Policy Research Working Paper 9803

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WORLD BANK GROUP
Macroeconomics, Trade and Investment Global Practice
October 2021

Policy Research Working Paper 9803

Abstract

In 1986 the Đổi Mới reform changed the economic and social policies in Vietnam, triggering steep economic growth and the shift from a low- to a middle-income economy. In parallel to the economic growth, Vietnam also experienced rapid social and demographic change, which resulted in modified consumption behavior. This paper estimates a Quadratic Almost Ideal Demand System, obtaining income and own- and cross-price elasticities for 10 groups of goods and services that can contribute to the further economic development of Vietnam. To control for potential bias generated by unobserved quality substitution and endogenous unit values, the analysis adopts an instrumental variable method. The results show that household equipment, clothing and accessories, telecommunication, transport, and medical and health services are responsive to income changes, while food, foodstuffs, beverages and tobacco, education, and electricity are income inelastic. Moreover, the analysis detects complementarity between education and the rest of the goods and services, and substitution between health care and household equipment, clothing, and telecommunication services. These results help in understanding recent socioeconomic development patterns in Vietnam and provide updated evidence to support business decisions and economic policy planning.

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Demand Analysis of Multiple Goods and Services in Vietnam*

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JEL: C03; D01; O12;

Keywords: price elasticity; quality substitution; QUAIDS; instrumental variable; endogeneity; household survey.

* We would like to thank Andrew Burns, Quang Hong Doan, Doerte Doemeland, Stephen Ling, Jacques Morisset, Carolyn Turk and Judy Yang for their support and valuable comments. This paper relies on research conducted under "Supporting Systematic Action to Implement Vietnam's NDC" project led by Stephen Ling and "COVID-19 and the Future of Work" project led by Jacques Morisset. We are also grateful to the National Center for Socio-economic Information and Forecast for supplying some of the data used in the study. Financial support from the Government of Australia, through the Australia – World Bank Group Strategic Partnership in Vietnam Phase 2 (ABP2) is greatly appreciated.

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1. Introduction

Since 1986, Vietnam performed one of the most successful transitions from a low- to a middle-income economy across the globe, fueled by steep economic growth and a number of subsequent reforms that changed the business and social environments in almost all parts of the country. Almost all the economic indicators improved, with significant increase in employment, productivity, and domestic and foreign investements. These have been closely followed by imrpovements in demographic and social indicators, with growing rates of access to education and health care, and improvements in terms of sanitary and health conditions and food and nutrition security. Today, the large majority of Vietnamese households, both in rural and urban settings, have access to basic services such as electricity and telephone lines, while higher quality mobile and internet services are expanding their outreach.

Despite this story of success, in order to further improve and to achieve the same economic and social security levels as high-income countries, Vietnam still needs to address some key contemporary challenges. A recent report from the World Bank (2020) identifies the issues constraining Vietnam's second transition towards an advanced economy: "*Fertility rates drop and the population ages. Automation and other technologies can reduce those jobs on which a large share of Vietnam's labor force currently depends. And the combination of rising pollution and climate change is affecting health, quality of life and, increasingly, output from both the rural and urban sectors. Global trade has been declining over the last ten years and the COVID-19 pandemic is an accelerator of several megatrends such as disruption of global supply chains, digitalization.*" (World Bank, 2020, pp. 14)

Demand analysis is necessary in order to indentify consumption patterns driving economic evolution. Knowing the income elasticity of demand for a variety of goods and services can support business decisions and economic policy planning. Similarly, own- and cross-price elasticities help identifying households' preferences and vulnerabilities, highlighting market signals and opportunities, and where there is a need for governmnet intervention. For example, the income elasticity of demand for supermarket products can reveal consumer preferences and, therefore, support supply chain actors to adjust to changing preferences and regulators to define quality and safety standards (Mergenthaler et al., 2009).

In the literature, there is a relative abundance of demand analyses for Vietnam, dating back from the Đổi Mới reforms in 1986. However, this literature has almost exclusively focused on food demand analysis (e.g. Niimi, 2005; Gibson and Kim, 2013a; Bairagi et al., 2020; Vu, 2020), with a few exceptions looking at electricity (Meyerhoefer et al., 2007) and health care services (Phu, 2020). A more detailed analysis looking at the main economic sectors that can contribute to further the economic development of Vietnam is therefore lacking and this paper aims to fill this gap. More specifically, in this paper we use micro-level household consumption data to estimate a Quadratic Almost Ideal Demand System (QUAIDS), obtaining income, own- and cross-price elasticities. We focus on 10 goods and services, namely food, foodstuffs, beverages and tobacco, household equipment, clothing and accessories, transport, telecommunication, education, medical and health, and electricity. These groups are broad aggregates, therefore the degree of unobserved quality substitution can be potentially high, generating overestimated demand elasticities. In order to control for this potential bias, and to reduce the bias potentially generated by using endgogenous unit values as proxies of market prices, we adopt an instrumental variable (IV) approach to the QUAIDS.

Our results show that all the goods and services considered are normal. However, household equipment, post and communication, clothing and accessories, transport, and medical and health services are much more responsive to income changes than food, foodstuffs, beverages and tobacco, education and electricity, which are income inelastic. These tendencies are confirmed also by the estimated own-price elasticities. Moreover, cross-price elasticities reveal a pivotal role of education and health services in driving household consumption, with a complementary relationship between education and the rest of the goods and services, and with medical and health care being substitutes for household equipment, clothing and telecommunication services.

The remainder of the paper is organized as follows. The next session provides a background of the economic growth, social transformation and reforms that have occurred in Vietnam since the Đổi Mới

in 1986. Section 3 is a literature review of demand analyses concerning Vietnam, with a focus on approaches to deal with quality substitution and endogeneity of unit values. Sections 4 and 5 explain the data and method applied in this paper, respectively, and are followed by results in section 6. Finally, section 7 concludes with some policy discussion.

2. Economic, social development and policies in Vietnman

In 1986 the Đổi Mới reforms produced a decisive change in the economic and social policies in Vietnam. The country shifted from a centrally-planned, highly subsidiezed Soviet-based economic system to a multi-sector, market-oriented and globally integrated economy (Hien, 2019; Khoa, 2021). Policy reforms and favourable global trends allowed progress and economic growth, so that in 2010 Vietnam transitioned from being one of the world's poorest countries to becoming a lower middle-income economy (World Bank, 2020).

Several factors helped the transition. A young population expanded the labor force while agricultural productivity increased thanks to new technologies, resulting in 30% of the workforce moving from the rural sector to the manufacturing and industrial sectors (World Bank, 2020). Domestic migration between regions is still significant. In 2018, the provinces of Sóc Trăng and Trà Vinh had a net migration of -14.5% and -11.2% respectively, while Ho Chi Minh City and the surrounding province of Bình Dương of 6.1% and 47.9% respectively (GSO data). The expansion of global trade particularly benefited Vietnam's exports, initially exporting important commodities such as rice thanks to a relative abundance of fertile land and water, and in a second step exporting labor-intensive products such as textiles and electronics (World Bank, 2020). The development of manufacturing industries was further improved by inflows of foreign direct investments (FDI) (Hien, 2019).

Since 2010 the yearly average GDP growth rate has been 6.3% (GSO data). In 2018, the main employing sectors were agriculture (37.6% of national workforce), manufacturing (18.4%) and wholesale and retail trade (13.4%). These are the sectors with the lower labor productivity, while higher-skill jobs still employ a minority of people (e.g. professional, scientific and technical activities 0.5%, financial, banking and insurance activities 0.8%, education and training 3.2%) (GSO data). Overall, the national average unemployment rate is relatively low at 2.2%, higher in urban areas (3.1%) and lower in rural areas (1.7%).

In the last 10 years, Vietnam has built up a relatively large stock of infrastructure. In 2018, the transport sector received 9.6% of total national investments, which is the second largest amount of investments after manufacturing (27.4%) (GSO data). However, large investements are not always accompained by efficient financing, operations and maintenance, hence infrastructure services could improve in quality (World Bank, 2020). This is particularly relevant for transport infrastructure as, despite that significant progress has been made, new constructions are not always planned in an integrated way (World Bank, 2020). The road network has seen an accelleration in building new motorways, but other secondary roads lack maintenance and appropriate design, hence traffic on these roads can be dangerous and slow. Financing for building new roads comes from a diversity of organizations, such as the government, business organizations and international donors such as the World Bank, the Asian Development Bank and the Japan Bank for International Cooperation. Lack of maintenance and need to upgrade concerns also the railway network, that is owned and operated by state-owned enterprise Vietnam Railways. On the contrary, air travel is rapidly developing with 34 national civil airports and 3 international hubs in Hanoi, Da Nang City, and Ho Chi Minh City.

