WILL THE HOUSING WEALTH EFFECT COMPENSATE THE MACRO-ECONOMY? EVIDENCE FROM TAIWAN'S DOMESTIC CONSUMPTION

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Abstract. This paper examines the relationship between the escalation in housing prices and categories of Taiwan's domestic consumption. While disposable income remains constant, a rapid escalation in housing prices should have a negative impact on unaffordability within society. However, under the hypothesis of the housing wealth effect, an increase in housing values should compensate the macro-economy by increasing consumption in the GDP calculation. Taiwanese data from 2007Q1 to 2018Q1 were adopted as the sample. From the vector error correction model results, it was found that over the course of the long-run equilibrium relationship, there was a statistically significant positive relationship that the society consumes more on durable goods of communication-related nature, as well as on non-durable goods such as personal clothing and accessories and leisure/cultural tourism. As for the short-run dynamic adjustment, there was a statistically significant positive relationship that the society consumes more in the durable goods component categories. It was identified that transportation-related consumption accounted for the major part of the durable goods component. Therefore, with the rapid escalation in housing prices, it was observed that these consumption would compensate the consumption figures in the GDP calculation in Taiwan, thereby providing evidence that housing prices were related to macroeconomic performance.

Keywords: housing wealth effect, housing prices, GDP, domestic consumption.

Introduction

The purpose of this paper was to provide an empirical analysis on the role of house prices upon determining the consumption behavior in Taiwan. As housing prices escalated rapidly while disposable income has remained constant, the issue of unaffordability arises that is considered to be a negative aspect within society as a whole (Dietz & Haurin, 2003; Rohe & Stegman, 1994). The PIR[1] in Taiwan reached 17.5, being ranked 14th on the Numbeo Property Prices Index for the Country in mid-2018[2]. However, from previous studies, in a region with high rates of homeownership and low loan interest rates, under the hypothesis of a housing wealth effect[3], changes in housing prices should exert an influence on consumption expenditure, which will then further influence the performance of the economy. The reason is that housing by its sheltering nature generates personal

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[1] The price to income ratio is the basic affordability measure for housing in a given area. It is generally the ratio of median house prices to median familial disposable incomes, expressed as a percentage or as years of income.

[2] Numbeo. Property Prices Index for Country 2018 Mid-Year. Retrieved on the 10th October, 2018, from https://www.numbeo.com/property-investment/rankings_by_country.jsp?title=2018-mid

[3] The housing wealth effect is the effect on current consumption of changes in a person's wealth, in particular changes in the prices of owner-occupied houses. Rapid increases in property values may encourage property owners to spend more on current consumption, either out of current disposable income or on credit.

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expenditure[4] that directly and indirectly contributes towards the categories of consumption (Aladangady, 2017; Angrisani et al., 2019; Attanasio et al., 2009; Campbell & Cocco, 2007; Carrol et al., 2011; Case et al., 2005; Chen et al., 2010, 2018; Cooper & Dynan, 2016; Dvornak & Kohler, 2007; Elbourne, 2008; Fereidouni & Tajaddini, 2017; Gan, 2010; Iacoviello & Neri, 2010; Muellbauer & Murphy, 2008; Paiella & Pistaferri, 2017; Simo-Kengne et al., 2013). As consumption is one of the main components in the formula for gross domestic product (GDP)[5], it is considered that the impact of a housing wealth effect on consumption suggests that there exists a strong positive link between the housing market and macroeconomic activity.

The concept on the sense of security, or referred to as the consumer confidence, was strengthened by the increment of housing equity value (Friedman, 1957). The wealth effect reflected the psychological effect from the rising asset values. In the instance of housing market; when an economy was experiencing a booming growth, the housing price would increase along with the booming growth of economic activities. As the value of the housing increases, it tends to influence on homeowners to feel more secure about its wealth and the level of spending behavior. In which, such confidence contributed to higher level of spending, but lower level of saving. This norm would be referred as the housing wealth effect regardless of changes in discretionary income, in both a positive or negative direction. For the most recent housing market cycle in Taiwan, it began from 2003 to the peak around 2013, and then starts to decline slowly from 2014 onwards (Chen, 2011, 2015). A decade of housing market prosperity have made many homeowners gained major increment or even multifold on its housing equity value.

