-10	10	-10	10	-10	9	-9
3	Low	33	67	13	87	22	78	27	73	42	58	60	40
	Change (3)-(1)			4	-4	5	-5	5	-5	5	-5	4	-4
	2030 scenarios												
4	High	45	55	25	75	34	66	39	61	54	46	72	28
	Change (4)-(1)			16	-16	17	-17	17	-17	17	-17	16	-16
5	Low	40	60	20	80	29	71	34	66	49	51	67	33
	Change (5)-(1)			11	-11	12	-12	12	-12	12	-12	11	-11

Source: Calculated.

Table 8: Projected budget shares at different expenditure growth rates

Food group	2010	2020		2030	
		4%	8%	4%	8%
Rice	20.4%	15.4%	11.3%	11.2%	6.0%
Pork	11.0%	10.6%	9.9%	9.9%	8.3%
Meat and fish	18.8%	19.7%	20.1%	20.1%	19.6%
Vegetables and fruits	11.0%	10.5%	10.0%	10.0%	9.1%
Sugar	2.2%	2.1%	1.8%	1.8%	1.4%
Drinks	4.4%	4.9%	5.3%	5.4%	6.1%
Misc.	32.1%	36.9%	41.5%	41.7%	49.6%

Source: Calculated.

Table 9: Per capita food demand projections, 2020 and 2030

Food group	2010	Scenarios	2020		2030	
			Optimistic	Pessimistic	Optimistic	Pessimistic
Rice	124.5	No urbanization effect	120.9	108.8	102.0	89.8
		Annual growth rate	-0.3%	-1.3%	-0.9%	-1.4%
		Low urbanization	119.1	107.3	98.3	86.4
		High urbanization	117.1	105.6	96.8	84.9
Pork	13.9	No urbanization effect	22.2	15.6	28.7	16.7
		Annual growth rate	6.0%	1.2%	5.3%	1.0%
		Low urbanization	22.1	15.5	27.8	16.4
		High urbanization	21.9	15.5	27.4	16.3
M&F	26.9	No urbanization effect	50.8	32.6	82.0	38.2
		Annual growth rate	8.9%	2.1%	10.2%	2.1%
		Low urbanization	50.5	32.4	80.1	37.7
		High urbanization	50.2	32.3	79.3	37.5
V&F	72.7	No urbanization effect	122.8	82.5	189.6	92.4
		Annual growth rate	6.9%	1.3%	8.0%	1.4%
		Low urbanization	123.1	82.7	190.2	93.0
		High urbanization	123.5	83.0	190.5	93.3
Sugar	5.5	No urbanization effect	8.0	5.9	9.6	6.0
		Annual growth rate	4.6%	0.7%	3.7%	0.5%
		Low urbanization	7.9	5.8	9.2	5.8
		High urbanization	7.8	5.8	9.0	5.7
Drinks	12	No urbanization effect	26.3	15.6	50.3	19.9
		Annual growth rate	11.9%	3.0%	16.0%	3.3%
		Low urbanization	26.5	15.7	50.6	20.1
		High urbanization	26.6	15.7	50.7	20.2

Source: Calculated.

Note: Per capita consumption for rice, pork, meat and fish (M&F), vegetables and fruits (V&F), and sugar are in kilograms except for drinks, which is in liters.

Table 10: Projected household food demand and annual growth rates, 2020 and 2030

Food group	Unit	2002	2010	2020		2030	
				Optimistic-Low	Pessimistic-High	Optimistic-Low	Pessimistic-High
Rice	Million MT	11.8	11.1	11.6	10.3	10.0	8.6
	Growth rate			*0.5%*	*-0.7%*	*-0.5%*	*-1.1%*
Pork	Million MT	0.8	1.2	2.1	1.5	2.8	1.7
	Growth rate			*7.3%*	*2.1%*	*6.4%*	*1.7%*
M&F	Million MT	1.6	2.4	4.9	3.1	8.2	3.8
	Growth rate			*10.5%*	*3.1%*	*12.0%*	*3.0%*
V&F	Million MT	3.8	6.5	12.0	8.1	19.4	9.5
	Growth rate			*8.5%*	*2.4%*	*10.0%*	*2.3%*
Sugar	Million MT	0.3	0.5	0.8	0.6	0.9	0.6
	Growth rate			*5.7%*	*1.4%*	*4.6%*	*1.0%*
Drinks	Million liters	0.6	1.1	2.6	1.5	5.1	2.1
	Growth rate			*14.0%*	*4.3%*	*19.1%*	*4.6%*

Source: Calculated.

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