

## LOW FERTILITY RATE AND CONSUMPTION BEHAVIOR OF HOUSEHOLDS IN TAIWAN

JR-TSUNG HUANG<sup>\*,¶</sup>, JIUN-NAN PAN<sup>†,||</sup>, MING-LEI CHANG<sup>‡,\*\*\*</sup> and SHIH-YI YOU<sup>§,††</sup>

*\*Department of Public Finance  
College of Social Sciences, National Chengchi University  
Taipei 116, Taiwan*

*†Discipline of Accounting, College of Management  
Yuan Ze University, Taoyuan 320, Taiwan*

*‡Department of Accounting, College of Business  
Chung Yuan Christian University  
Taoyuan 320, Taiwan*

*§Institute of Guangdong, Hong Kong and Macao  
Development Studies, Sun Yat-sen University  
Guangzhou 510275, P. R. China*

*¶jthuang@nccu.edu.tw  
||edouard@saturn.yzu.edu.tw  
\*\*\*minglei@cycu.edu.tw  
††youshiyi@mail.sysu.edu.cn*

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Since the economic consequences of a low fertility rate, such as a change in consumption patterns, might affect the path of economic growth, this study investigates how the relationship between the low fertility rate and consumption behavior in Taiwan has changed over time. Using county-level panel data from 1995 to 2014 to examine the impact of the low fertility rate on the consumption behavior of households in Taiwan, the major finding of this study is that a low fertility rate will change the behavior and the composition of consumption. A low fertility rate will increase the share of the total consumption expenditure in a household's disposable income, in particular, in relation to the consumption categories of food, health care, education, and transportation and communication, but will decrease the share of expenditure on clothing in the household's disposable income.

*Keywords:* Consumption behavior; fertility rate; panel data model; Taiwan.

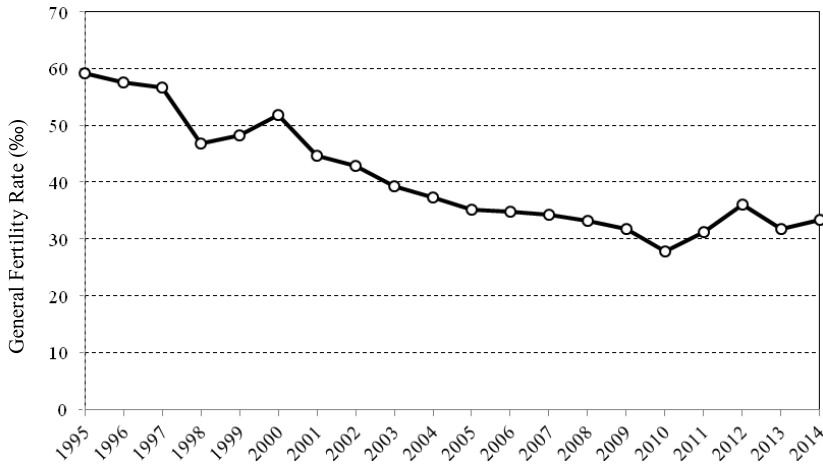
JEL Classification: D12, J13, R23

### 1. Introduction

Over the past two decades in Taiwan, there have been increasing numbers of young adults who do not want to get married or have children. Therefore, the crude marriage rate (per thousand persons) has gradually declined from 7.5 pairs in 1995 to 6.3 pairs in 2014

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|| Corresponding author.

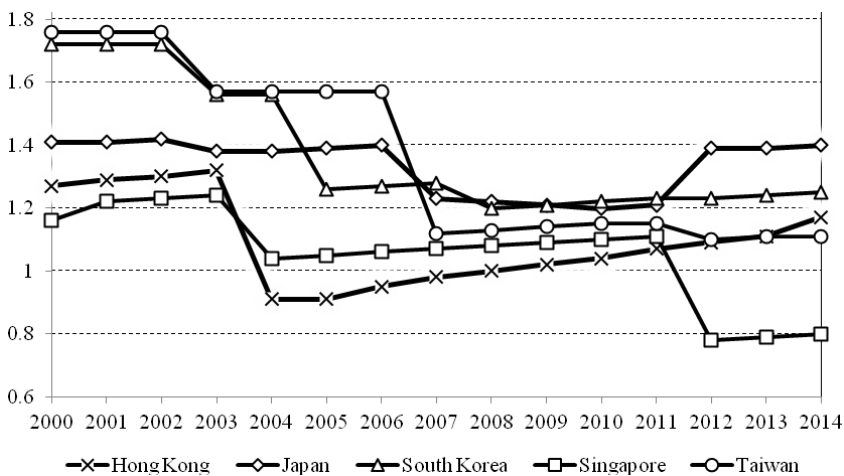


Source: Directorate General of Budget, Accounting and Statistics (DGBAS), Executive Yuan, Taiwan.

Figure 1. General Fertility Rate of Women of Childbearing Age in Taiwan (1995–2014)

and, according to Figure 1, the general fertility rate (GFR) of women of childbearing age (per thousand women) has exhibited a slight fluctuation and downward trend during the period from 1995 to 2014, having declined from 59.2 in 1995 to 33.5 in 2014.

