Changes in Household Income in Korea: A Quantile Regression Analysis

Eunice Jihyun Hong, Korean Women's Development Institute[1]
Kyoung Tae Kim, University of Alabama[2]
Sherman D. Hanna, Ohio State University[3]

Abstract

Little research has been conducted on factors related to household income volatility. Hong and Hanna (2018) calculated the percent change in inflation-adjusted household income between 2006 and 2008, using the Korean Labor and Income Panel Study (KLIPS). Ten percent of households had an increase of 90% or more, and 10% of households had a 53% decrease or more. The distribution of the percent change was very skewed, with a maximum increase of 56,823%. Because of the skewed distribution, Hong and Hanna presented a logistic regression on the likelihood of a decrease in inflation-adjusted household income of more than 50%. However, their analysis only could test for the bottom section of the income change distribution. We extend their analysis, using a quantile regression as well as an Ordinary Least Squares (OLS) regression to estimate the effects of household characteristics on the percent change in income, at different quantile levels of percent change. The quantile regression results were very different from the OLS regression results, suggesting that the extreme values of the dependent variable distorted estimations in the OLS regression. In the quantile regression, the only variable that had significant effects on the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} percentiles was the income level in 2006, with higher income households having lower increases in income than lower income households. At each percentile except for the 10^{th} and the 90^{th}, age had a significant curvilinear effect on the income increase, with the growth increasing with age, then decreasing with age with the age for maximum growth equal to 33 to 44, depending on the percentiles.

Keywords: Household income; Income volatility; Income Change; Korean Labor and Income Panel Study
JEL classification: D12, D14

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[1] Associate Research Fellow, Korean Women's Development Institute, 225 Jinheung-ro Eunpyeong-gu Seoul Korea 03367 Phone: 82-2-3156-7139 Fax: 82-2-3156-7276. Email: eunicehong84@gmail.com
[2] Assistant Professor, Department of Consumer Sciences, 312 Adams Hall, Box 870158, University of Alabama, Tuscaloosa, AL 35487. E-mail: ktkim@ches.ua.edu
[3]Professor, Human Sciences Department, Ohio State University, 1787 Neil Ave., Columbus, OH 43210, USA. Phone: 614.292.4584. Email: hanna.1@osu.edu

The Effects of Family Types, Gender Differences and Population Structure on the Electricity Consumption of Households in Taiwan

Jiun-Nan Pan, Yuan Ze University, Taiwan[1]
Jr-Tsung Huang, National Chengchi University, Taiwan[2]

Abstract

Electricity has always been regarded as one of the important energy that affects the country's economic development and national security. In recent years, due to the factors such as climate change and power shortage, most countries in the world have paid more attention to the issues of electricity. According to the information provided by the Bureau of Energy, Ministry of Economic Affairs, we can find the trend of total electricity consumption in Taiwan. Figure 1 shows the total electricity consumption in Taiwan in 2001-2016. We can see that except the decline in electricity consumption in 2007-2009 due to the global economic downturn and the Asian financial crisis. The trend of total electricity consumption in Taiwan is increasing. On the other hand, figure 2 shows that the electricity consumption in the industrial sector is the largest, accounting for about 50% of the total consumption, followed by the service sector and the residential sector, with electricity consumption accounting for about 20%. The energy sector for their own use, transport sector and the agricultural sector are accounted for about 20% of electricity consumption.

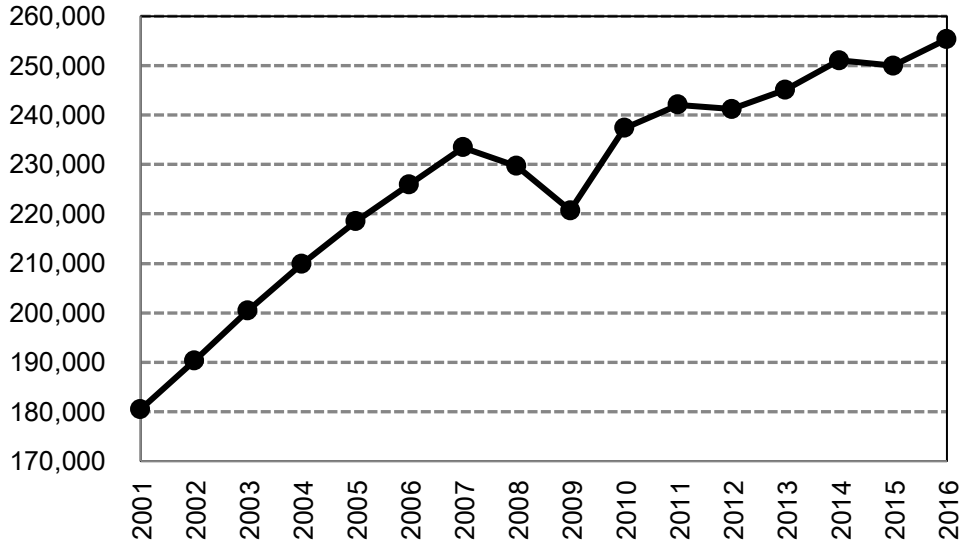

Figure 1: The Total Electricity Consumption in Taiwan (Unit: Gwh)
Source：Bureau of Energy, Ministry of Economic Affairs, Taiwan.