From a culture perspective, it suggested that changing of housing prices in Taiwan was more of a wealth security and investment decision. The nature of housing, besides it provide as a shelter necessity and sense of security, it also generate rental income or/and increment on equity value for homeowners. Therefore, the specific feature of housing incorporated both consumption and investment decisions (Holly & Jones, 1997; Simo-Kengne et al., 2013). In the long history of ethnic Chinese society, it was acknowledged that,"… along with land comes about wealth". The phrase was referred from the Li ji (Book of rites)[6] that dated back

during the Chinese Warring State Period (453–221 BC), which the ideology of land or housing ownership that symbolized wealth was deeply embedded in the ethnic Chinese culture. To the modern period, particularly in Taiwan, as the majority of populations are mostly ethnic Chinese descendants, ownership of land or household was still viewed as a sense of wealth security and social status. As regards, many people in Taiwan strived to own and maintain a housing unit. Also, in general, ethnic Chinese parents with sufficient financial capability would often purchase additional housing units for their offspring. It could also be referred as a sense of wealth security and passing down wealth security and investment in family generations. As effect, the household ownership rates in Taiwan were extreme high in comparison with other countries[7], reaching 78.6% in 1987 and became even higher to 84.23% in 2015[8].

Another generalization that housing purchases in Taiwan was mainly an investment decision due to the consequence of previous defective real estate property and transaction tax laws. Previous defective real estate tax laws and institution granted investors to gain high abnormal returns with little or no costs from the housing market. The household equity value gained major or even multifold increment in a short period of time. In Taipei City, the household equity value increased up to 110% from 2003 to 2016. Moreover, due to the financial crisis in 2008, the central bank lowered the interest rate to react on possible economic recession, which the average loan interest rate of the five state-owned banks fell from 2.24% in 2007 to 1.01% in 2010[9]. As consequence, speculative behaviors were lured into the market and spread uncontrollably. It affected that the housing market in Taiwan to occur three concurrent norms of high price, high ownership, and high vacancy rate (Bourassa & Peng, 2011). These norms, expressed by Shiller[10], during his speech in the 2017 Master Think Bank Forum in Taiwan, were unusual and doubtful to appear concurrently in the housing market (Chuang, 2017). With the amendment of real estate property and transaction tax laws in 2014, property and transactions taxes were constricted, housing transaction began to experience a radical declination (Lin et al., 2019). Yet, the low mortgage rate and institution of base-free loan payment period have contributed on housing price to scuffle between sellers and buyers for over a period of time. It only from mid of 2017,

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[4] Personal expenditures fall under one of the following categories: durable goods, nondurable goods, and services.

[5] The formula GDP $(Y) = C + I + G + (X - M)$ is the sum of consumption (C), investment (I), government spending (G) and net exports $(X - M)$, where C (consumption) is normally the largest GDP component in the economy, consisting of private expenditures in the economy (household final consumption expenditure).

[6] Li ji (The book of rites) is one of the Five Classics of the Confucian canon, which had significant influence on Chinese history and culture. World Digital Library. Retrieved on the 15th August, 2019, from https://www.wdl.org/en/item/11379/

[7] Home Ownership Rate. Retrieved on the 15th August, 2019, from https://tradingeconomics.com/country-list/home-ownership-rate

[8] Homeownership rates are obtained from the 2015 Report on the Housing Status Survey of the Construction and Planning Agency, Ministry of Interior, R.O.C.

[9] The five Taiwanese state-owned banks are the Bank of Taiwan, the Taiwan Cooperative Bank, the Taiwan Land Bank, Hua Nan Bank, and the First Commercial Bank.

[10] Robert. J. Shiller. The 2013 Nobel Prize Laureate in Economic Science. Speech Presentation at the 2017 Master Think Bank Forum in Taiwan. 07/12/2017.

the housing market began to experience a considerable decrease of 20–30% on housing prices.

The empirical consumption model adopted in this paper was motivated by the Life Cycle-Permanent Income Hypothesis (LC-PIH) (Attanasio et al., 2009; Campbell & Cocco, 2007; Chen et al., 2010; Chen & Wang, 2011; Cooper & Dynan, 2016; Dvornak & Kohler, 2007; Fuhrer, 1992; Hall, 1978; Iacoviello, 2004; Miles, 1992). The LC-PIH suggests that consumers will choose current consumption after considering the state of resources available to them over their entire life-time. The LC-PIH serves as the theoretical basis that links the consumption and wealth channels, and implies that the relationship between asset values (wealth) and consumption may be attributable to the direct asset wealth effect. The liquidity constraint[11] (Aladangady, 2017; Aoki et al., 2002; Benito, 2009; Canner et al., 2002; Ebner, 2010) and common factors[12] (Attanasio et al., 2009; Case et al., 2005; Chen & Wang, 2011; Dvornak & Kohler, 2007; Lin et al., 2019) hypotheses should also be taken into account in the empirical analysis.