Since the total fertility rate (TFR) is defined as the average number of children that would be born to a woman over her lifetime, it is a more direct measure of the level of fertility than the crude birth rate. Moreover, the TFR can also reveal the potential for population change in the country. Figure 2 presents the TFR for Hong Kong, Japan, South Korea, Singapore and Taiwan. We can find that the rates for these five countries/regions



Source: The World Bank. <http://data.worldbank.org/indicator/SP.DYN.TFRT.IN>.

Figure 2. Total Fertility Rates of Hong Kong, Japan, South Korea, Singapore and Taiwan (Children Born/Woman)

were all below two children, thereby indicating that their populations are decreasing in size and growing older.

The decrease in the TFR has occurred not only in the above five countries/regions but also in western industrialized countries. During the 20th century, although the rapid economic growth of western industrialized countries was labeled as a human development achievement, the fertility rate declined significantly at the same time. Fertility rates have consequently declined in most countries to levels that are well below those needed to secure generation replacement. While attitudes towards this decline in fertility rates differ across countries, governments have introduced specific measures aimed at countering it. For example, in 2005, half of the developed countries had policies in place to raise their birth rates, up from one third just a decade ago (Callister and Didham, 2007).<sup>1</sup> By contrast, in the UN report on world population policies (United Nations, 2006), New Zealand, with its near-replacement fertility, was listed as having a ‘satisfactory’ level of fertility and was classified as wanting to ‘maintain’ this level.

Although the trend toward low fertility rates prevails in many countries, the data presented in Figure 2 shows that Taiwan has experienced a serious decline in its fertility rate and this might play an important role in the consumption behavior of households in Taiwan. For example, a decline in the fertility rate might directly affect the involvement of women in the workforce (Ahn and Mira, 2002; Brewster and Rindfuss, 2000). As a result, the consumption structures of a household will change. In addition, a low fertility rate corresponds to a higher teacher–student ratio and will further result in changing the student-centered learning environment because teachers will find it easier to modify instructional practices (Ehrenberg *et al.*, 2001). Hence, to some extent, when the fertility rate is low, households can save on some of the educational investment that they would otherwise have to make in their children. Besides, a lower fertility rate implies that households have more leisure time and this will typically affect their consumption behavior. In addition, a decline in fertility may increase financial savings for old age and retirement (Bloom *et al.*, 2009).

In addition, with regard to demographic indicators, the consumption behaviors of households vary substantially according to their age structure. For example, in general, young people will have higher expenditures in the field of education, while older people will demand more goods and services with regard to health services. By contrast, the demand for work-related consumption, such as for transportation & communication and clothing, might decrease for retirees (Hurst, 2008). Furthermore, the consumption structure differs by age cohort due to the comparable historical, economic or societal frameworks that people went through (Evans *et al.*, 2009).

As a consequence, a society with a lower fertility rate has two mechanisms to influence the consumption structure of an economy. The first involves affecting the consumer behavior of a household as we already mentioned. The second has to do with changing

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<sup>1</sup> Countries which have TFRs under 1.5 and which have policies in place include Italy, Spain and Japan. Even Australia, with a rate of around 1.7, has recently changed its policy stance from ‘no intervention’ to putting in place an explicit and indirect pro-natal fertility policy.

the population structure and further gives rise to a change in the consumption structure. The existing literature has paid more attention to the second mechanism or the impact of low fertility on the economy. However, it is necessary to evaluate the influence of the decline in fertility on the consumption structure of an economy based on the following reasons. First, many industries are sensitive to the consumption structure which is highly correlated with the fertility rate. Second, a predictable consumption structure can provide important information for the government to implement policies to promote industrial structural adjustment.

Therefore, the purpose of this study is to investigate how a low fertility rate affects a household's consumption in Taiwan, particularly in relation to the composition of household consumption. By using county-level panel data for 1995–2014 and variables drawn for various years from the *Report on the Survey of Family Income and Expenditure* (1995–2014) published by the Directorate-General of Budget, Accounting and Statistics (DGBAS), Executive Yuan,<sup>2</sup> Taiwan to estimate seven regressions for the ratio of the household's total consumption expenditure as well as of spending in the highest six consumption categories to household disposable income, respectively, this study finds that a low fertility rate does play a different role in the different consumption categories of households in Taiwan.

This remainder of this study is organized as follows. Section 2 provides a literature review on the low fertility rate and consumption. Section 3 introduces an empirical model for analyzing the impact of the low fertility rate on the different types of consumption. In Section 4, the estimation results of the empirical model are analyzed and some specification tests are applied to examine the correctness of the empirical model, followed by conclusions in Section 5.

## 2. Literature Review

There exist a number of studies in the literature that try to identify the factors that influence household spending, with many of them being aimed at investigating the macroeconomic factors.<sup>3</sup> At the same time, it is argued that the preferences of a household may change since the household's characteristics (such as size, structure, etc.) are changing over time, and this further gives rise to changes in the consumption structure of a family. However, as to what the impacts of a low fertility rate on the structure of consumption are is less discussed.<sup>4</sup> In spite of this, the trend toward a low fertility rate and population aging is now a characteristic of most developed as well as some developing nations. Such a transition is an important issue and is considered to exert both economic and social influences on these countries.

<sup>2</sup>The Executive Yuan is the executive branch of the central government of Taiwan.