[1] Professor at Yuan Ze University University, Taiwan
[2] Distinguished Professor of Public Finance at National Chengchi University, Taiwan

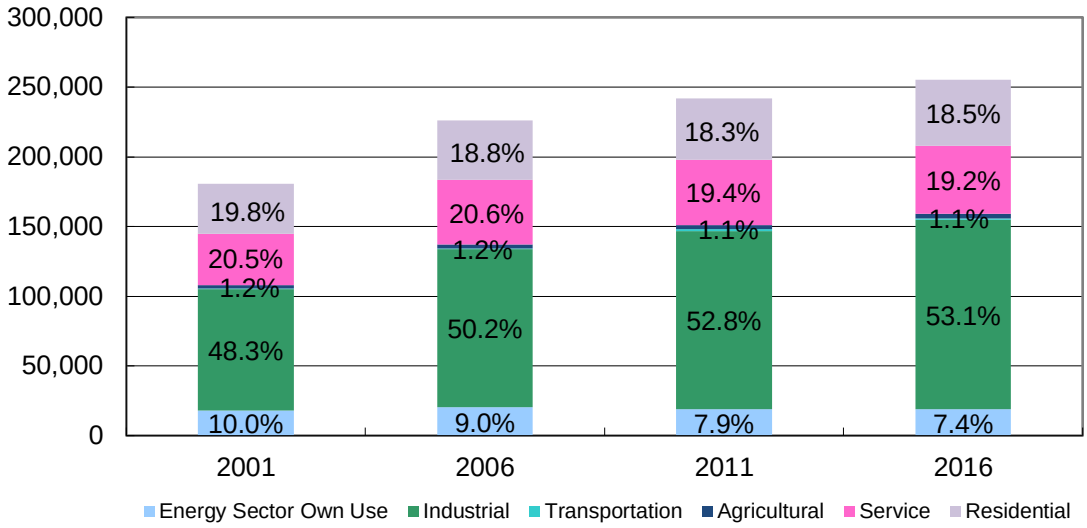

Figure 2: The Total Electricity Consumption by Sector in Taiwan (Unit: Gwh)

Source：Bureau of Energy, Ministry of Economic Affairs, Taiwan.

The energy use differs between households due to differences in the level of disposal income/expenditure, with a strong correlation reported between energy and income/expenditure (Herendeen and Tanaka, 1976; Herendeen, 1978; Pachauri and Spreng, 2002; Reinders et al., 2003). This creates problems for countries world-wide as they attempt to lower their energy use while maintaining their economic growth. However, the effect of increasing income varies considerably across countries, even allowing for socioeconomic and demographic variables (Lenzen et al., 2006). An additional variable explaining levels of total energy use is lifestyle, with urban living 10-15% less energy-intensive than rural (nonfarming) living (Herendeen and Tanaka, 1976; Herendeen, 1978).

In addition, gender may be a determinant of total energy use from household consumption patterns. A study by Carlsson-Kanyama et al. (2003) calculated the energy requirements for producing foods 'from farm to table' and used these to estimate the embodied energy for food consumed by men and women. The results showed that the energy inputs were 14-21% higher for food consumption by men than for women, with men's higher meat consumption partly explaining the difference. Another study examining travel patterns among men and women in different age and income classes and related energy use found that men used more energy for travelling than women in most classes studied, a difference attributed to women travelling shorter distances than men and using more fuel-efficient vehicles (Carlsson-Kanyama and Linden, 1999).

Therefore, this paper will analyze the factors that affect the electricity consumption of households from the micro and macro perspective. First, this paper will use the data of "The Survey of Family Income and Expenditure" from 1990-2016, and will apply the Double Hurdle model to analyze the effects of family types and gender differences on the electricity consumption of households in Taiwan. Secondly, this paper collects county-level panel data of 22 cities in Taiwan from 1990 to 2016, and uses the spatial econometric model to explore the effects of population structure on the electricity consumption of households. In general, this paper is the first study that explores the effects of family types and gender differences on the electricity consumption of households in Taiwan. This is also the first study that uses the spatial econometric model to analyze the effects of population structure on the electricity consumption of households in Taiwan.

Keywords: Family Types, Gender Differences, Population Structure, Electricity Consumption, Double Hurdle Model, Spatial Econometric Model.
JEL classification: D12, J12, J16

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The High Return Investment Ownership of Chinese Households: A Multivariate Probit Model

Guangyi Wang, The Ohio State University[1]
Sherman D. Hanna, The Ohio State University[2]

Abstract

This study analyzed the high return investment ownership of Chinese households using the 2011 Chinses Household Finance Survey (CHFS). We defined high return investment ownership as stock ownership, business asset ownership, and investment real estate ownership. Besides investigating the impact of socioeconomic factors on each type of high return investment ownership, we also used a multivariate probit model to test whether the decisions to own high return investment assets are jointly determined. Overall, we found age, education, household income, and risk tolerance level have significant impacts on Chinese household decision on high return investment ownership. In addition, there are significant interrelationships between each ownership choice. Stock ownership is negatively related to business asset ownership while investment real estate ownership is positively related to both stock ownership and business asset ownership.

Introduction

Investment is an important factor that affects wealth accumulation. Previous normative analyses suggested that all households should invest some wealth on high return investment assets like stocks regardless of the level of risk preference (Haliassos & Bertaut, 1995; Hanna & Chen, 1997). There are extensive studies on household high return investment ownership based on the evidence from different countries such as United States and Australia (e.g., Gutter and Fontes 2006; Cardak and Wilkins 2009; Shin and Hanna, 2015). Most of them found household characteristics including age, marital status, education, income, and risk tolerance have significant impacts on the decision to own high return investment assets such as stocks and business assets. Usually, the higher the education and risk tolerance, the more likely that the household will own high return investment assets. However, most studies about Chinese households' investment decisions have only focused only on stock ownership. Other high return investment assets such as business assets and investment real estate have been understudied.