The Vietnamese business landscape is composed of three main types of firms. The business sector is composed of 90% small family enterprises with up to three employees. These small firms have low capital intensity and are concentrated in traditional sectors, with low opportunities to grow and to benefit from finance and technologies. Some key utility markets, such as banking and telecoms, are controlled by state-owned enterprises (SOEs) and a few large domestic firms, while the export-oriented manufacturing firms are foreign-owned or FDI firms, often far more productive than domestic ones (World Bank, 2020).

The changed business environment needs to be followed by a skilled and specialized workforce. In Vietnam, basic education is well aligned to global standards, but vocational-technical education and university level are still under-supplied (World Bank, 2020). The share of students in technical or vocational training is about 6%, compared to 27% in the Republic of Korea and 50% in other OECD countries. Secondary, tertiary and technical school enrollment is quite low and the rate of abandonment high. One of the reasons is the cost of higher schooling, as Vietnamese students cover about 40% of the costs and the government expenditure on universities is only 0.5% of GDP (World Bank, 2020).

Since the Đổi Mới, universities have more autonomy and privatization was promoted (Pham & Fry, 2004). Having an education system capable of supplying the growing economy is a policy goal in the Higher Education Reform Agenda- Resolution 14 (2005) and in the National Strategies for Education Development 2001-2010, 2010-2020 (2001; 2012). In response to these initiatives, universities developed international cooperation in education and research, promoting the international mobility of students and academics overseas (Trinh, 2018). Domestic strategies have also been applied, adopting English in many graduate courses, importing foreign curriculums and encouraging transnational institutional mobility. For example, in 2000 the Royal Melbourne Institute of Technology was the first foreign-owned university opened in Vietnam, followed by the British Vietnamese University in 2009, and the US Fulbright University in 2016. Examples of model borrowing, where universities receive support and partnership from foreign governments, are also present in Vietnam, such as the Vietnamese-German University in Ho Chi Minh City; the Vietnamese-Russian University in Hanoi (Trinh, 2018).

In parallel to the economic growth, Vietnam experienced also a rapid social and demographic change. The population grew from 23.5 million in 1945 to 96.5 million in 2019 (World Bank, 2020). In 2018, about 70% of the population was under 35 years old. Between 1950 and 2019, life expectancy increased from 52 to 75 years, which is qurrently the highest in Southeast Asia (Khoa, 2021). However, the welfare generated by the economic growth is unevenly distributed with no substantial improvements. The national GINI index measuring income inequalities has been steadily around 42%-43% since the early 2000s. Inequalities are higher in rural areas, especially in Northern midland and mountain areas where in 2018 the GINI index increased to 44%, while urban areas in the South-East had a GINI index of about 37% (GSO data).

Health indicators improved along with the economic growth. Between 1990 and 2015, maternal mortality rates declined by 61%, while child mortality rates droped from 8.6% in 1964 to 2.1% in 2017. These achievements have been followed by a significant increase in public spending on the health care system, which however remains insufficient as households still spend a substantial amount of out-of-pocket money on private health care (Dang et al., 2021). Since 2000, about 15% of the households in Vietnam spent over 10% of their income on health care, and 5% of the population fell into poverty because of health care costs. From 1995 to 2006, the government share of the health care expenditure was about 30% while out-of-pocket payments were about 50%. After 2006, the proportion shifted to 40%-40% and in 2014 government spending accounted for over 50% (Khoa, 2021).

Currently, Vietnam has a mixed public-private health care system with two types of health insurance: the governmant's social health insurance and private health insurance offered by private insurance companies. The coverage rate of the social health insurance increased from 12.5% in 1998 to about 70% in 2013, while from 2005 to 2014 private insurance covered 5% of the population. Private hospitals are concentrated mainly in urban areas. Public hospitals have problems of overcrowding because of the rapid population growth, making private solutions more appealing to middle- and higher-income households.

The economic and social changes that started in 1986 resulted also in modified consumption behavior. This is particularly evident with respect to the change in demand and consumption of electricity. Between 1995 and 2014, electricity consumption grew 11.3-fold, while during the same period the global average growth was 1.4-fold (World Bank, 2015). Between 2015 and 2018, in only four years the electricity consumption per capita increased of 29.1%, reaching in 2018 the national average of 1,981.1 Kwh/person (GSO data). Today, Vietnam has achieved an almost universal rate of electrification, with up to 98% of all households connected to the electric grids, compared to only 50% in 1995 (Asian Development Bank, 2015; Phu, 2020).

The fast and wide diffusion of electricity was helped also by cheap prices. In Vietnam, the 2019 average retail electricity price was about 8.1 US cents/kWh, compared to 14 US cents/kWh in the United States and 31 US cents/kWh in Germany in 2018 (Phu, 2020). These low tariffs are maintained by government regulations. A subsidised scheme charges lower tariffs from small or marginalized users with financial difficulties and compensates with higher tariffs from large consumers of electricity (Phu, 2020).

The cheaper electricity in Vietnam compared to its neighboring countries had also an impact on the industrial development, fostering investments in energy-intensive industries, such as mining, steel and cement. As a result, Vietnam is currently the largest steel producer in Southeast Asia and the eighth largest cement exporter worldwide. However, Vietnam's steel and cement producers are highly energy inefficient and less competitive with respect to their regional counterparts (Hien, 2019). Inefficiencies depend also on Vietnam's source of energy, which is a mix of oil, coal, natural gas and hydropower.

One of the consequences of the rapid growing energy consumption, is the inability of Vietnam to self-supply its domestic demand. Since 2015, Vietnam became a net energy importer with negative potential consequences for energy security. The fast growth in energy consumption corresponded also to an increase of emissions per capita of 24.7% (GSO data). The 2018 index of renewable energy on total primary energy supply decreased by 10.1% (GSO data). This makes it challenging to meet Vietnam's Nationally Determined Contributions to the Paris Agreement which target is a reduction of 8% GHG emissions by 2030. The most promising renewable energy sources for Vietnam are hydro, wind and solar energy, with contributions from biomass, biogas, geothermal and solid wastes (Shem et al., 2019). However, their market competitiveness is strongly challenged by the low electricity and coal prices.

In correspondence to the diffusion of electricity, also the telecommunication sector had a fast and wide development. Since 1995, the year of introduction in the country of the global system for mobile communication (GSM) and code division multiple access (CDMA), the telecom market has grown about 79% per year untill 2008 (Hwang et al., 2009). Initially, the Vietnamese telecom market was a monopoly with only one firm, the Vietnam Post and Telecommunications Corporation, and a weak competition between its two subsidiaries Vinaphone and Mobiphone (Hwang et al., 2009). Important reforms started at the beginning of the 2000s, when the government promoted competition by opening to foreign companies. The first Korean mobile telephone services started in 2003 and since then the competition continued growing, although the government set up a pricing control regulation (Hwang et al., 2009). A second policy stepstone was the 2005 "Program on the provision of public telecommunications services till 2010". The objective of the programme was to improve telecom access to all households living in areas with a tele-density below 2.5 sets per 100 inhabitants by subsidizing: the development of telecom infrastructures in all districts; public telephone and internet centers; fixed telephone and internet services to rural users. In five years the program achieved many of its objectives. At the end of 2010 the tele-density raised to 16 sets per 100 inhabitants, the penetration of the internet services doubled, the public telephone and internet centers were operating in 97% of communes across the country (Thai and Falch, 2018).

3. Literature review

In Vietnam the General Statistics Office (GSO) regularly collects household consumption data as part of the longitudinal household living survey. The first Vietnam Living Standards Survey (VLSS) was conducted in 1992 and the second in 1997. Since 2002, the Vietnam Household Living Standards Survey (VHLSS) is conducted every two years. This generated an abundance of household consumption data with respect to other countries that conduct household surveys less frequently. As a result, there exist a relatively high number of studies analyzing Vietnamese household consumption patterns and elasticities, especially with respect to studies fousing on Sub-Saharan African or Caribbean countries. In this review we focus on studies conducted in the last 20 years.

An advantage of looking at the literature on consumption elasticities in Vietnam is that, thanks to the above mentioned data availability and number of studies, it is possible to analyze differences across applications of different demand systems and econometric strategies. However, most of the studies on

Vietnam focus on food and foodstuff goods, while consumption of other goods and services, such as household equipment, energy, health and education are often disregarded or confined to broad aggregates such as "other" or "non-food" expenditure.