<sup>3</sup>For instance, [Verter and Osakwe \(2014\)](#) pointed to net disposable income, cross-cultural dynamics, the inflation rate, and the saving rate as factors influencing household spending in the Czech Republic. [Parker \(1999\)](#) refuted this view, however, based on microdata from household surveys conducted in the United States and argued in favor of the life-cycle permanent-income hypothesis, suggesting that predictable changes in income have no effect on the growth rate of consumption expenditure. [De Bonis and Silvestrini \(2012\)](#) showed that both net financial wealth and real wealth have a positive effect on consumption.

<sup>4</sup>A sub-replacement fertility rate will definitely change the structure of a family. [Foot and Gomez \(2007\)](#) mentioned that the effect of a change in age structure on a family's consumption is relatively less understood.

The major economic impact of a low fertility rate may be the demographic transition and this results in a change in household consumption. The earlier literature placed emphasis on the relationship between human capital accumulation and fertility choice. [Becker and Lewis \(1973\)](#) and [Becker \*et al.\* \(1990\)](#) claimed that when income increases, parents will choose to substitute the quantity with the quality of children, which has been referred to as the so-called quantity–quality trade-off hypothesis. This human capital-driven mechanism will enable a country to open up possibilities for growth ([Lee and Mason, 2010](#)). In addition, a demographic transition can boost the economy temporarily ([Bloom \*et al.\*, 2001](#)). As income increases with economic growth, household consumption will also increase ([Abeyasinghe and Choy, 2004](#); [Dhakal \*et al.\*, 2009](#); [Akekere and Yousuo, 2012](#); [Ofwona, 2013](#)).

The demographic transition not only affects the accumulation of human capital in an economy but also affects the population structure and consequently brings about a change in the consumption structure. According to the well-cited life-cycle hypothesis of saving and consumption ([Modigliani and Brumberg, 1954](#)), the level of consumption is determined by average expected lifetime income but not the current income. As a result, people possess diverse opportunity costs and demands at different stages of their life. Hence, people's decisions regarding their bundle of goods and services may not be the same at different ages. [Li and Li \(2014\)](#) employed data from 1990 to 2010 in China and used gray correlation analysis to conclude that households with different age structures have diverse structures of consumption; a low fertility rate will increase the demand for young people products and decrease the household's total income and consumption ratio.

Besides those parts of the literature that try to identify the factors that influence consumption, some studies have focused attention on analyzing certain types of household expenditure. For example, some studies have shed light on household health expenditure ([Newhouse, 1977](#); [Hitiris and Posnett, 1992](#); [Matteo and Matteo, 1998](#)). In addition, [Di Matteo \(2005\)](#), using the example of the US and Canada, pointed out that the age distribution, income, and time will affect health expenditure in the private sector. The results of [Di Matteo \(2005\)](#) have also indicated that age distribution and income account for only a small share of the changes in health expenditure, the main factor being the time used, which explains approximately two-thirds of the increase in health expenditure. The health expenditure model, constructed by [Narayan and Narayan \(2008\)](#), illustrates the need to consider environmental factors that have an impact on health expenditure.

From the viewpoint of a family's structure, the number of one-child families resulting from the low fertility rate is increasing. Therefore, parents are willing to meet the child's needs in accordance with the compensation mentality. Furthermore, the low fertility rate underscores the rarity; therefore, parents are willing to use their accumulated savings to give the best living surroundings to their child. Despite the economic downturn, children-related business is still booming. In addition, [Fan \(2009\)](#) indicated that in Taiwan the proportion of recurrent expenses (i.e., food, clothing, education, health care, and transportation & communication) in families with a child or children is higher than in families without them.

### 3. Methodology

#### 3.1. Data and variables

The main purpose of this study is to analyze the influence of the low fertility rate on the structure of household consumption in Taiwan. Therefore, this study uses official county-level panel data for 20 counties and cities over the 1995–2014 period in Taiwan. First, the primary explanatory variable is the fertility rate since there have been many contributions to the literature that seek to prove that the population structure is impacted by the birth rate and it will further bring about changes in the structure of consumption.<sup>5</sup> This study adopts the general fertility rate of women of childbearing age (GFR) instead of the TFR as an explanatory variable to represent the low fertility rate because GFR represents the number of “live births” per 1,000 females of childbearing age between the ages of 15 and 44, but the TFR is an age-adjusted rate because it is based on the assumption that each age group has the same number of women.<sup>6</sup> Therefore, it is believed that GFR can precisely explain the effect of the low fertility rate on consumption behavior in Taiwan.

According to the Keynesian consumption function, consumption is primarily determined by the level of disposable income, and the higher the level of disposable income, the higher the level of consumer spending. Therefore, household income (INCOME) has played an important role in consumption decision making and is considered to be one of the explanatory variables in our empirical model. It is expected that the level of average household income will cause consumption to increase. With regard to the effect of the performance of the economy on household consumption, the unemployment rate (UNEMPLOY) is adopted. In addition, population aging is also a factor that affects household consumption. Changes in the population age structure affect the consumer demand and consumption structure of a country or region. With population becoming more and more critical, the elderly have special consumption requirements and habits. Therefore, the ratio of people over the age of 65 (AGING) is employed to explain how population aging affects household consumption.