In this study, we explored the impact of socioeconomic factors on Chinese households' high return investment ownerships, including stock ownership, business asset ownership, and investment real estate ownership. Previous studies pointed out that there could exist substitution effects of high return investment ownerships based on the differences in the nature of risk (Hanna et al. 2008). For example, a household who owns private business assets or investment real estates might substitute them for publicly traded stocks. Hence, households who own business assets or investment real estates might be less likely to own stocks. Therefore, it might be important to jointly analyze decisions for each high return investment ownership rather than separately. We exploited a multivariate probit model for three ownerships to test whether the decisions to own are jointly determined and what is their interrelationship.

Background and Literature Review

High return investment ownerships

[1] PhD student, Human Sciences Department, Ohio State University, 1787 Neil Ave, Columbus, OH 43210, USA. Phone: 415.987.7945. Email: wang.7884@osu.edu
[2] Professor, Human Sciences Department, Ohio State University, 1787 Neil Ave, Columbus, OH 43210, USA. Email: hanna.1@osu.edu

Historical high mean returns and volatility can be used as criteria to classify which investment is a high return investment. Stocks and business assets are commonly treated as high return investment (Gutter, et al. 1999; Gutter and Fontes 2006). Recent studies also included investment real estate (real estate other than the primary residence) as high return investment asset since households may chose them as an alternative investment to stocks (Hanna et al. 2010; Shin and Hanna 2015).

Unlike stocks, business assets and investment real estate are important non-financial assets that are not traded in financial markets. While stock is subject to financial risk, business asset and investment real estate are subject to non-financial market risk, or background risk (Campbell, 2006). Since non-financial assets account for a large proportion of households' wealth, it is important to understand their roles when analyze the household portfolio choices. Campbell (2006) concluded that private business assets can explain the low participation in stock markets for wealthy households. Wang and Hanna (2007) found business owners with active roles of management were less likely to own stocks than otherwise similar households that were not active business owners. Kullmann and Siegel (2003) found that larger real estate exposure is associated with lower likelihoods of stock ownership because real estate investment can be a substitute for stock investment. Based on the fact that investors are more likely to invest in assets that they are familiar with, Hanna et al. (2008) pointed out that business owners and investment real estate owners are more likely to have undiversified portfolios because they think they have superior information about those investments than stock market. Similarly, stock owners might be more familiar with financial markets, thus will be less likely to invest in risky nonfinancial assets.

To sum up, there are many plausible reasons and evidence indicate that there exists an interrelationship between each high return investment ownership. Thus, we should jointly analyze decisions for high return investment ownerships rather than separately.

High return investment ownership of Chinese households

Stock Ownership

In China, very few households participate in the public stock market. Accord to Gan et. al (2013), the direct stock market participation rate in China was only 8.84% in 2011. The percentage was much lower than the United State, where about 50% of households held stock assets (Shin and Hanna, 2015). In addition, stock equity accounts for only a small proportion of total household assets in China. Based on a report by Bloomberg Intelligence (2015), Chinese households allocated less than 1% of their total wealth to stock equity in 2013, while real estate, and business assets accounted for more than 80% of household total assets.

In China, participation in the stock market varies considerably with education, income, employment sector, and region of residence. According to Bloomberg Intelligence (2015), the stock ownership distribution is highly concentrated in people who are wealthier, highly educated, and live in large metropolitan area. The wealthiest 20% of Chinese households accounted for 91.8% of household stock ownership. People living in the largest cities such as Beijing, Shanghai, and Guangdong accounted for 52.5% of stock ownership. Moreover, people who have college degrees have 4.6 times the amount of stocks as people without college degrees.

Copper and Zhu (2017) explored the heterogeneity in Chinese households' stock ownership by education since education is highly correlated with other important factors that affect stock ownership. For instance, highly educated people are usually much wealthier and live in large cities. They found the stock market participation rate of highly educated households are still low in China when compared with US. Only 25% of highly educated Chinese households owned stocks in 2011 (Copper and Zhu, 2017) while in 2013 almost 81% of US households with a post-bachelor degree owned stocks directly or indirectly (author estimate based on 2013 Survey of Consumer Finances dataset).

Business asset ownership

After the implementation of reform and opening, Chinese household who became rich usually accumulated their wealth from investing in business assets and real estate assets. With the change of the economic environment, the booming manufacturing industry provided huge opportunities, and thus attracted many people to either create their own business or invest in business assets. According to Gan et al. (2013), about 14% of Chinese households had industrial/commercial business assets.

Investment real estate ownership

Home ownership in China is very high. About 90% of households in China reported that they own the primary residence house. The percentage is much higher than other countries. For example, the home ownership rates of the United States and Japan were constantly about 60 to 66% from 1960-90 (Noguchi and Poterba, 1994). In terms of number of houses owned by Chinese households, more than 19% of households living in urban area owned more than one house, and more than 14% of households living in rural area owned more than one house (based on author's calculation using 2011 CHFS data).

Why Chinese households are obsessed in investing in real estate is highly debated internationally. Besides the traditional view of homeownership aspiration and upgraded demand for more modern standard new houses, the limited available investment channels in China is an important reason that could possibly explain the phenomenon. Due to the government control, many financial derivatives or products require high entry costs. For instance, the threshold for investing in a trust is one million RMB (about 150,000 USD). Lack of financial knowledge also hinders Chinese households to invest in financial markets. Moreover, Chinese household might consider real estate investment to be more secured channel to put their excess cash into since real estate property is something more concrete that they can see, unlike "intangible" financial assets such as stocks. Real estate investment could also provide more choices for investors. For example, they can choose to either live in it, rent it, or sell it, based on their needs across lifetime. Finally, real estate ownership is widely treated as an essential marriage criteria in China. The sex-ratio bias in China is becoming more severe. It is predicted that there will be about 30 million more men than women reaching adulthood by 2020 (Brooks, 2013). To be more competitive in the mating market, real estate ownership could become the first investment choice for Chinse households.