The study of Niimi (2005) is probably the best known paper on Vietnamese consumption elasticities, not only because it estimates an AIDS using the first two waves of the VLSS (1992-93 and 1997-98), but also because it addresses a key issue in demand analysis, namely comparing different methods to account for quality effects and measurement errors in the context of Vietnam. This issue concerns demand analyses using household surveys. Such surveys are the most frequently used sources of data, as they are nationally representative and have detailed consumption questionnaires. However, in the large majority of the cases household surveys do not collect household-level goods' prices. To obviate this lack of information, researchers calculate a unit value as the quantities consumed of a given good divided by the good's total expenditure. Unit values are largely used in demand systems as proxies for household prices, but they can generate biased estimations.

Deaton (1988, 1990) discussed and addressed in details the potential bias of unit values, identifying two main sources. First, bias can be due to unobserved quality substitution. Commodities are subject to aggregation and unit values reflect the quality of diversified goods within the commodity aggregation. For example, the commodity group "rice" might be composed by a mix of high-quality and more expensive sweet Jasmine rice and lower-quality and cheaper glutinous rice. Households can respond differently to an increase in the price of Jasmine rice: they can decide to reduce the quantity consumed, or they can switch to glutinous rice in order to maintain the same total calorie intake. But if the two are aggregated this trade-off is not observed. Second, quantities and expenditures are likely to be measured with errors, therefore also unit values derived from the ratio between the two are likely to be measured with errors.

Deaton (1988) proposed a procedure to correct this bias. In order to estimate price elasticities, Deaton's method is based on two assumptions. The first is the weak separability assumption that assumes that the household utility is weakly separable in the commodity groups. This allows to use unit values as a proxy for price. The second assumption is that surveyed households are geographically clustered in groups that share the same market prices. Price elasticities are then estimated on the basis of inter-cluster variation correcting quantities and unit values, reducing the bias due to quality effects and measurement errors.

Niimi (2005) tested the robusteness of Deaton's method comparing expenditure and price elasticities (see tables 1 and 2) and the welfare impact of price changes in Vietnam, estimatimating different food demand systems using market price data, unit values and Deaton's procedure. The author concludes that Deaton's procedure tends to overestimate the expenditure elasticities and that it is possible that it does not identify and correct appropriately the quality effects. Subsequently, several other studies found significant differences in price elasticities estimated with Deaton's method with respect to actual market prices, among these McKelvey (2011) and Gibson and Kim (2013a; 2019). The disadvantage of Deaton's method is that the variation used to correct price elasticities is not only due to price variation but also it can be affected by other unexplained factors. Moreover, Deaton's approach is quite complex and therfore difficult to implement.

Deaton's method was used recently by Bairagi et al. (2020) to estimate a demand system with 15 major food items in Vietnam (see tables 1 and 2 for detailed items). Their main contribution consisted of using three waves of the VHLSS (2012, 2014 and 2016) and to consider income and urbanization effects. Bairagi et al. (2020) found a large variation in expenditure and price elasticities across rural/urban areas and different income groups. Moreover, Vietnamese households prefer animal proteins and fruits and vegetables to the traditional staple rice. This tendency is stronger in higher-income urban households, where rice is already an inferior good, and Bairagi et al. (2020) explain it as an effect of the economic growth of Vietnam and the consequent increase in income and urbanization. The authors aknowledge the limitations of Deaton's method, however, in absence of actual market data, they prefer it over other methods.

Others authors, such as Vu (2020), used Deaton's method in comparison with alternative methods to deal with quality effects. One popular alternative is the one of Cox and Wohlgenant (1986) (CW), which is based on fewer assumptions and it is easier to use compared with Deaton's (e.g. Park et al., 1996; Lazaridis, 2003). CW uses the deviations of unit values from regional or seasonal means as proxies of quality effects. They regress them on household characteristics and use the residulas to correct unit values, obtaining quality-adjusted prices. However, the main issue with CW is that the adjusted prices are household-specific, disregarding the fact that, in theory, nearby households share similar market prices. In order to fix this problem, Vu (2009) developed a modified version of CW using communal average unit values instead of household unit values. This modified CW is used by Vu (2020) and many others (see below), however neither CW nor its modified version deals with measurement error problems.

Mergenthaler et al. (2009) used the CW approach to analyze fresh fruits and vegetables demand in the two major cities of Vietnam, Hanoi and Ho Chi Minh City. Instead of the VHLSS, they used their own survey data collected in 2005, looking at effects of different supply chains with different quality and safety standards. They conclude that fruits and vegetables from modern supply chains with higher standards, such as supermarkets or non-traditional imports, are highly income elastic, and that income effects are prevalent over price competitiveness and supermarket penetration, suggesting once again that the effects of Vietnamese economic growth affect consumption preferences, not only in terms of quantity consumed but also in terms of food quality. Hoang (2018) used the modified CW approach (Vu, 2009) in QUAIDS concluding that, despite the growing income and urbanization levels in Vietnam, the demand for rice is still expenditure and price inelastic with respect to other foods. Moreover, Hoang (2018) shows that a 10% decrease in income or a 30% increase in rice prices would induce Vietnamese households to revert a larger portion of expenditure on rice away from other foods. This suggests that despite the economic growth, in Vietnam rice remains a core staple for housheolds' food security.

Despite the availability of methods to (partially) address quality effects, some studies still employed market prices without quality correction. Meyerhoefer et al. (2007) studied the relationship between the demand for health care and the consumption of food, non-food goods, and leisure using the VHLSS 1997 and market data at the commune level with LAIDS in Vietnam. Their results suggest that, overall, Vietnamese consumption patterns are not strongly influenced by changes in health care costs, unless the household is directly affected by illness and some of the members are under treatment. On the contrary, the demand for health care is responsive to changes in income and in the prices of rice and non-food goods. Le (2008) used market prices to analyze the demand for rice, other food, meat and fish, but with the advantage of using prices collected with the Community Price Survey conducted by the GSO in parallel to the VLSS 2004.

A more direct approch to separate the quality from the quantity effect of price changes is the unrestricted method (UM) proposed by McKelvey (2011). This direct approach is seldom adopted because it requires both price and unit value data. Apart from McKelvey (2011), published applications of this direct approach are Gibson and Kim (2013a), Gibson and Romeo (2017) and Gibson and Kim (2019). The UM uses the relationship between unit values and actual prices to directly estimate the magnitude of quality substitution. McKelvey (2011) demonstrates that quality substitution can induce biased price elasticities even when prices are actually observed.

Gibson and Kim (2013a) provide an application of the UM for Vietnam, estimating a demand system with eight food groups and data from the VHLSS 2010. They demonstrate that price elasticities estimated with approaches that do not allow for quality substitution are overestimated because quality demand response is attributed to quantity response. This has significant repercussions on food security assessments. Gibson and Kim (2013a) show that, when ignoring quality substitution, a 10% increase in the relative price of rice wrongly results in a 4% drop in household calories consumption, while the actual reduction in calorie consumption is less than 2% when quality substitution is accounted for. This because Vietnamese households have considerable room to switch to lower quality rice before having to reduce the calories intake (assuming that different quality rices have the same nutritional value and that different quality varieties are available on the market). For the same reasons, Gibson and Kim

(2013b) also demonstrate that unit values are unsuited to measure differences in food prices between income and spatial groups. In the poorer metropolitan areas of Vietnam, food prices are 4.5% lower than in upper income neighborhoods, but unit values for the richest households are 20% higher than for poorest households. Gibson and Kim (2019) compares the UM with the Standard Price Method (SPM) and Deaton's method using the VHLSS 2012. In this instance, Gibson and Kim demonstrate that the own-price elasticity of quantity demand is overstated by a factor of four when the quality response is disregarded.

Looking at the expenditure and price elasticities in tables 1 and 2 we note a strong heterogeneity across studies. For example, the expenditure elasticity of "Other meats and seafood" ranges from 0.25 (Le, 2008) to 1.75 (Vu, 2020), passing from normal to luxury goods; the uncompensated own price elasticiy of rice ranges from -0.06 (Le, 2008) to -1.01 (Niimi, 2005), covering many degreases of inelastic responsiveness. This heterogeneity is mainly explained by publication bias, demand system (AIDS, LAIDS, QUAIDS), sample size and data (Colen et al. 2018). Time differences are also very important as income growth can increase food consumption and inequality growth can increase the diversity of diets and preferences.