Finally, as regards the demand-side factors of consumption theory, consumer activity is concentrated in areas of high population density (DENSITY). In addition, we use population density to represent the level of urbanization, and the more highly urbanized regions might give rise to more consumption. Hence, we expect that population density will have a positive effect on household consumption in the empirical model. The definitions, descriptive statistics and expected signs of all of the variables are listed and described in Table 1. All variables are drawn from various years of the *Report on the Survey of Family Income and Expenditure* published by the DGBAS, Executive Yuan, Taiwan, during 1995–2014.

<sup>5</sup> A detailed discussion on the relationship between the birth rate, population structure and consumption structure is provided in the literature review in this study.

<sup>6</sup> Some counties in Taiwan have offered relatively good subsidy programs to encourage higher fertility rates. However, the GFR is defined as the average live births per 1,000 women of childbearing age (15–44) at the end of the year. Thus, the calculation of the fertility rate has already excluded some people who might move into the counties due to the better subsidy programs provided and who might probably move out later in the same year. Therefore, the estimation bias caused by the subsidy program is mitigated and not as serious as we expected. On this point we would like to thank an anonymous reviewer.

Table 1. Descriptive Statistics and Definitions of Variables

| Variables                       | Definitions  | Mean<br>(S.D.)         | Min<br>(Max.)   | Expected<br>Sign |
|---------------------------------|--|------------------------|-----------------|------------------|
| <i>A. Dependent Variables</i>   |  |                        |                 |                  |
| THC                             | The ratio of total household consumption expenditure to disposable income (%)      | 76.08 (5.04)           | 61.47 (89.18)   |                  |
| FOOD                            | The ratio of food expenditure to disposable income (%)                             | 15.56 (3.13)           | 8.40 (23.14)    |                  |
| RENT                            | The ratio of rent expenditure to disposable income (%)                             | 12.85 (5.02)           | 1.43 (21.68)    |                  |
| HEALTH                          | The ratio of health care expenditure to disposable income (%)                      | 9.34 (2.96)            | 3.21 (17.65)    |                  |
| EDU                             | The ratio of education expenditure to disposable income (%)                        | 7.31 (3.35)            | 0.74 (13.08)    |                  |
| CLOTHING                        | The ratio of clothing expenditure to disposable income (%)                         | 7.26 (6.92)            | 1.81 (24.24)    |                  |
| TRANSCOM                        | The ratio of transportation and communication expenditure to disposable income (%) | 6.72 (3.90)            | 0.11 (14.06)    |                  |
| <i>B. Explanatory Variables</i> |  |                        |                 |                  |
| GFR                             | General fertility rate of childbearing age women (%)                               | 40.76 (11.29)          | 19.68 (73.90)   | +                |
| INCOME                          | Average household income (unit: NT\$10,000)  | 104.08 (21.73)         | 66.06 (168.41)  | +                |
| AGING                           | The ratio of people over the age of 65 (%)   | 10.74 (2.34)           | 5.88 (16.84)    | Uncertain        |
| UNEMPLOY                        | The unemployment rate (%)  | 3.91 (1.10)            | 1.0 (6.0)       | -                |
| DENSITY                         | Population density (people/km <sup>2</sup> )                                       | 1,564.74<br>(2,222.94) | 63.86 (9,942.3) | +                |

Sources: 1. *Report on the Survey of Family Income and Expenditure* published by the Directorate-General of Budget, Accounting and Statistics (DGBAS), Executive Yuan, Taiwan.

2. The website of DGBAS: <http://www.dgbas.gov.tw>.

### 3.2. Model specifications

Panel data analysis was adopted because this paper examines the relationship between fertility and consumption. A major advantage of using the panel data method, as pointed out by Hsiao (1986), is that it can resolve or reduce the magnitude of a key econometric problem that often arises in empirical studies, namely, the omitted (mismeasured, not observed) variables that are correlated with the explanatory variables. Panel data not only possess the dynamic characteristic of time-series data but also include cross-section data and may thereby express different properties between samples. Compared with cross-section data, panel data analysis can observe the dynamic variations in the data which cross-section data cannot. Moreover, panel data also use the fixed-effects model to analyze

the fixed effects of observations and to understand individual characteristics of the sample.<sup>7</sup> By using panel data analysis, this study can reduce the estimation bias of the population parameters. Consequently, if we wish to analyze the long-term determinants of certain observations, the adoption of panel data can result in more correct and conscientious results. It is exactly the purpose that this paper needs.

In addition, this paper adopts panel data for 20 counties and cities in Taiwan from 1995 to 2014.<sup>8</sup> The regional time-invariant characteristics of 20 counties and cities may have different impacts on household consumption. If regional-specific effects are neglected in the regression models, this might lead to biased estimation results.<sup>9</sup> Thus, when we choose an econometric method to conduct a panel data analysis, it is appropriate to use a fixed-effects model that could control for regional-specific diversities in the estimation.

As mentioned above, this study aims to understand the relationship between fertility and consumption. From the relevant empirical literature, we summarize the major potential variables that will affect consumption, and these variables are introduced into the empirical model to estimate their impact on consumption behavior. The advantage of panel data is that, compared with time series or cross-sectional data, such data contain more information and observations. Due to the larger sample size, the use of panel data can increase the number of degrees of freedom and make the estimation more accurate.