Methodology

Data

We used data from the 2011 China Household Finance Survey (CHFS), which is a nationally representative survey of Chinese households. The survey is administrated by the Research Center at Southwest University of Financial and Economics (SWUFE) and sponsored by the People's Bank of China. The survey includes rich information about microlevel of Chinese households' financial status such as assets and liabilities, and demographic characteristics including age, education, and region of residence. The survey is conducted biannually from 2011. However, only the 2011 wave of the survey was publicly available when our research was conducted. The total sample size is 8,438 in 2011 CHFS.

Measurement of variables

Dependent variables

The CHFS has comprehensive information about household's asset holdings. We counted households have stock ownership if they directly hold publicly traded stocks, or indirectly held stocks through mutual fund, financial derivatives, and wealth management products. For business asset ownership, the survey asked questions about whether the household is engaged in production and management projects related to agriculture and industry/commerce activities. Households who reported that they were engaged in production or operation of these projects were counted as having business asset ownership. For ownership of real estate other than primary residence, the survey asked respondents about how many homes their families own. Households who owned more than one home were counted as having ownership of investment real estate.

Explanatory variables

Explanatory variables are major household characteristics including age of respondent, gender (male/female), marital status (married, cohabit, single male, single female), region of residence (rural/urban), education of respondent (less than high school, high school degree, some college, bachelor degree, post-bachelor degree), family income, have children under 18 (yes/no), risk tolerance (no risk, low risk, average to high risk, substantial risk), and economic outlook (worse, same better).

Model

To investigate the determinants of each high return investment ownership, we used multivariate analysis to analyze the impact of household characteristics and their risk preference on those ownerships. Rather than estimating three equations separately, we used the multivariate probit model to run the regressions simultaneously since the choice of each high return investment ownership could be interrelated.

We estimated the following three equations together:

$$Prob(\ y_{1i} = 1) = b_1 \cdot X_{1i} + \varepsilon_{1i}$$

$$Prob(\ y_{2i} = 1) = b_2 \cdot X_{2i} + \varepsilon_{2i}$$

$$Prob(\ y_{3i} = 1) = b_3 \cdot X_{3i} + \varepsilon_{3i}$$

Where y_{1i} is stock ownership of individual i, y_{2i} is business asset ownership, and y_{3i} is investment real estate ownership. X is a vector of explanatory variables that we mentioned previously.

Multivariate probit is an extension of the bivariate probit model, which was firstly introduced by Greene (1984). Using multivariate probit model, we can test the correlation of residuals of more than two equations, without assuming each probability is independent from each other. unlike the bivariate probit model, multivariate probit model estimates all equations simultaneously using simulated maximum likelihood method rather than maximum likelihood method, to produce an unbiased estimate of the correlation of the residuals for each pair of predictors, which is called ρ_j. For example ρ_{12} represents the correlation between stock ownership and business asset ownership. If it is significant and positive, then it means stock ownership is positively correlated with business asset ownership. In other words, the decision to own stock has a positive effect on the decision to own business assets. If ρ_{12} is not significantly different from zero, then we can conclude that stock ownership is not correlated with business asset ownership, and therefore, the decision to own stock will not affect the decision to own business assets.

Results

Descriptive results

Table 1 summarizes household characteristics and risk attitude by each type of high return investment ownership. For all households in the 2011 CHSF, 63.89% of them own at least one type of high return investment. The ownership for stock, include direct holding and indirect holding, was 10.81%. The ownership of investment real estate (e.g., a second house) was 15.55%. The ownership of business asset (including industrial/commercial and farming) is much higher, almost 50%, mainly due to the large proportion of farmers in China.

For stock ownership, the percentage of owning stock is higher for the group with higher education. For example, only 4% of households who receive less than high school degree owned stocks, while 52% of households who receive graduate degree owned stocks. The pattern is reversed for business ownership, where the percentage of owning business assets is higher for the group with lower education. For investment real estate ownership, the variation for each education group is not as large as stock ownership and business asset ownership. The percentage of real estate ownership increases from 12% for the lowest education level to 24% for the highest education level.

Households in the higher income groups have larger percentages of owning stocks and investment real estate but smaller percentages of owning business assets. Only 3% households with family income below the 25th percentile (RMB 12,500) owned stocks, while 41% households with family income above the 90th percentile (RMB 103,100) owned stocks. The pattern is very similar for investment real estate ownership. The variation in business asset ownership for each income level is not very big. The percentage decreases from 55% for the lowest income level group to 33% for the highest income level group.