As discussed so far, the demand analysis literature of Vietnam focuses mainly on foods and beverages, sometimes including other goods in the demand system, while studies specifically addressing other goods and services are rare. One noticeble exception is the study of Phu (2020) that estimates the elasticity of residential electricity demand for various income groups in Vietnam, using 2015 microdata. Instead of a demand system, Phu (2020) adopts a double-log function with a two-stage instrumental variable (2SLS) estimator and finds an own price elasticity from − 1.48 to − 0.94; a very low income elasticity between 0.05 and 0.08; and a limited elasticity of substitution between electricity and other fuels (LPG, coal or firewood) with a cross-price elasticity from 0.05 to 0.06.

Table 1 – Expenditure elasticities

Authors	**Niimi, 2005**	**Niimi, 2005**	**Niimi, 2005**	**Niimi, 2005**	**Niimi, 2005**	**Niimi, 2005**	**Meyerhoefer et al., 2007**	**Le, 2008**	**Mergenthaler et al., 2009**	**Hoang, 2018**	**Bairagi et al., 2020**	**Bairagi et al., 2020**	**Vu, 2020**	**Vu, 2020**	**Vu, 2020**	**Vu, 2020**
Demand System	AIDS	AIDS	AIDS	AIDS	AIDS	AIDS	LAIDS	LA/AIDS	AIDS	QUAIDS	QUAIDS	QUAIDS	LA/AIDS	LA/AIDS	LA/AIDS	LA/AIDS
Price method	MP	UV	Deaton	MP	UV	Deaton	MP	MP	CW	CW	Deaton	Deaton	UV	MP	CW	Deaton
VHLSS wave	1992	1992	1992	1997	1997	1997	1997	2004	2005 (own survey)	2010	2012-2014-2016 (rural)	2012-2014-2016 (urban)	2006	2006	2006	2006
Rice	0.62	0.83	0.55	0.50	0.71	0.46	0.28	0.76	.	0.35	0.28	0.10	0.96	0.37	0.31	0.53
Starch crops	.	.	.	.	.	.	0.88	.	.	.	.	.	.	.	.	.
Protein crops	.	.	.	.	.	.	1.28	.	.	.	.	.	.	.	.	.
Fruits	1.51	1.21	1.50	1.36	1.09	1.32	1.07	.	0.61	0.88	1.51	1.30	1.00	1.20	1.23	1.13
Vegetables	0.92	0.99	0.80	0.82	0.86	0.73	1.07	.	0.61	0.88	0.81	0.83	0.99	0.85	0.84	0.69
Pork	.	.	.	.	.	.	.	.	.	0.96	1.17	1.17	1.01	1.13	1.13	1.12
Beef	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chicken	.	.	.	.	.	.	.	.	.	.	0.59	0.49	1.01	1.10	1.10	1.20
Fish	1.24	0.94	1.27	1.07	0.85	1.11	.	.	.	.	2.23	2.07	1.03	1.05	1.07	0.99
Other meets and seafood	1.46	0.74	1.65	1.43	0.79	1.61	.	0.25	.	1.20	.	.	1.02	1.63	1.75	1.73
Eggs	.	.	.	.	.	.	.	.	.	.	0.77	0.72	.	.	.	.
Milk	.	.	.	.	.	.	.	.	.	.	1.55	1.30	.	.	.	.
Spice	0.57	0.52	0.60	0.55	0.63	0.56	.	.	.	.	.	.	.	.	.	.
Staples	0.90	0.65	1.21	0.99	0.69	1.13	.	.	.	.	.	.	1.00	0.96	0.99	0.99
Noodle	.	.	.	.	.	.	.	.	.	.	0.89	0.87	.	.	.	.
Sugar	1.22	0.94	1.34	0.97	0.86	1.04	.	.	.	0.81	1.34	1.39	.	.	.	.
Dairy	1.56	0.85	1.61	1.62	0.86	1.67	.	.	.	.	.	.	.	.	.	.
Cooking oil	.	.	.	.	.	.	.	.	.	.	0.65	0.60	.	.	.	.
Cooking sauce	.	.	.	.	.	.	.	.	.	.	0.97	0.96	.	.	.	.
Other food	.	.	.	.	.	.	1.54	1.26	.	0.65	.	.	0.98	0.98	0.95	0.98
Food away from home	.	.	.	.	.	.	.	.	.	.	.	.	1.07	2.10	2.24	2.08
Drinks	.	.	.	.	.	.	.	.	.	1.20	0.67	0.66	1.02	1.44	1.46	1.52
Alcoholic drinks	.	.	.	.	.	.	.	.	.	.	1.37	1.33	.	.	.	.
Non food	.	.	.	.	.	.	1.79	.	.	.	.	.	.	.	.	.
Leisure	.	.	.	.	.	.	82.00	.	.	.	.	.	.	.	.	.

Table 2 – Uncompensated own-price elasticities (continue)

Authors	**Niimi, 2005**	**Niimi, 2005**	**Niimi, 2005**	**Niimi, 2005**	**Niimi, 2005**	**Niimi, 2005**	**Meyerhoefer et al., 2007**	**Le, 2008**	**Mergenthaler et al., 2009**	**Gibson and Kim, 2013**	**Gibson and Kim, 2013**	**Gibson and Kim, 2013**
Demand System	AIDS	AIDS	AIDS	AIDS	AIDS	AIDS	LAIDS	LA/AIDS	AIDS	AIDS	AIDS	AIDS
Price method	MP	UV	Deaton	MP	UV	Deaton	MP	MP	CW	UM	SPM	UV
VHLSS wave	1992	1992	1992	1997	1997	1997	1997	2004	2005 (own survey)	2010	2010	2010
Rice	-0.84	-0.95	-0.83	-1.01	-0.89	-0.79	-0.38	-0.06	.	-0.27	-0.83	-0.60
Other cereals	.	.	.	.	.	.	.	.	.	.	.	.
Roots and tubers	.	.	.	.	.	.	.	.	.	.	.	.
Starch crops	.	.	.	.	.	.	-0.61	.	.	.	.	.
Protein crops	.	.	.	.	.	.	-0.74	.	.	.	.	.
Fruits	-0.92	-0.79	-0.86	-0.92	-0.82	-1.17	-0.91	.	-0.64	.	.	.
Vegetables	-1.07	-0.92	-0.90	-1.11	-0.94	-1.03	-0.91	.	-0.64	.	.	.
Pork	.	.	.	.	.	.	.	.	.	-0.26	-0.87	-0.68
Beef	.	.	.	.	.	.	.	.	.	-0.19	-0.93	-0.69
Chicken	.	.	.	.	.	.	.	.	.	-0.15	-0.70	-0.34
Fish	-1.06	-0.89	-1.49	-1.21	-0.86	-1.16	.	.	.	-0.13	-1.08	-0.82
Other meets and seafood	-0.76	-0.36	-0.65	-0.55	-0.29	-0.80	.	2.36	.	.	.	.
Eggs	.	.	.	.	.	.	.	.	.	.	.	.
Milk	.	.	.	.	.	.	.	.	.	.	.	.
Spice	-0.93	-0.79	-0.73	-0.87	-0.79	-0.68	.	.	.	.	.	.
Staples	-1.35	-0.97	-1.04	-2.07	-1.02	-1.28	.	.	.	.	.	.
Noodle	.	.	.	.	.	.	.	.	.	-0.11	-0.90	-0.44
Sugar	-0.59	-0.39	-0.61	-0.80	-0.88	-1.02	.	.	.	0.05	-1.06	-0.27
Dairy	-0.44	0.01	-0.72	-0.60	-0.22	-1.57	.	.	.	.	.	.
Fats and cooking oil	.	.	.	.	.	.	.	.	.	0.00	-0.75	-0.07
Cooking sauce	.	.	.	.	.	.	.	.	.	.	.	.
Other food	.	.	.	.	.	.	-0.68	-0.30	.	.	.	.
Food away from home	.	.	.	.	.	.	.	.	.	.	.	.
Drinks	.	.	.	.	.	.	.	.	.	.	.	.
Alcoholic drinks	.	.	.	.	.	.	.	.	.	.	.	.
Beer	.	.	.	.	.	.	.	.	.	.	.	.
Non food	.	.	.	.	.	.	-1.27	.	.	.	.	.
Leisure	.	.	.	.	.	.	-0.82	.	.	.	.	.