According to Fan (2009), household consumption (CONSUM) in Taiwan is influenced by the ratio of women of childbearing age (GFR). In addition, household average income (INCOME), the ratio of people over the age of 65 (AGING), the unemployment rate (UNEMPLOY), population density (DENSITY) and a time trend (TIME) also play a role in the consumption decision making of households.<sup>10</sup> Hence, this paper thus establishes a household consumption function as follows:

$$\text{CONSUM} = f(\text{GFR}, \text{INCOME}, \text{AGING}, \text{UNEMPLOY}, \text{DENSITY}, \text{TIME}). \quad (1)$$

Equation (1) can be further expressed by a fixed-effects regression model presented as Equation (2):

$$\begin{aligned} \text{CONSUM}_{i,t}^k &= \alpha_i + \beta_0 \text{GFR}_{i,t} + \beta_1 \ln \text{INCOME}_{i,t} + \beta_2 \text{AGING}_{i,t} \\ &+ \beta_3 \text{UNEMPLOY}_{i,t} + \beta_4 \ln \text{DENSITY}_{i,t} + \beta_5 \text{TIME}_{i,t} + \varepsilon_{it} \end{aligned} \quad (2)$$

<sup>7</sup>The fixed-effects model assumes that those individual effects are correlated with the regressors. There have been many contributions to the literature to investigate regional issues by means of the fixed-effects model. For example, Islam (1995) used the fixed-effects model to estimate the speed of convergence among regions. In addition, Mohl and Hagen (2010) adopted the fixed-effects model to analyze the growth effects of EU structural funds. In contrast to the fixed-effects model, the random effects model assumes the exogeneity of all regressors and the random individual effects. The Hausman test (Hausman 1978) is often used to choose between the fixed-effects and random-effects model by testing for the correlation between the random effects and the regressors. In this paper, we subsequently use the Hausman test to identify our empirical model.

<sup>8</sup>The 20 counties and cities are Taipei City, New Taipei City, Taoyuan City, Taichung City, Tainan City, Kaohsiung City, Yilan County, Hsinchu County, Hsinchu City, Miaoli County, Changhua County, Nantou County, Yunlin County, Chiayi County, Pingtung County, Taitung County, Hualien County, Penghu County, Keelung City and Chiayi City.

<sup>9</sup>The differences between these counties also include geographical and cultural diversities.

<sup>10</sup>According to Cameron (2005), a time trend allows for a shift in the intercept over time, capturing the time effects, such as technological change, regulations, taxes, etc.



In Equation (2),  $i$  represents the  $i$ th county and  $t$  refers to the  $t$ th year, where  $i = 1, 2, \dots, 20$  and  $t = 1995, 1996, \dots, 2014$ .  $\alpha_i$  is the individual-specific effect and  $\varepsilon_{i,t}$  represents the error term with zero mean and variance  $\sigma^2$ . In addition,  $\beta_j$ , where  $j = 0, 1, 2, \dots, 5$  represents the estimation coefficient. In order to eliminate any fluctuations in prices, all values of variables in this paper are adjusted by the CPI deflator (base year = 2011). It is worth noting that the dependent variable — household consumption (CONSUM) — can be defined as the proportion of a household's total consumption expenditure to disposable income (THC), the proportion of a household's consumption expenditure on food to disposable income (FOOD), the proportion of a household's consumption expenditure on rent to disposable income (RENT), the proportion of a household's consumption expenditure on health care to disposable income (HEALTH), the proportion of a household's consumption expenditure on education to disposable income (EDU), the proportion of a household's consumption expenditure on clothing to disposable income (CLOTHING), and the proportion of a household's consumption expenditure on transportation and communication to disposable income (TRANSCOM). Therefore, in Equation (2),  $k = 1, 2, \dots, 7$ .

#### 4. Estimation Results

Prior to the analysis of the estimation results, it is also necessary to resolve the econometric problem of collinearity between two explanatory variables, if any. This study adopts pair-wise correlation coefficients and the  $R$ -square of the auxiliary regression to deal with this issue. It is shown that none of the pair-wise correlation coefficients is greater than 0.8 and it is thus concluded that no collinearity exists between any two explanatory variables. With regard to the  $R$ -square of the auxiliary regression, this is found to be less than 0.8, implying that there is no collinearity among the explanatory variables. There are seven specifications of Equation (2), each with a different dependent variable, in this study. Therefore, the seven specifications of Equation (2) are estimated and the estimation results are presented in Table 2. According to Table 2, the Hausman tests for all the specifications indicate that the fixed-effects model is better than the random-effects model. This result also implies that the conclusions reached by this study are reliable.<sup>11</sup>

As shown in Table 2, the fertility rate has a significant and negative impact on total household consumption, as well as on food, health care, education, and transportation and communication expenditure. However, it does have a significant and positive impact on clothing expenditure. Since a decrease in the fertility rate means a lower fertility rate, the estimation results imply that a low fertility rate will increase the ratio of a household's total consumption expenditure to disposable income, especially in relation to food, health care, education, and transportation and communication expenditure, but will decrease the ratio of a household's expenditure on clothing to disposable income. The result is consistent with Becker (1960) and Fan (2009), implying that a low fertility rate will lead parents to invest more time and money in each individual child.

<sup>11</sup> The estimated fixed effects of consumption are presented in the appendix of this study.