Table 1. Means of household characteristics and risk attitude

	Stock ownership	Business ownership	Real estate ownership	At least one ownership
Age of head				
< 35	0.18	0.34	0.19	0.52
35-44	0.16	0.47	0.17	0.65
45-54	0.11	0.51	0.16	0.65
55-64	0.08	0.53	0.15	0.65
>= 65	0.06	0.36	0.11	0.45
Education				
Less than high school	0.04	0.57	0.12	0.64
High school	0.14	0.38	0.18	0.54
Some college	0.27	0.21	0.23	0.51
Bachelor	0.38	0.12	0.27	0.55
Graduate	0.52	0.03	0.24	0.63
Family Income (RMB)				
< 12,500	0.03	0.55	0.08	0.6
12,500-30,000	0.05	0.51	0.11	0.57
30,000-56,284	0.12	0.4	0.14	0.55
56,284-103,100	0.2	0.36	0.23	0.61
> 103,100	0.41	0.33	0.41	0.76
Household type				
Married	0.12	0.48	0.16	0.62
Cohabit	0.16	0.41	0.3	0.53
Single male	0.09	0.42	0.14	0.52
Single female	0.14	0.21	0.12	0.35
Rural	0.02	0.77	0.12	0.8
Have kids less than 18	0.12	0.53	0.18	0.67
Risk tolerance				
no risk	0.05	0.46	0.12	0.55
low-average risk	0.14	0.45	0.17	0.61
slight higher risk	0.28	0.43	0.25	0.72
high risk	0.19	0.52	0.2	0.71
Economic outlook				
worse look	0.22	0.31	0.2	0.56
same look	0.19	0.37	0.16	0.58
better look	0.09	0.48	0.15	0.61
Observations	971	3858	1197	5046
Weighted percent of sample	10.81	49.44	15.55	63.89

Analyses by authors of the 2011 China Household Finance Survey, N=8,438

Households with higher risk tolerance levels have larger percentages of owning stocks and investment real estate. The percentage increases from the no risk group to the average to the high risk group and then decreases for the substantial risk group. For stock ownership, the percentage increases from 5% for the no risk group, to 28% for the average to high risk group, then decreases to 19% for the substantial risk group. For investment real estate ownership, the percentage increases from 12% for the no risk group, to 25% for the average to high risk group, then decreases to 20% for the substantial risk group. The pattern is not very consistent for business asset ownership. The percentage ranges from 43% to 52% for different risk tolerance group.

Owners of stocks and investment real estate are highly concentrated in urban area while owners of business assets are concentrated in rural area. 98% and 88% households live in urban area reported the ownership of stocks and real estates, while 77% households lived in rural area reported business asset ownership.

Multivariate analysis

Table 2 shows the result of our multivariate probit model. The correlations between the residuals of each equation ρ_j were all significant, indicating that there exists interrelationships between choice of

each high return investment ownership and we should estimate them jointly. We found that there was a negative relationship between stock ownership and business asset ownership, and a positive relationship between investment real estate and both stock and business asset ownership. In other words, decision to own investment real estate is positively correlated with the decision of stock ownership and business asset ownership, while the decision to own stock and decision to own business asset are negatively correlated. While the relationship between stock ownership and business ownership is consistent with the conclusions of previous studies, our empirical result about investment real estate ownership and stock ownership is somewhat different from our expectation since many studies assert that real estate investment can explain the low participation in stock market.

Table 2. Multivariate probit model of household high return investment asset ownership

	Stock ownership	Business ownership	Real estate ownership
Age of head	4.69809***	4.68428***	3.14416***
	(0.000)	(0.000)	(0.001)
Age squared/10000	-4.66160***	-5.32979***	-3.05588***
	(0.000)	(0.000)	(0.001)
Education (reference: less than high school)			
High school	0.36042***	-0.32456***	0.08988
	(0.000)	(0.000)	(0.094)
Some college	0.62966***	-0.75824***	0.13025*
	(0.000)	(0.000)	(0.023)
Bachelor	0.76978***	-1.15456***	0.18173*
	(0.000)	(0.000)	(0.014)
Graduate	0.96245***	-2.15611***	-0.14061
	(0.000)	(0.000)	(0.482)
Family Income (Log)	0.29947***	0.06603***	0.23548***
	(0.000)	(0.000)	(0.000)
Household type (reference: married)			
Cohabit	-0.11608	0.64215*	0.40375
	(0.755)	(0.042)	(0.174)
Single male	-0.08870	0.18305*	0.09524
	(0.444)	(0.020)	(0.286)
Single female	0.30495**	-0.48252***	-0.02254
	(0.002)	(0.000)	(0.804)
Rural	-0.77841***	1.27810***	-0.07462
	(0.000)	(0.000)	(0.078)
Have kids less than 18	0.02445	0.20451***	0.13296***
	(0.620)	(0.000)	(0.001)
Risk tolerance (reference: no risk)			
Low risk	0.36582***	0.07362	0.07848
	(0.000)	(0.052)	(0.062)
Average to high risk	0.66455***	0.29140***	0.25357***
	(0.000)	(0.000)	(0.000)
Substantial risk	0.59269***	0.22485**	0.14561
	(0.000)	(0.002)	(0.062)
Economic outlook (reference: worse)			
Same	0.05701	0.08625	-0.04630
	(0.502)	(0.245)	(0.554)
Better	-0.20605**	0.17484**	-0.01217
	(0.004)	(0.004)	(0.850)
Intercept	-5.72062***	-2.19953***	-4.33031***
	(0.000)	(0.000)	(0.000)
ρ (correlation between error terms)			
Stock and business ownership	-0.14818***		
	(0.000)		
Stock and real estate ownership		0.14813***	
		(0.000)	
Real estate and business ownership			0.07465**

Table 2. Multivariate probit model of household high return investment asset ownership

	Stock ownership	Business ownership	Real estate ownership (0.001)

Unweighted analysis based on 2011 CHFS datasets.
p-values in parentheses
="* p<0.05 ** p<0.01 *** p<0.001"