Table 2 – (continue) Uncompensated own-price elasticities

Authors	**Hoang, 2018**	**Gibson and Kim, 2019**	**Gibson and Kim, 2019**	**Gibson and Kim, 2019**	**Bairagi et al., 2020**	**Bairagi et al., 2020**	**Vu, 2020**	**Vu, 2020**	**Vu, 2020**	**Vu, 2020**
Demand System	QUAIDS	AIDS	AIDS	AIDS	QUAIDS	QUAIDS	LA/AIDS	LA/AIDS	LA/AIDS	LA/AIDS
Price method	CW	UM	Deaton	SPM	Deaton	Deaton	UV	MP	CW	Deaton
VHLSS wave	2010	2012	2012	2012	2012-2014-2016 (rural)	2012-2014-2016 (urban)	2006	2006	2006	2006
Rice	-0.48	-0.11	-0.19	-0.62	-0.41	-0.33	-0.89	-0.73	-0.80	-0.69
Other cereals	.	.	.	.	-0.88	-0.89	.	.	.	.
Roots and tubers	.	-0.32	-0.86	-1.04	.	.	.	.	.	.
Starch crops	.	.	.	.	.	.	.	.	.	.
Protein crops	.	.	.	.	.	.	.	.	.	.
Fruits	-0.90	.	.	.	-0.42	-0.65	-0.93	-0.93	-0.94	-0.88
Vegetables	-0.90	.	.	.	-0.79	-0.81	-0.97	-0.99	-1.00	-0.88
Pork	-0.85	-0.28	-0.66	-0.70	-0.65	-0.64	-0.79	-0.79	-0.83	-0.55
Beef	.	-0.21	-0.97	-1.00	.	.	.	.	.	.
Chicken	.	-0.10	0.56	-0.59	-0.26	-0.13	-1.09	-1.08	-1.07	-0.09
Fish	.	-0.15	-0.71	-1.01	-0.74	-0.81	-0.94	-0.99	-0.99	-1.24
Other meets and seafood	-0.83	.	.	.	.	.	-0.94	-0.83	-0.95	-1.04
Eggs	.	.	.	.	-0.25	-0.14	.	.	.	.
Milk	.	.	.	.	-0.22	-0.52	.	.	.	.
Spice	.	.	.	.	.	.	.	.	.	.
Staples	.	.	.	.	.	.	-0.75	-0.74	-0.75	-0.73
Noodle	.	.	.	.	-0.64	-0.63	.	.	.	.
Sugar	-0.72	.	.	.	-0.43	-0.31	.	.	.	.
Dairy	.	.	.	.	.	.	.	.	.	.
Fats and cooking oil	.	0.01	-0.83	-0.92	-0.29	-0.19	.	.	.	.
Cooking sauce	.	-0.04	-0.61	-0.97	-0.41	-0.41	.	.	.	.
Other food	-1.65	.	.	.	.	.	-1.07	-1.01	-1.01	-0.89
Food away from home	.	.	.	.	.	.	-1.11	-2.65	-2.03	.
Drinks	-0.87	-0.87	-0.82	-0.90	-0.89	-0.89	-1.01	-1.03	-1.00	-1.01
Alcoholic drinks	.	.	.	.	-0.25	-0.33	.	.	.	.
Beer	.	-0.14	-0.93	-0.98	.	.	.	.	.	.
Non food	.	.	.	.	.	.	.	.	.	.
Leisure	.	.	.	.	.	.	.	.	.	.

4. Data

We use the VHLSS conducted by the Vietnamese GSO in 2016 (VHLSS 2016). This survey has national coverage and a sample size of 9,399 households from a multi-stage stratified random sampling design. The sample is representative at national, regional, urban, rural and provincial levels. Information was collected in four quarters of 2016 through face-to-face interviews with household heads and using an household questionnaire divided into the following sections: household members characteristics; education; health care; income (employment, salaries, wages, agro-forestry and aquaculture activities); expenditure and consumption of food and non-food goods and services; participation in aid schemes.

Before estimations, the VHLSS 2016 data set was cleaned. We considered outliers those households with variables value five times the sample's standard deviation. After removing outliers and missing values, the remaining sub-sample counts 1,461 households. From the VHLSS 2016 we derive prices and expenditure for 10 groups of goods and services. Table 3 reports the groups and the goods of which they are composed. The households' expenditure of the first seven groups – i.e. food, foodstuff, beverages and tobacco, household equipment, clothing and accessories, transport, and post and communication; was calculated summing up the individual values in Vietnamese dongs (VND) of each item in the group. The survey did not collect items prices, therefore for each group we calculated a unit value dividing expenditure by the number of items. Unit values are then used in the demand system as proxies for prices. As expenditure for education we used the total expenditure on education over the past 12 months for compulsory subjects in school, and the unit value was calculated dividing this for the number of household members attending school in last 12 months. For medical and health expenditure we used the total expenditure for medical check and treatment provided in the VHLSS 2016, calculating the unit value dividing by the total number of resident and non-resident medical visits in the household. For electricity, we used the household expenditure on electricity for daily activities in the last 12 months and unit values were obtained dividing the expenditure on electricity in the last 30 days by the kilowatts (KW) consumed in the last 30 days. The last five columns of table 3 provide summary statistics of expenditure for each group.

The demand system includes also socio-economic variables to account for households heterogeneity. Socio-economic characteristics can affect households' consumption patterns and decisions, especially with respect the cross substitution between goods and quality levels. There are three main factors potentially affecting consumption patters, namely the decision making behavior of the household head which is driven by her/his individual profile; the economic situation of the household which is defined by the earnings and the sector of employment; the dimension and composition of the household that might drive consumption towards certain goods and services rather than others. We therefore include four variables on the household head characteristics which are age, gender and education level (either primary or tertiarty, being secondary education the baseline alternative). Three variables describe the income source of the household head, distinguishing between salary from a hired job, income from self-employment in agriculture, aquaculture or forestry and income from self-employment in other sectors. Finally, four variables describe the household size and composition in terms of number of household members and share of children, young adults and elders among the household members. These socio-economic variables are reported in table 4 with their description and summary statistics.

Table 3 – Groups, their composition and households' expenditure descriptive statistics of goods and services included in the QUAIDS

	Groups	Items		Obs	Mean	Std. Dev.	Min	Max
1	FOOD	Fragrant plain rice, specialty rice Sticky rice Pork Beef Buffalo meat Chicken meat	Other types of meat (goats, dogs, etc.) Eggs of chickens, ducks Beans of various kinds Fruits Duck and other poultry meat	1,461	1371.46	1075.25	64	11720
2	FOODSTUFF	Processed meat Other fish and seafood Sugar, molasses	Confectionery Outdoors meals and drinks Other meals and drinks	1,461	1442.74	1373.72	60	22995
3	BEVERAGES AND TOBACCO	Alcohol of various kinds Beer of various kinds Coffee	Bottled, canned, boxed beverages Dried tea Cigarettes, tobacco	1,461	633.268	552.195	10	6660
4	HOUSEHOLD EQUIPMENT	Video player(s), DVD player(s) Electricity generator(s) Printer(s) Sewing machine(s) Electric fan(s) TV(s) Music rack Radio/radio-cassette player(s) Disk player(s) Computer(s) Water heater(s) Refrigerator(s) Air conditioner(s) Washing/drying machine(s)	Cupboard(s), cabinet(s), wardrobe(s) Vacuum cleaner(s), dehumidifier(s) Gas/magnetic cooker(s) Electric cooker(s) Trolleys of various kinds Pumping machine(s) Bed(s) Desk(s), chair(s), long bench(es) Microwave/baking oven(s) Piano(s), keyboard(s) Others (Specify) Juice extractor(s) Camera(s), video recorder(s)	1,461	1392.96	1340.02	16	12120
5	CLOTHING AND ACCESSORIES	Garment (including underwear) Fabrics Hats, umbrellas	Shoes, slippers, wooden underfoot Kerchiefs, turbans, scarfs Watches, eyewear, jewelry Other garment accessories	1,461	4198.15	3847.99	0	38100
6	TRANSPORT	Automobile(s) Motorbike(s) Ship(s), boat(s)	Other means of travel Bicycle(s)	1,461	827.674	1292.85	10	11900
7	POST AND COMMUNICATION	Fax machine(s) Mobile telephone(s)	Landline telephone(s)	1,461	2747.64	2523.01	10	21472
8	EDUCATION	Expenditure on education over the past 12 months for compulsory school		1,461	7568.12	9136.31	50	75337
9	MEDICAL AND HEALTH	Medical checks and treatments		1,461	4700.75	8573.86	10	80092
10	ELECTRICITY	Expenditure on electricity for daily activities in the last 12 months		1,461	3728.25	3113.22	100	36000

Table 4 - Description and summary statistics of socio-economic variables included in the QUAIDS