Household income has a significant and positive influence on rent, education, and transportation and communication expenditure, but has a significant and negative impact on clothing expenditure. As the household income increases, this means that consumption will increase, especially in the form of expenditure on rent, education, and on transportation and communication, but expenditure on clothing will decrease. In addition, the aging index has a significant and positive influence on most kinds of expenditure, but a significant and negative impact on expenditure on clothing. The influence of AGING on the proportion of household income expended on health care and on transportation and communication is greater than that for other consumption categories. This implies that health care and transportation and communication are two most important consumption goods of the elderly.

The unemployment rate has a significant and negative impact on the expenditure on food and rent. The unemployment rate represents economic performance. As the unemployment rate decreases, meaning that the economic performance is better, expenditure on food and rent will increase. In addition, population density has a significant and positive impact on overall household consumption, as well as on the expenditures on food, health care, education, and transportation and communication. However, it has a significant and negative impact on expenditure on clothing. We thus use population density to represent the level of urbanization, and the more highly urbanized regions are found to result in more consumption. Finally, there is a significant and negative time trend for household expenditure as a proportion of consumption as a whole and as a proportion of all kinds of consumption, with the exception of clothing.

According to the empirical results, there are three interesting findings. First, a low fertility rate will increase overall household consumption expenditure, especially on food, health care, education, and transportation and communication. This means that families with fewer children are more prepared to treat their children better. Therefore, the ratio of consumption to disposable income will increase if the fertility rate is low. Second, the two consumption categories affected by AGING the most are health care and transportation and communication, implying that they are the two most important consumption goods for the elderly. As we mentioned earlier, parents will spend more time and more money on their children due to the “compensation mentality”. Similarly, we speculate that elderly people will also treat themselves better. For example, retired people will be more willing to spend more on health care, or will travel more. They will tend to enjoy their retirement by engaging in leisure activities and various forms of entertainment.

Third, a low fertility rate and population aging will lead to a reduction in expenditure on clothing. Similarly, high-income households and urban households will spend less on clothing. We speculate that there are two reasons: (1) According to the *Report on the Survey of Family Income and Expenditure* published by the DGBAS, the proportion for expenditure on clothing in total household consumption in Taiwan has fallen from 7.2 in 1976 to 3.02 in 2014; (2) Engel’s law suggests that the income elasticity of demand for necessities (i.e., food and clothing) is between 0 and 1, and consumers will therefore increase their expenditure on clothing at a rate that is less than proportionate to the increase in their income.

Table 2. The Estimation Results of the Fixed-Effects Models

|                               | MODEL 1             | MODEL 2              | MODEL 3             | MODEL 4             | MODEL 5             | MODEL 6              | MODEL 7              |
|-------------------------------|---------------------|----------------------|---------------------|---------------------|---------------------|----------------------|----------------------|
| <b>Total Household</b>        |                     |                      |                     |                     |                     |                      |                      |
| <b>Consumption</b>            |                     |                      |                     |                     |                     |                      |                      |
| <b>Y = THC</b>                |                     |                      |                     |                     |                     |                      |                      |
| <b>Y = FOOD</b>               |                     |                      |                     |                     |                     |                      |                      |
| <b>Y = RENT</b>               |                     |                      |                     |                     |                     |                      |                      |
| <b>Y = HEALTH</b>             |                     |                      |                     |                     |                     |                      |                      |
| <b>Y = CLOTHING</b>           |                     |                      |                     |                     |                     |                      |                      |
| <b>Y = TRANSCOM</b>           |                     |                      |                     |                     |                     |                      |                      |
| <b>GFR</b>                    | -0.16***<br>(-4.53) | -0.13***<br>(-6.74)  | 0.06<br>(1.11)      | -0.08***<br>(3.91)  | -0.20***<br>(-10.0) | 0.39***<br>(8.06)    | -0.18***<br>(-5.84)  |
| <b>ln (INCOME)</b>            | -39.28<br>(-0.64)   | -4.61<br>(-1.39)     | 28.42***<br>(3.24)  | 0.92<br>(0.19)      | 10.22***<br>(2.96)  | -32.12***<br>(-3.90) | 16.47***<br>(3.10)   |
| <b>AGING</b>                  | 2.43***<br>(5.88)   | 0.79***<br>(3.53)    | 1.64***<br>(2.77)   | 1.90***<br>(5.85)   | 1.15***<br>(4.91)   | -1.77***<br>(-3.18)  | 2.08***<br>(5.79)    |
| <b>UNEMPLOY</b>               | 0.23<br>(1.01)      | -0.25**<br>(-2.01)   | -1.26***<br>(-3.86) | -0.01<br>(-0.08)    | 0.42<br>(0.32)      | 0.13<br>(0.67)       | 0.29<br>(1.48)       |
| <b>ln (DENSITY)</b>           | 120.16***<br>(6.13) | 48.54***<br>(7.03)   | 22.51<br>(1.24)     | 80.02***<br>(80.0)  | 40.69***<br>(5.68)  | -45.80***<br>(-2.68) | 55.95***<br>(5.07)   |
| <b>TIME</b>                   | -0.66***<br>(-6.13) | -0.74***<br>(-12.57) | -0.36**<br>(-2.29)  | -0.75***<br>(-8.70) | -1.06***<br>(-17.3) | 1.84***<br>(12.61)   | -1.23***<br>(-13.21) |
| <b>Observations</b>           | 400                 | 400                  | 400                 | 400                 | 400                 | 400                  | 400                  |
| <b>Adjusted R<sup>2</sup></b> | 0.68                | 0.73                 | 0.28                | 0.88                | 0.66                | 0.67                 | 0.95                 |
| <b>Hausman test</b>           | 7.82*               | 54.35***             | 12.10**             | 14.59**             | 11.16**             | 18.44***             | 17.13***             |
| <b>F-Statistics</b>           | 21.31***            | 15.83***             | 1.76**              | 6.52***             | 5.74***             | 3.29***              | 4.68***              |

Notes: 1. The standard errors are corrected for heteroskedasticity.