For stock ownership, we found age, education, family income, area of residence, and risk preference had significant impacts on the household decision. The combined effect of age and age squared implies that the likelihood of owning stock increased with age up to age 50, then decreased. Households with higher education, higher income, living in the urban area, and had higher risk tolerance were more likely to have stock ownership. For business asset ownership, most effects were similar, except for the education effect. It seems households who have business assets are more likely to have less education. It is possible since we accounted households who are engaged in farm business as having business assets, and farmers usually receive low education in China. It can be further confirmed since the result shows household in the rural area were more likely to own business assets. Even though farmers in China can't privately own the land, we still treated them as having business assets since they are highly engaged in the usage of the land and generate profits from the production. In addition, the combined age effect shows the likelihood of owning business assets increased with age only up to age 44, then decreased. For investment real estate ownership, the likelihood of owning investment real estate increased with age to age 51, then decreased. Compared with stock ownership and business asset ownership, education and risk tolerance seem to have less significant impact on investment real estate ownership. It probably reflects the fact that most Chinese household wants to invest in real estate no matter what, if they are not constrained by their income. In addition, we noticed that having kids less than 18 has positive effect on investment real estate ownership. It is very likely due to Chinese parents' high attention to children's education. Many of them who can afford a second house will purchase one in a good school district when their children reach school age.

Conclusion

This study investigated the determinants of high return investment ownership of Chinese households and the interrelationship between each type of high return investment ownership. Besides stock ownership, we also discussed the business asset ownership and investment real estate ownership, which have been understudied by previous studies. Our results demonstrate that researchers have to jointly analyze the high return investment decisions related to stock, business asset, and real estate, because those decisions are interrelated with each other. For instance, we found stock ownership has a negative relationship with business asset ownership, while investment real estate ownership has a positive relationship with both stock and business asset ownership.

We found age, education, household income, and risk tolerance level have significant impacts on Chinese households' decision on high return investment ownership. Households with higher income and risk tolerance are more likely to own high return investment assets. Most determinants are significant for stock ownership and business asset ownership, but become less significant for investment real estate ownership, indicating that Chinese households have strong desire of owning real estate regardless education, risk attitude, etc. For example, education has significant positive effect on stock ownership and negative effect on business asset ownership, but has less significant effect on real estate ownership. Risk tolerance did not have a significant effect on ownership of investment real estate.

An important issue for Chinese households is the need to diversify the investments. We discussed the plausible reasons for Chinese households to be obsessed in real estate investment, including the limited available investment channels and high entry cost in financial market in China, and lack of financial knowledge to participate in the stock market. Different from 20 years ago, when people who audaciously made any investments can generate a lot of wealth since there were tremendous opportunities in the market, the more matured market and highly developed technology nowadays make the room for growth in real estate market and business sector limited. The fundamental way of improving

wealth management through making investment is to improve the formal education and financial knowledge of Chinse households.

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Title: Effects of SNAP on Diet Quality of Food Consumption: Evidence from the National Household Food Acquisition and Purchase Survey

Yunhee Chang, Ph.D.
Associate Professor and Graduate Program Coordinator
The University of Mississippi
Department of Nutrition and Hospitality Management
P.O. Box 1848
202 Lenoir Hall
University, MS 38677-1848
U.S.A.
chang@olemiss.edu
Jinhee Kim, Ph.D.
Professor and Extension Specialist
1142 School of Public Health, Bldg. 255
Department of Family Science
School of Public Health
University of Maryland
College Park, MD 20742
jinkim@umd.edu
Swarn Chatterjee, Ph.D.
Associate Professor and Graduate Coordinator
Swarn Chatterjee, Ph.D.
205, Dawson Hall
Department of Financial Planning, Housing and Consumer Economics
University of Georgia, Athens, GA 30622
swarn@uga.edu

Abstract

This study uses the newly released *National Household Food Acquisition and Purchase Survey* (FoodAPS) dataset 1) to estimate the effect of SNAP dollars on nutritional quality of acquired foods, subjective dietary status, and obesity, and 2) to examine whether the effects of SNAP dollars are different from that of income from other sources. Results show that SNAP dollars lower the sodium-dense food consumption but do not have significant effects on other dietary measures such as energy density, saturated fat, and SoFAAS contents. Income effects of SNAP dollars on objective dietary measures were different (opposite) from the effects of income from other sources. Income in general positively affected the subjective diet status among participants and income-eligible nonparticipants, while SNAP dollars did not consistently improve the subjective diet status of the households. Implications for researchers and policymakers are presented.

Introduction

Since the 1964 Food Stamp Act, the Supplemental Nutrition Assistance Program (SNAP), formerly known as the food stamp, has grown to be the largest nutrition assistance program in the U.S. The goal of this program is to provide a safety net against food insecurity and poverty, contributing to the nutrition and health of participants. With the growth of the SNAP program, the effectiveness of the program has been widely debated. In general, SNAP participation contributes to the reduction of food insecurity and hunger of beneficiaries as its intent (Andreyeva, Tripp, & Schwartz, 2015; Nord, 2012). However, the effects of SNAP on dietary quality and intake are mixed (Leung et al., 2014). Studies have found non-significant or less favorable effects of SNAP on dietary qualities of participating adults and children (Andreyeva et al., 2015; Auld et al., 2015; Kaiser et al., 2015; Leung et al., 2013; Leung et al., 2015; Nguyen, Shuval, Njike, & Katz, 2014; Nguyen, Shuval, Bertmann, & Yaroch, 2015; Wolfson & Bleich, 2015). By reviewing recent publications on SNAP participation, dietary intake, and quality, Andreyeva et al. (2015) found that although SNAP reduced the food insecurity of participants, the participants scored lower in Healthy Eating Index compared to income-eligible or higher-income non-participants. However, the differences for nutrient intake were less significant when compared with the low-income non-participants. For example, most studies have found that SNAP participants consumed more sugar-added beverages compared with higher-income non-participants but not

different from income-eligible non-participants (Andreyeva et al., 2015). Overall, many low-income individuals in the U.S. have suboptimal dietary quality and intake regardless of their SNAP participation status.