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
Age of the household head	Years	1,461	48.236	12.468	24	94
Female head	Dummy equal to 1 if the household head is a female and 0 otherwise	1,461	0.190	0.392	0	1
Primary	Dummy equal to 1 if the household head has a primary education and 0 otherwise	1,461	0.253	0.435	0	1
Tertiary	Dummy equal to 1 if the household head has a higher education in college or university and 0 otherwise	1,461	0.093	0.291	0	1
Wage	Dummy equal to 1 if the household head earns a salary from a hired job and 0 otherwise	1,461	0.458	0.498	0	1
Farmer	Dummy equal to 1 if the household head is self-employed in agriculture, aquaculture or forestry and 0 otherwise if HH head	1,461	0.531	0.499	0	1
Self employed	Dummy equal to 1 if the household head is self-employed but not in agriculture, aquaculture or forestry and 0 otherwise	1,461	0.243	0.429	0	1
Household size	Logarithm of number of HH members	1,461	1.477	0.269	0.693	2.398
Share of children	N. children in the household/N. of household members	1,461	0.350	0.167	0	0.75
Share of young adults	N. young adults aged 18-35 in the household/N. of household members	1,461	0.243	0.190	0	1
Share of elders	N. of elders aged 65 or more in the household/N. of household members	1,461	0.047	0.105	0	0.75
Food	Household's share expenditure on food	1,461	0.057	0.041	0.001	0.325
Foodstuff	Household's share expenditure on foodstuff	1,461	0.055	0.034	0.001	0.271
Beverage and tobacco	Household's share expenditure on beverage and tobacco	1,461	0.025	0.019	0.000	0.165
Household equipment	Household's share expenditure on household equipment	1,461	0.056	0.045	0.001	0.375
Clothing and accessories	Household's share expenditure on clothing and accessories	1,461	0.153	0.085	0.000	0.565
Transport	Household's share expenditure on transport	1,461	0.031	0.040	0.000	0.354
Post and communication	Household's share expenditure on post and communication	1,461	0.098	0.061	0.000	0.380
Education	Household's share expenditure on education	1,461	0.240	0.177	0.005	0.832
Medical and health	Household's share expenditure on medical and health	1,461	0.142	0.167	0.000	0.940
Electricity	Household's share expenditure on electricity	1,461	0.142	0.077	0.002	0.520

5. Demand system estimation

The challenge of estimating demand functions is to maintain empirical applications coherent with microeconomic theory, especially with respect to assumptions and restrictions from demand and consumer behavior theories. Since the seminal work of Stone in 1954, who developed the Linear Expenditure System (LES), the evolution of empirical demand models progressed significantly. The highest coherence with demand theory has been achieved so far by considering the non-linearity of the Engel's curves and including in the demand function a quadratic term of the relationship between total expenditure and prices. The quadratic model that follows the demand and consumer theories most closely is the Banks et al. (1997) QUAIDS, which is employed in this paper.

Although QUAIDS can effectively deal with the issues related to the coherence with microeconomic theory, a remaining issue is the potential endogeneity of prices and expenditure when using survey data and unit values as proxies for market prices. That is, expenditure and/or unit values can be correlated with the errors, resulting in inconsistent estimations and in biased shapes of the Engel curves. This endogeneity can be caused by a variety of factors, such as measurement errors, unobserved commodity quality and unobserved prices and expenditure shocks (Blundell and Robin, 1999).

In Section 3, we discussed the two main approaches that are used in the literature to address this endogeneity bias when market prices are not available – i.e. Deatons' and CW's approaches. Both approaches assume that the variation in unit values that cannot be explained by the household characteristics is caused by quality differences, correcting the unit values. Moreover, Deaton's method necessitates weak separability restrictions, which overstate quantity responses over quality responses, and it uses the geographical clustering structure of data assuming that households in the same cluster share the same market price. The CW's approach has the advantage of being easier to implement, but it does not deal with measurement error problems.

However, if there is correlation between prices/expenditure and the error terms, such correlation can be accounted for with instrumental variable and augmented regression techniques (Hausman 1978; Holly and Sargan 1982). A novel approach based on instrumental variables (IV) methods for reducing the endogeneity bias in demand systems has been developed by Lecocq and Robin (2015). This method shares with Deaton's and CW's methods the implicit assumption that price changes have no impact on quality, but it has significant advantages: i) it relies on fewer assumptions, ii) it does not require a clustered structure of the data, iii) it is computationally efficient, and iv) can potentially rely exclusively on the data available in the household surveys. For these reasons, in this paper we apply the Lecocq and Robin's method.

In order to estimate consistent expenditure, own- and cross-price elasticities we estimate the following demand system in vector notation, which is the Banks et al. (1997) quadratic extension of the Deaton and Muellbauer's (1980) AIDS model:

$$w_i^h = \alpha_i + \gamma_i' p^h + \beta_i \{x^h - a(p^h, \theta)\} + \lambda_i \frac{\{x^h - a(p^h,\theta)\}^2}{b(p^h,\theta)} + u_i^h \quad (1)$$

where *a* and *b* are non-linear price aggregator functions defined as:

$$a(p^h, \theta) = \alpha_0 + \alpha' p^h + \frac{1}{2} p^{h\prime} \gamma p^h \quad (2)$$

$$b(p^h, \theta) = exp(\beta' p^h) \quad (3)$$

w^h_i is the share of the expenditure of good $i = 1, \ldots, 10$ (see table 3 for a list and description of the goods) on the total expenditure x^h of household $h = 1, \ldots, H$; p is a vector of prices; u is the error term; and $\alpha, \beta, \gamma, \theta$ are the parameters to be estimated. These parameters satisfy the theoretical restrictions of additivity, homogeneity, symmetry, which are defined, respectively:

$\sum_{i=1}^{n} \alpha_i = 1$ *Additivity*

$\sum_{i=1}^{n} \beta_i = 0; \sum_{j=1}^{n} \gamma_{ij} = 0; \sum_{i=1}^{n} \lambda_i = 0$ *Homogeneity*

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

Equation (1) can be estimated with different estimators, for example using seemingly unrelated regressions (SUR) with iterated feasible generalized nonlinear least-squares estimator (FGNLS) through nonlinear three-stage least squares (Poi, 2012). A preferred alternative is to use the Iterated Linear Least-Squares (ILLS) estimator developed by Browning and Meghir (1991) and later generalized by Blundell and Robin (1999), which is computationally more attractive (Lecocq and Robin, 2015). It is based on the conditional linearity property – i.e. all equations in (1) are linear in all parameters conditional on the price aggregators functions – and it requires linear SUR to obtain consistent and asymptotically normal estimation of the demand system. In order to allow the level of demand to vary according to household heterogeneity, the intercepts *a*'s are parametrized with the sociodemographic variables s^h from the household survey and described in Table 4, such that:

$$\alpha^h = As^h; A = (\alpha_i') \quad (4)$$

Lecocq and Robin's model (2015) allows accounting for endogenous prices by using instrumental variable techniques. the error $u^h{}_i$ in equation (1) is augmented with the vector Z^h predicted from estimating reduced forms for x^h and p^h:

$$u_i^h = \rho_i \hat{Z}^h + \varepsilon_i^h \quad (6)$$

The independent variables in the reduced form equations are the sociodemographic variables in s^h plus the instruments. The instruments used are the unit values calculated for each good *i*, corrected with price indexes for 2015, so to obtain one-year lagged unit values. Finally, price and expenditure elasticities are calculated at the mean of the household sample.

6. Results

Table 5 displays expenditure and own-price elasticities obtained from the estimation of the QUAIDS with 10 goods and services. Column 1 reports expenditure (income) elasticities, while columns 2 and 3 report the uncompansate and compensated price elasticities. Uncompensated (Marshallian) elasticity of demand measures both the substitution (e.g. when the relative price of a good *i* increases, the household substitutes it with other goods) and the income (e.g. when the relative price of a good *i* increases, the household's purchasing power has decreased, therefore the entire bundle is re-optimized further reducing the consumption of the good *i*) effects; while compensated price elasticities measures only the substitution effect, ignoring the income effect. Therefore, the uncompensated elasticity of demand is greater than the compensated one and it is the most useful one for observing demand behavior. For this reason, in what follows the discussion will focus on the uncompensated price elasticities.

Starting from expenditure elasticities (table 5 column 1), they are all positive and statistically significant at 1% level. This suggests that all the goods and services considered in the demand analysis are normal – i.e. an increse in budget expenditure is followed by an increase in the quantity consumed of each good and service. However, some of the goods and services are much less responsive to expenditure change than others.