2. *t*-values are in parentheses.

3. \*\*\*, \*\* and \* denote significance at the 1%, 5% and 10% levels, respectively.

Finally, most of the literature claims that household consumption will increase with an increase of income. However, the empirical results presented in Table 2 indicate that the findings are insignificant in the case of Taiwan. This implies that, compared to the overall consumption level, the structure of consumption is more sensitive to income. In addition, when income increases, households may prefer to increase their saving by maintaining the previous consumption level. Furthermore, the variance of disposable income (0.0071) is small, meaning that the finding that the relationship between disposable income and consumption is insignificant in our model is quite reasonable.

## 5. Concluding Remarks

In order to explore the relationship between the low fertility rate and consumption behavior, this study uses an official county-level panel data for 20 counties and cities over the 1995–2014 period in Taiwan and estimates seven fixed-effects regressions with different kinds of consumption as the dependent variable.

The major finding of this study is that a low fertility rate will change the consumption behavior in terms of the composition of consumption. As the fertility rate becomes lower, the household's share of consumption spending will increase, especially in relation to food, health care, education and transportation and communication expenditures. In addition, the health and transportation and communication expenditures are mainly affected by AGING, thereby providing a reasonable conclusion due to the fact that they are the two most important consumption goods for the elderly. In addition, it is also found that an increase in household income will result in an increase in the expenditure on rent, education, and transportation and communication, and conversely a decline in the expenditure on clothing. Besides, as the unemployment rate falls, expenditure on food and rent will increase. Finally, by using population density to represent the degree of urbanization, we find that the more highly urbanized regions will give rise to more consumption.

According to the findings of this study, a low fertility rate will result in an increase in household consumption, and this will also be the case in the short run. However, the governments of many industrialized countries are expressing growing concern about the long-term consequences of the currently low fertility rates, including the effect of rapid population aging on pension systems, health systems, intergenerational equity issues, global economic competitiveness, and relative global political and cultural influence. Nevertheless, besides paying more attention to finding measures that can be adopted to maintain or raise the fertility rate, it is worth considering the possible benefits of a lower fertility rate. For example, a low fertility rate implies that women will have a stronger incentive to invest in education for themselves and further devote themselves to the whole of society. In addition, a decline in the fertility rate may enhance each family's investment in both education and health, which will further accelerate the long-term growth of the economy. Nevertheless, the low fertility rate may threaten sustainability due to a decrease in the world's population.

This study proves an important but rarely discussed hypothesis whereby a low fertility rate is able to affect a household's consumption behavior which is very important for a

country’s economic development. Therefore, the government must implement more efficient industrial policies to help industries respond to the impact of a low fertility rate. For example, the industries that focus on infants, adolescents and clothing should abandon their low-cost strategy, and reinforce the ability to engage in research and development in order to improve their product quality. In fact, in addition to Taiwan, many other countries have also undergone a gradual transition from labor-intensive manufacturing to a knowledge-intensive economy and creative industries. These economies will no longer rely on the quantity of population, but the quality of talent in the future. Since each country’s consumption habits are not the same, our findings may not be applicable to all other countries. However, our findings could provide some useful insights for certain economies mostly made up of Chinese people, such as Hong Kong, Macao and Singapore.

Finally, due to the lack of household panel data, this study adopts an aggregated country-level panel dataset that might omit the demographic characteristics of a household and only capture the variables in the aggregated data. This study suggests that as household panel data become available, collecting household and individual level data in studies similar to this one could generate more direct evidence regarding the relationship between the low fertility rate and consumption behavior.

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### Appendix A

Table A.1. The Estimated Fixed Effects of Consumption in 20 Counties/Cities

| Counties/<br>Cities | MODEL 1        | MODEL 2             | MODEL 3             | MODEL 4             | MODEL 5             | MODEL 6           | MODEL 7             |
|---------------------|----------------|---------------------|---------------------|---------------------|---------------------|-------------------|---------------------|
| Keelung City        | 0.68<br>(0.63) | -1.65***<br>(-2.86) | -5.57***<br>(-3.66) | -4.26***<br>(-4.98) | -3.57***<br>(-5.72) | 7.33***<br>(5.07) | -5.50***<br>(-5.81) |
| Taipei City         | 0.25<br>(0.23) | -1.87***<br>(-3.15) | -5.70***<br>(-3.64) | -4.59***<br>(-5.21) | -3.71***<br>(-5.77) | 7.57***<br>(5.08) | -5.75***<br>(-5.89) |
| New Taipei City     | 0.92<br>(0.87) | -1.57***<br>(-2.75) | -5.47***<br>(-3.64) | -4.11***<br>(-4.86) | -3.49***<br>(-5.65) | 7.25***<br>(5.06) | -5.38***<br>(-5.74) |
| Taoyuan City        | 0.96<br>(0.91) | -1.54***<br>(-2.70) | -5.49***<br>(-3.66) | -4.07***<br>(-4.81) | -3.46***<br>(-5.61) | 7.20***<br>(5.04) | -5.34***<br>(-5.70) |