Further, SNAP participants may have high levels of stress and life challenges such as long work hours with less available time for food preparation or consumption related activities, which might contribute to the lower diet quality in the food consumed by the SNAP participants. While SNAP participants have a slightly lower score on the overall Healthy Eating Index (HEI), they are also less likely to consume saturated fat and sodium than eligible non-participants (Gregory, Ver Ploeg, Andrews, & Coleman-Jensen, 2013). Gregory (2013) found a small positive effect on whole fruit but negative effects on dark green and orange vegetables and speculated the reduced cooking time may be an explanation considering that many SNAP participants work long hours. Recently, Nguyen et al. (2015) found that SNAP might aid individuals, who have marginal or low food security, access healthier diet and weight status (Nguyen et al., 2015).

In addition to the diet quality, participation in SNAP has been linked to obesity and poor health of adults and children (Baum, 2007; Leftin et al., 2013; Leung et al., 2016; Meyerhoefer & Pylypchuk, 2008). Meyerhoefer and Pylypchuk (2008) found that SNAP participation resulted in an increased likelihood of being overweight or obese among women and increased the probability of higher health care spending. However, Almada, McCarthy and Tchernis (2016) found no evidence to support that SNAP increased the likelihood of being overweight or obese among adults, and suggested that bias in causal inference may have produced inconsistent findings in previous studies.

Despite its goal of providing nutrition assistance for the poor, the program has been questioned for being responsible for the contemporaneous growth of obesity among the low-income population. Due to the possibility of endogeneity among the various sources of benefits, evidence of SNAP effects on obesity and diet quality has not been conclusive. Nevertheless, additional policies and programs to improve diet quality of SNAP participants have been discussed. Changes to policies that ban or restrict SNAP usage on sugar-sweetened beverages and incentivize healthier items such as fruits and vegetables have been suggested and/or explored. Research suggests that an educational component of the program such as SNAP-Ed may advance the effectiveness of SANP by improving nutrition and comprehensive home cooking skills (Wolfson & Bleich, 2015; Taillie & Poti, 2017), improving food resource management skills (Auld et al., 2015; Kaiser et al., 2015), and reducing the perception that healthy food is not affordable (Carlson & Frazão, 2015).

Utilizing the *National Household Food Acquisition and Purchase Survey* (FoodAPS), this study investigates the effect of SNAP on nutrition quality and obesity. Furthermore, we examine whether the effect of SNAP dollars is different from that of income from other sources.

Method

The FoodAPS is a survey of nationally representative sample of 4,826 households on detailed records of foods acquired or purchased for both at-home and away-from-home consumption during the seven-day reporting period. This study interviewed the participating household's main food shopper or meal planner on various aspects of their food acquisition behavior. The dataset also includes detailed records of food acquisition of the participants during the 48-hour reporting period.

Three measures for dietary quality and obesity were included as dependent variables: .objective nutritional quality of food acquired for at-home consumption; subjective dietary status; and obesity. Nutritional quality of acquired foods for at-home consumption was measured in continuous scales. Subjective dietary status and obesity were measured as dichotomous variables.

An *Instrumental Variable* model was estimated using the proportion of household children receiving free or reduced lunch or breakfast (PCFR). This was based on the previous research on direct certification program, "As more family members receive school-based food assistance increases, need for in-home meals decrease without affecting SNAP benefits" (Almada & Tchernis, 2016).

Caswell et al. (2013)'s framework was considered in identifying control variables such as resource constraints including income and time, household factors such as education, knowledge and skills that may affect dietary choice, and environmental factors such as food prices, locations, and distance to stores. Control variables included reported benefit amount, estimated benefit amount (using state rules), age, gender, race, ethnicity, education, marital status, employment status, household size, number of children, income (logged), poverty status, homeownership, vehicle, urban, and Census region.

Results

Direct effects of SNAP dollars on self-rated diet quality were positive. The effects of SNAP dollars on subjective diet status were larger in magnitude than income effect from other income. For further

understanding, additional analyses that included food access variables were conducted. It showed that having close access to SNAP-authorized supermarkets or fast food retailers could undermine positive effects. Also, SNAP benefits also increased the likelihood of obesity while income from other sources did not have significant effects on obesity.

The effects of SNAP on dietary quality were estimated using nine measures: fruit density, whole fruit density, whole grain density, vegetable density, dark green/red/orange vegetable density, energy density, sodium density, saturated fat percentage, and SoFFAS percentage. The effects of SNAP on dietary quality were insignificant and mostly negative while effects of other income sources were positive and significant. However, we found consistent evidence that SNAP was negatively associated with sodium dense food intake.

Discussion

The findings from this study indicate that the effect of SNAP dollars on objective measures of diet quality are negligible. This finding is consistent with the findings from the Gregory et al. (2013) study. The positive association between SNAP dollars and the subjective measures of diet quality is encouraging and corroborates with previous findings that SNAP also reduces household food insecurity (Gundersen & Ziliak, 2015). More research is needed to develop better policies to reduce the association between SNAP dollars and unhealthy nutritional practices. Additional evidence is required to better develop policies that can improve dietary quality and health of SNAP participants.

Providing incentives for fruits and vegetables and limiting the use of SNAP dollars to purchase sugary beverages have been discussed in changing SNAP policy (Basu et al., 2014; Harnack et al., 2016). More research is needed to examine whether providing incentives for smaller retailers to stock healthier foods could create greater accessibility to healthy food options for SNAP participants, who often live in locations, where shopping for food at small convenience or grocery stores is their only choice.