The least responsive, and therefore inelastic, items are food and education, with an expenditure elasticity of 0.458 and 0.556 respectively. An increase in household expenditure (or income) is followed by a halved increase in these items. For example, if household income increases of 1%, the corresponding

increase of food consumption is 0.458% and it is of 0.556% for education. This suggests that both food and education are income inelastic. The average level of food expenditure in our sample is quite low and only about 5.7% of total household expenditure (see table 3).[4] This item contains basic and staple foods such as rice, meat and fruits with a relative lower quality differentiation with respect items such as household equipment and clothing. Food demand patterns have changed dramatically in Vietnam due to the fast economic growth, with rice consumption per capita steadily declining and consumption of high-protein foods (e.g. meat, seafood, eggs) steadily rising (Hoang, 2018). Food represents a fix cost for households and the quantity consumed depends mainly on the household size, as there are individual upper and lower limits of the quantity of calories that can be consumed, explaining the low level of elasticity. The same can be said for foodstuff and beverages and tobacco, whose average expenditures account for 5.5% and 2.5% of the households' budget. Despite having a higher expenditure elasticity with respect food, both are still relatively low indicating low responsiveness to income changes. Education has very low responsiveness to income changes, but it is the main item of expenditure in our samples' households, accounting for an average of 24% of the households budget. Primary education is diffused in Vietnam, while secondary and higher education are expensive and with low enrollment rate. We could not differentiate between different classes of education with the data at hand, but it is likely that higher education has a much higher income responsiveness in Vietnam. This would be in line with existing work (e.g. World Bank, 2020) showing that wealthy households spend a lot more on education compared with the poor ones.

Electricity is also quite inelastic to income changes and accounts for an average of 14.2% of the household total expenditure. This suggests that with growing household income, electricity became essential to the living standards of Vietnamese households. Indeed, in the last 10 to 20 years, energy-intensive appliances became more accessible to Vietnamese households who passed from low- to middle-income families. Currently, the large majority of households have at least a televisions and a rice cooker. Refrigerators are owned by up to 60% of households and more households plan to buy air conditioners, computers and washing machines (Phu, 2020). The more energy-intensive appliancies, the higher the household's demand for electricity. Electricity demand is also affected by the level of technology, with newer and upgraded devices being more energy efficient.

Column 1 of table 5 reports also a number of expenditure elasticities that are above 1, indicating that the response of these items to a change in the households' expenditure (or income) is more than proportional. Moreover, the higher the expenditure elasticity, the more sensitive the household demand is to income changes. This concerns, in order, household equipment, post and communication, clothing and accessories, transport, and medical and health services.

The current telecom market in Vietnam is quite competitive and diversified, covering cheaper and subsidiesed public access to telephones and internet, as well as private providers. Mobile technology also developed fast, and better and faster telecom services are more likely to be delivered by private companies. Shifting from low- to middle-income, households have gretaer margin in deciding how much of their budget they want to spend on these services, and the higher the income the higher is the willingess to have fast, broad-coverage and more expensive mobile and internet services. However, contrary to electricity or transport, once basic requirements of telecommunication are meet, these services provide luxury entertainment that is very responsive to income changes.

In our data set transport reflects mainly the household's owning of vehicles (e.g. cars, motorbikes, bicicles) rather than expenditure on train, bus or airplane tickets. Therefore, it is likely that our results capture the income elasticity of passing from lower-quality, cheap vehicles to modern, fully equiped, powerful ones. A typical means of tranport in Vietnam is small motorbikes or scooters which are flexible and easier to use in cities with heavy traffic. However, the development of motorways is inducing also an increase in registered passenger cars, which increased by 437.5% between 2008 and 2019, while the number of registered motorcycles increased by 145.5% (ASEAN data).

[4] There is a modest degree of self-production of food among the poorer households, which might explain the relatively low level of food expenditure.

Given the mixed public-private health care system in Vietnam, it is not surprising that medical and health expenditure has the highest income elasticity. At increasing income levels, households might decide to avoid overcrowded medical facilities and apply for a private health insurance. The high responsiveness can be explained also by the fact that medical costs can represent a larger proportion of the income of poor households, while such proportion is relatively smaller for richer households. Illness can also lead to the inability of some household members to earn an income. Therefore, large health care bills affect more those households that are economically disadvantaged (Khoa, 2021).

Moving to own-price elasticities, column 2 of table 5 displays the uncompensated ones measuring how households' demand changes due to price changes considering both substitution and income price effects. The estimated price elasticities reflect quite closely the expenditure elasticities described above. Food own-price elasticity is negative but does not responds much to price changes, confirming that food is a necessity good. The responsiveness to price changes of foodstuff and beverage and tobacco is greater than food but still quite inelastic. The goods whose demand is more price elastic are household equipment, post and communication, clothing and accessories, transport, and medical and health services. The own-price elasticity of these goods and services is just below 1, suggesting that they are not luxury goods in absolute terms, but they are luxury goods relative to the other items groups.

The fact that telecommunication is price inelastic in absolute terms can be due also to the subsidized tariffs provided to households, keeping prices low and avoiding large fluctuations. Regarding medical and health services, price inelasticity might reflect the fact that the Vietnamese social health insurance has a progressive scheme subsidizing different groups of the population at different rates for the same benefit package (Khoa, 2021). In this case, the low responsiveness to medical and health prices can be due to price changes that are proportional to the expenditure capacity of households, maintaining the level of consumption almost unchanged.

Interestingly, the uncompensated own-price elasticity of education is not significant. This might be due to the duality of the education system in Vietnam that scores well on basic and public education, but has an expensive and low enrollment rate to university and vocational/technical education.

Finally, the own-price elasticity of electricity is quite inelastic, confirming its role of necessity goods. This is in line with studies on other fast-developing countries. For example, some studies report an own price elasticity between -0.77 and -0.15 in China (Lin et al. 2014; Yin et al. 2015) and between -0.51 and -0.29 in India (Filippini and Pachauri 2004).

As Phu (2020) noted, subsistence use of electricity (e.g. lighting and basic entertainment) is less responsive to price than for leisure or other luxury purposes, such as air conditioning. In terms of economic policy, Phu (2020) also noted that "*The responsiveness of electricity demand to price signals is important for estimating the impact of energy efficiency programs and technological improvements. When electricity is considered a necessity, a higher price will not be effective in moderating demand, while shifting the cost burden to the users. However, when demand is responsive to price signals, pricing instruments could be effectively used to curb excessive consumption*." (Phu, 2020, pp. 511). However, in the context of Vietnam we are already observing the effects of subsidized electricity tariffs schemes that keep prices low and less volatile, therefore it is difficult to use this result to derive conclusions in a context of perfect competition.

Tables 6 and 7 display the uncompensated and compensated cross-price elasticities between the goods and services analyzed, respectively. Once again, we are going to focus on uncompensated price elasticities, while table 7 has been reported for completeness.

The cross-price elasticities of demand shown measure how the quantity consumed of a good/service *i* responds to changes in the price of a related good/service *j*. It can take positive, negative or null values, depending on whether the two goods are substitutes, complements or independent, respectively.

There is a complementary relationship between education and the rest of the goods and services, in particular with medical and health services. This is particularly important as it suggests that an increase in demand for education will lead to an increase in demand for all other goods and services. Education is therefore a main complementary driver of household consumption, especially of medical and health

goods and services, but much less of beverages and tobacco which can lead to unhealthy behavior. Education is therefore associated to higher consumption and health behavior. Other interesting complementarity is observed between telecommunication services and household equipment; electricity and clothing; food and telecommunication services.

Not surprisingly, foodstuff and food are substitute goods, and to a lesser extent also beverage and tobacco and food. Moreover, consumption of household equipment, clothing and telecommunication services are affected by medical and health care costs. Meyerhoefer et al. (2007) suggest that, when non-food goods are substitutes for health care, a tax on these goods could represent an alternative financing mechanism for the national health care system: "*these items are substitutes for health services, so that taxing them will actually encourage more health seeking behaviour. A further advantage of such a tax is that non-food items are typically consumed in greater proportion by wealthier individuals, making their taxation more progressive than taxes on other commodities*." (Meyerhoefer et al., 2007, pp. 1487) Other interesting substitution effects are detected between clothing and foodstuff; transport and electricity; electricity and food, household equipment, beverage and tobacco.