Table A.1. (Continued)

| Counties/<br>Cities | MODEL 1          | MODEL 2             | MODEL 3             | MODEL 4             | MODEL 5             | MODEL 6           | MODEL 7             |
|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|-------------------|---------------------|
| Hsinchu County      | 1.64<br>(1.59)   | -1.26**<br>(-2.26)  | -5.37***<br>(-3.67) | -3.62***<br>(-4.40) | -3.25***<br>(-5.41) | 6.94***<br>(4.98) | -5.04***<br>(-5.52) |
| Hsinchu City        | 0.66<br>(0.61)   | -1.69***<br>(-2.91) | -5.61***<br>(-3.66) | -4.30***<br>(-4.98) | -3.56***<br>(-5.65) | 7.34***<br>(5.03) | -5.50***<br>(-5.76) |
| Miaoli County       | 1.60<br>(1.55)   | -1.26**<br>(-2.28)  | -5.37***<br>(-3.68) | -3.61***<br>(-4.40) | -3.26***<br>(-5.43) | 6.94***<br>(5.00) | -5.05***<br>(-5.56) |
| Taichung City       | 1.10<br>(1.04)   | -1.48***<br>(-2.63) | -5.44***<br>(-3.65) | -3.97***<br>(-4.74) | -3.42***<br>(-5.59) | 7.15***<br>(5.04) | -5.28***<br>(-5.69) |
| Changhua County     | 0.94<br>(0.90)   | -1.49***<br>(-2.64) | -5.51***<br>(-3.69) | -4.03***<br>(-4.79) | -3.45***<br>(-5.61) | 7.15***<br>(5.03) | -5.33***<br>(-5.72) |
| Yunlin County       | 1.20<br>(1.16)   | -1.39**<br>(-2.48)  | -5.46***<br>(-3.70) | -3.82***<br>(-4.61) | -3.36***<br>(-5.55) | 7.03***<br>(5.01) | -5.21***<br>(-5.67) |
| Chiayi County       | 1.59<br>(1.55)   | -1.20**<br>(-2.18)  | -5.38***<br>(-3.70) | -3.60***<br>(-4.40) | -3.27***<br>(-5.48) | 6.91***<br>(4.99) | -5.06***<br>(-5.58) |
| Chiayi City         | 0.47<br>(0.44)   | -1.73***<br>(-2.99) | -5.61***<br>(-3.66) | -4.37***<br>(-5.07) | -3.60***<br>(-5.73) | 7.38***<br>(5.07) | -5.57***<br>(-5.84) |
| Tainan City         | 1.13<br>(1.08)   | -1.44***<br>(-2.56) | -5.45***<br>(-3.67) | -3.93***<br>(-4.70) | -3.41***<br>(-5.60) | 7.13***<br>(5.04) | -5.27***<br>(-5.70) |
| Kaohsiung City      | 1.11<br>(1.06)   | -1.46***<br>(-2.58) | -5.45***<br>(-3.66) | -3.94***<br>(-4.71) | -3.42***<br>(-5.60) | 7.14***<br>(5.04) | -5.28***<br>(-5.69) |
| Pingtung County     | 1.54<br>(1.50)   | -1.26**<br>(-2.29)  | -5.37***<br>(-3.69) | -3.64***<br>(-4.44) | -3.26***<br>(-5.46) | 6.94***<br>(5.01) | -5.07***<br>(-5.59) |
| Yilan County        | 1.82*<br>(1.79)  | -1.17**<br>(-2.13)  | -5.31***<br>(-3.67) | -3.46***<br>(-4.26) | -3.21***<br>(-5.41) | 6.88***<br>(5.00) | -4.97***<br>(-5.51) |
| Hualien County      | 2.46**<br>(2.48) | -0.87<br>(-1.63)    | -5.13***<br>(-3.64) | -3.04***<br>(-3.82) | -3.01***<br>(-5.19) | 6.62***<br>(4.93) | -4.67***<br>(-5.31) |
| Taitung County      | 2.43**<br>(2.46) | -0.86<br>(-1.61)    | -5.11***<br>(-3.64) | -3.01***<br>(-3.81) | -2.99***<br>(-5.19) | 6.57***<br>(4.92) | -4.64***<br>(-5.30) |
| Nantou County       | 2.07**<br>(2.06) | -1.02*<br>(-1.89)   | -5.24***<br>(-3.66) | -3.29***<br>(-4.09) | -3.13***<br>(-5.32) | 6.76***<br>(4.97) | -4.84***<br>(-5.44) |
| Penghu County       | 1.03<br>(0.99)   | -1.46***<br>(-2.59) | -5.52***<br>(-3.72) | -3.94***<br>(-4.71) | -3.42***<br>(-5.60) | 7.11***<br>(5.03) | -5.30***<br>(-5.72) |

Notes: 1. *t*-values are in parentheses.

2. \*\*\*, \*\* and \* denote 1%, 5% and 10% significance levels, respectively.

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