Further, building a greater emphasis on healthy nutrition practices within the SNAP-Ed curriculum would be effective. There is some evidence that nutrition education (and resource management) along with SNAP benefits may reduce food insecurity (Auld et al., 2015; Kaiser et al., 2015) and healthy food purchase (Dollahite, et al., 2014) of low income families. SNAP-Ed should also focus on helping participants make healthy food choices such as increasing fruits and vegetable consumption within their budget by managing their resources. Specifically, recent studies suggest that cooking at home may improve diet quality of SNAP participants (Taillie & Poti, 2017; Wolfson, & Belich, 2014). Taillie and Poti (2017) found using the cross-sectional data of National Health and Nutrition Survey (NHANES) that cooking at home or consuming home cooked meals were associated with better dietary intake such as lower sugar-sweetened beverage intake, and decreased prevalence of overweight/obesity for the SNAP participants, but not for the eligible non-participants. However, these associations were reduced after controlling for fast food intake. They suggested that controlling fast food consumption need to be further studied as an effective strategy to improve dietary intake among households (Taillie & Poti, 2017). Additional research is needed to examine the relationships between SNAP, nutrition quality, and food away from home.

By analyzing the literature review and public datasets, Carlson and Frazão (2014) argued that healthy foods are affordable and there are some households that practice consuming healthier diets even though they are income constrained, and argued a need for education and other strategies to change people's perception that healthy foods and diets are expensive and not affordable. Changing this perception that is prevalent among many Americans, regardless of income levels, will require changes to be made to SNAP programming, and to the educational efforts that target SNAP participants.

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Table 1 Descriptive Statistics

Variables	Eligible (n=2244)	Participants (n=1378)	Eligible Non-participants (n=1071)
Fruit density	0.39	0.294	0.433
Whole fruit density	0.325	0.233	0.366
Whole grain density	0.481	0.352	0.563
Vegetable density	0.663	0.466	0.764
Dark green, red, orange vegetable density	0.141	0.096	0.162
Energy density	1.42	1.39	1.43
Sodium density	2101.6	1740.9	2248.5
Saturated fat percent	10.3	10.4	10.3
SoFAAS percent	36.7	40.2	34.9
Diet status is good	0.446	0.472	0.442
Diet status is very good	0.187	0.163	0.2
Household obesity (1=obese)	0.349	0.402	0.321
SNAP recipient (1=recipient)	0.338	1	0
Reported SNAP amount ($100, monthly)	0.907	2.39	0.099
Estimated benefit ($100, monthly)	2.67	2.75	2.36
Household income ($100, monthly)	24.3	20.6	29.1
Proportion of children receiving free/reduced meals (PCFR)	0.159	0.273	0.095

Note: Weighted sample means using FoodAPS

Table 2: Effects of PCFR and Household Income on Nutritional Quality of Acquired Foods, by SNAP Status

Specification of Variables (Sample)	(1) Fruit density	(2) Whole fruit density	(3) Whole grain density	(4) Vegetable density	(5) Dark green, red, orange veg density
Specification #1: (Eligible hhs)					
PCFR x SNAP	-.005 (.053)	-.027 (.053)	-.058 (.104)	.131 (.150)	-.072 (.058)
Log income	.018 (.007)**	.017 (.007)**	.003 (.012)	.012 (.015)	.007 (.004)*
Specification #2: (Participants)					
PCFR	-.021 (.041)	-.035 (.036)	-.124 (.080)	.106 (.147)	-.005 (.024)
Log income	.005 (.006)	.002 (.005)	-.002 (.016)	.012 (.011)	.001 (.008)
Specification #3: (Eligible nonparticipants)					
PCFR	-.133 (.089)	-.137 (.099)	-.042 (.137)	-.384 (.141)**	-.188 (.126)
Log income	.029 (.016)*	.029 (.017)*	.018 (.024)	.056 (.041)	.021 (.015)

Table 2: (Continued)

Specification of Variables (Sample)	(6) Energy density	(7) Sodium density	(8) Saturated fat percent	(9) SoFAAS percent
Specification #1: (Eligible hhs)				
PCFR x SNAP	-.018 (.069)	-321 (344)	.898 (.731)	.707 (1.704)
Log income	-.010 (.010)	-1.26 (51.55)	-.127 (.108)	-.022 (.345)
Specification #2: (Participants)				
PCFR	-.071 (.082)	-517.2 (285.1)*	.532 (.593)	.548 (2.072)
Log income	-.016 (.014)	18.3 (39.0)	-.125 (.133)	.233 (.307)
Specification #3: (Eligible nonparticipants)				
PCFR	-.033 (.077)	-1075 (578)*	2.42 (1.12)**	3.35 (3.48)
Log income	-.004 (.018)	36.7 (127.7)	-.140 (.159)	-.651 (.528)

Table 3: Effects of PCFR and Household Income on Self-Rated Diet Quality and Obesity

Specification of Variables (Sample)	Diet status is good	Diet status is very good	Obese household
Specification #1: (Eligible hhs)			
PCFR x SNAP	.107 (.066)	.002 (.042)	.141 (.054)**
Log income	.024 (.004)***	.008 (.003)**	.004 (.008)
Specification #2: (Participants)			
PCFR	.122 (.059)**	.008 (.042)	.128 (.045)***
Log income	.023 (.005)***	.008 (.003)**	.003 (.012)
Specification #3: (Eligible nonparticipants)			
PCFR	-.049 (.060)	-.099 (.079)	.038 (.074)
Log income	.032 (.008)***	.014 (.006)**	-.002 (.010)