Table 5 – Expenditure and own-price elasticities estimated with IV QUAIDS

		Expenditure Elasticity	Uncompensated Price elasticity	Compensated Price elasticity
		(1)	(2)	(3)
1	Food	0.458***	-0.289***	-0.265***
		(0.064)	(0.041)	(0.039)
2	Foodstuff	0.802***	-0.723***	-0.680***
		(0.052)	(0.036)	(0.036)
3	Beverage and tobacco	0.870***	-0.712***	-0.691***
		(0.063)	(0.029)	(0.029)
4	Household equipment	1.027***	-0.981***	-0.923***
		(0.068)	(0.038)	(0.039)
5	Clothing and accessories	1.212***	-0.947***	-0.762***
		(0.042)	(0.040)	(0.045)
6	Transport	1.203***	-0.932***	-0.895***
		(0.107)	(0.060)	(0.061)
7	Post and communication	1.064***	-0.943***	-0.840***
		(0.052)	(0.027)	(0.030)
8	Education	0.556***	0.020	0.145**
		(0.039)	(0.063)	(0.054)
9	Medical and health	1.643***	-0.927***	-0.645***
		(0.059)	(0.039)	(0.035)
10	Electricity	0.888***	-0.685***	-0.564***
		(0.044)	(0.045)	(0.044)

Table 6 – Uncompensated cross-price elasticities estimated with IV QUAIDS

		Food	Foodstuff	Beverage and tobacco	Household equipment	Clothing and accessories	Transport	Post and communication	Education	Medical and health	Electricity
1	Food		-0.032	0.024	-0.014	0.038	-0.014	-0.112***	-0.061	0.094	-0.091
			(0.041)	(0.026)	(0.032)	(0.049)	(0.031)	(0.032)	(0.056)	(0.056)	(0.058)
2	Foodstuff	0.175***		0.034	-0.073**	-0.062	0.025	-0.026	-0.134**	-0.040	0.022
		(0.031)		(0.023)	(0.028)	(0.043)	(0.026)	(0.026)	(0.047)	(0.045)	(0.050)
3	Beverage and tobacco	0.073*	0.022		-0.029	-0.125*	-0.007	-0.070*	-0.143*	-0.032	0.153*
		(0.037)	(0.044)		(0.034)	(0.053)	(0.032)	(0.032)	(0.057)	(0.056)	(0.061)
4	Household equipment	0.032	-0.008	0.028		0.037	0.026	-0.016	-0.208**	-0.086	0.149*
		(0.042)	(0.049)	(0.031)		(0.059)	(0.036)	(0.036)	(0.064)	(0.063)	(0.069)
5	Clothing and accessories	0.037	0.127***	0.034	-0.042		0.039	-0.047*	-0.230***	-0.083*	-0.100*
		(0.027)	(0.031)	(0.020)	(0.025)		(0.023)	(0.024)	(0.043)	(0.042)	(0.043)
6	Transport	-0.113	0.053	-0.079	-0.023	-0.081		-0.116	-0.203	-0.09	0.381**
		(0.070)	(0.081)	(0.053)	(0.063)	(0.101)		(0.062)	(0.107)	(0.104)	(0.117)
7	Post and communication	0.107**	0.024	0.046	-0.092**	-0.003	0.022		-0.198***	-0.039	0.011
		(0.032)	(0.038)	(0.024)	(0.030)	(0.047)	(0.028)		(0.050)	(0.049)	(0.053)
8	Education	-0.137***	-0.106***	-0.065***	0.016	-0.04	-0.061**	-0.039		0.045	-0.188***
		(0.024)	(0.028)	(0.018)	(0.022)	(0.035)	(0.021)	(0.023)		(0.043)	(0.039)]
9	Medical and health	-0.290***	-0.033	-0.058*	0.120***	0.162***	0.013	0.125***	-0.715***		-0.041
		(0.036)	(0.042)	(0.027)	(0.031)	(0.047)	(0.030)	(0.027)	(0.042)		(0.059)
10	Electricity	0.130***	-0.053	0.041*	-0.028	-0.159***	-0.005	0.018	-0.143***	-0.003	
		(0.027)	(0.032)	(0.020)	(0.025)	(0.038)	(0.024)	(0.023)	(0.040)	(0.040)	

Table 7 – Compensated cross-price elasticities estimated with IV QUAIDS

		Food	Foodstuff	Beverage and tobacco	Household equipment	Clothing and accessories	Transport	Post and communication	Education	Medical and health	Electricity
1	Food		-0.008	0.036	0.011	0.108*	0.000	-0.068*	0.041	0.173***	-0.028
			(0.042)	(0.026)	(0.033)	(0.053)	(0.031)	(0.035	(0.045)	(0.048)	(0.058)
2	Foodstuff	0.217***		0.054*	-0.029	0.061	0.050	0.052	0.045	0.098*	0.132**
		(0.031)		(0.023)	(0.029)	(0.047)	(0.027)	(0.028	(0.039)	(0.039)	(0.050)
3	Beverage and tobacco	0.119**	0.068		0.019	0.008	0.020	0.014	0.052	0.118*	0.272***
		(0.037)	(0.044)		(0.035)	(0.058)	(0.033)	(0.035	(0.048)	(0.049)	(0.061)
4	Household equipment	0.086*	0.046	0.054		0.194**	0.058	0.083*	0.022	0.090	0.290***
		(0.042)	(0.049)	(0.031)		(0.064)	(0.036)	(0.038	(0.055)	(0.055)	(0.068)
5	Clothing and accessories	0.101***	0.191***	0.064**	0.026		0.077**	0.070**	0.042	0.126**	0.066
		(0.027)	(0.031)	(0.020)	(0.026)		(0.023)	(0.026	(0.039)	(0.039)	(0.043)
6	Transport	-0.05	0.117	-0.050	0.044	0.104		0	0.067	0.117	0.545***
		(0.070)	(0.082)	(0.052)	(0.065)	(0.108)		(0.066	(0.091)	(0.093)	(0.115)
7	Post and communication	0.163***	0.081*	0.072**	-0.032	0.160**	0.055		0.041	0.144***	0.157**
		(0.032)	(0.038)	(0.024)	(0.031)	(0.051)	(0.028)		(0.044)	(0.044)	(0.052)
8	Education	-0.108***	-0.076**	-0.052**	0.047*	0.045	-0.044*	0.015		0.140***	-0.112**
		(0.025)	(0.029)	(0.018)	(0.022)	(0.038)	(0.022)	(0.024		(0.038)	(0.039)
9	Medical and health	-0.204***	0.055	-0.017	0.212***	0.414***	0.065*	0.283***	-0.347***		0.184**
		(0.036)	(0.042)	(0.027)	(0.032)	(0.047)	(0.030)	(0.029	(0.035)		(0.058)
10	Electricity	0.177***	-0.005	0.062**	0.021	-0.023	0.023	0.103***	0.056	0.150***	
		(0.027)	(0.032)	(0.020)	(0.025)	(0.041)	(0.024)	(0.024	(0.034)	(0.034)	

7. Conclusions

This paper estimates expenditure and price elasticities for the main categories of goods and services in Vietnam. Results show that education has low responsiveness to income changes despite higher and vocational/technical schooling is expensive in Vietnam and households bear most of the costs. This suggests that Vietnamese households are keen to improve their education level, which can lead to higher wages, healthy behavior and poverty reduction. Moreover, education is a complementary driver of household consumption and healthy behavior.

While electricity became a necessity with the economic growth, telecommunication, health care, household appliances and clothing are income elastic and their consumption changes significantly across income levels. Important services such as electricity, telecommunication and health care are own-price inelastic, but this can be an effect of current policies and subsidy schemes designed to keep prices low and widen the access to these services to most households, especially for the poorer groups of the population.

These results provide new and updated evidence in support of understanding recent development patterns and fast socio-economic evolution occurred in Vietnam in the last 20 years. While Vietnam's shift from a low- to a middle-income country happened fast, the continuation of this trend towards becoming a high-income country necessitates further reforms and upgraded economic policies. Given the large amount of FDI, new reforms in Vietnam should especially consider the new international geo-political balance and focus on closing the productivity gap between domestic and foreign firms. While basic services have reached almost universal access in both rural and urban Vietnam, disparities in the quality of such services are still an issue that current and future reforms could address, especially in terms of health care and higher education. This could be done taking advantage of the diffused access to telecommunication services, with the government investing in the digitalization of public and private administration and procurement, favoring inclusive finance and education such as e-payments and e-learning.

Other structural challenges that could be addressed to reduce inequalities and improve inclusiveness are the transparency of administrative and legal decisions, often percevied by households and businesses as based on favoritism or corruption; and the reduction of barriers to the labor market (e.g. inadequate training, limited information, insufficient mobility) that particularly affects the ethnic minorities living in remote areas and that represent the large majority of Vietnam's poor. In this regard, further research addressing consumption differences across ethnic groups in Vietnam would be useful.

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