Many studies have utilized non-durable goods consumption and labor services to describe consumption expenditure. The reason was that the effect of durable goods from housing unit survey tends to disperse in later stage. It would be less significant for a standard macro-economic model since the setting of utility function often requires at a specific moment and the time frame could be divided. Moreover, as the durable goods consumption tends to be limited by the borrowing constraints (Aoki et al., 2004; Iacoviello, 2004, 2005; Monacelli, 2009), there are major differences in the response towards the changes in wealth arising from the consumption of durable goods and non-durable goods. As regards, the durable goods consumption has seldom been explored (Campbell & Cocco, 2007; Carroll et al., 2011; Dvornak & Kohle, 2007; Kishor, 2007; Ludvigson & Steindel, 1999; Palumbo et al., 2006).

In this paper, sub-categories of consumption are also explored in order to examine which specific categories of consumption tend to be influenced by escalating housing prices. Due to the conditions described above, this paper adopts Taiwanese quarterly data from 2007Q1-2018Q1. This paper seeks to examine whether the escalation in housing prices should have, first, no significant relationship with the categories of consumption; second, a positive and significant relationship with specific categories of consumption that would compensate for the increases in housing prices; or, third, a negative and significant relationship with specific categories of consumption that would further intensify the negative impacts of the high housing prices.

The remaining sections of this paper are as follows. Section 1 provides a review of the literature. Section 2 presents the adopted methodology. Section 3 discusses the data and empirical analyses. Finally, the last section concludes and suggests further applications.

1. Literature review

There is a growing body of empirical literature that investigates the relationship between consumption and housing prices. By exploring the wealth effect from a housing perspective, these studies indicate that the relationship between house prices and consumption is found to be theoretically based on the LC-PIH, which refers to a combination of the Life Cycle Theory (Modigliani & Brumberg, 1954) and the Permanent Income Theory (Friedman, 1957). The LC-PIH suggests that consumers choose their current consumption after considering the state of the resources available to them over their entire life-time. Hall (1978) extends the theories to include an explicit description of how consumers estimate expected lifetime resources. According to the asset wealth effect, an increase in an individual's housing wealth or stock wealth will raise his/her life-time wealth, which in turn will lead to an increase in desired consumption. However, as for the housing wealth effect, this will only benefit homeowners, while those who rent housing or families hoping to improve their housing will suffer from the effect. In regions with a high homeownership rate, the housing wealth effect will be more significant (Aladangady, 2017; Attanasio et al., 2009; Campbell & Cocco, 2007; Carrol et al., 2011; Case et al., 2005; Chen et al., 2010, 2018; Cooper & Dynan, 2016; Dvornak & Kohler, 2007; Elbourne, 2008; Fereidouni & Tajaddini, 2017; Gan, 2010; Iacoviello & Neri, 2010; Muellbauer & Murphy, 2008; Paiella & Pistaferri, 2017; Simo-Kengne et al., 2013).

In general, it is often found that significantly positive relationships exist between the aggregate growth of consumption and changes in house prices (Case et al., 2005). Campbell and Cocco (2007) compared individuals who owned homes across different age groups, and found that homeowners benefited from the rising housing prices. The interpretation of this result supports the hypothesis of the wealth effect because homeowners are more likely to benefit from increasing housing prices, particularly elderly homeowners who are likely to have higher home values. Angrisani et al. (2019) found the marginal propensity to consume out of an unexpected housing wealth change to be 6 cents per dollar among older American households. As for homeowners, if housing prices do have an impact on consumption, then individuals should respond to increases in their housing wealth by either saving less or borrowing more. This form of borrowing accounts for a larger proportion of household debt, and is generally available on more favorable terms, which suggests a natural

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[11] The liquidity constraint is a form of imperfection in the capital market which imposes a limit on the amount an individual can borrow, or brings about an alteration in the interest rate they pay. As houses serve as collateral for loans, it is related to the mortgage rate and mortgage amount limit.

[12] The common factor hypothesis is one possible explanation for the housing wealth effect. Under this hypothesis, shocks to a common unobservable factor, such as expected future income, simultaneously affect both house prices and non-housing consumption.

ordering of borrowing, where the majority of household debt is secured on the housing equity value (Disney et al., 2002). Existing studies on the mortgage equity withdrawal decision focus on the role of the life cycle or consumption and financial motives, such as remortgaging to take advantage of lower interest rates. It allows homeowners to obtain loans and engage in consumption without realizing profits from actual housing transactions (Aoki et al., 2002; Benito, 2009; Canner et al., 2002; Ebner, 2010).

In theory, there are a few explanations as to why housing wealth gives rise to a smaller wealth effect than stock wealth. First of all, in comparison with stock assets, the liquidity of housing assets is much lower than that of stock assets, and a longer period of time and more procedures are required to realize the incremental part of the household equity value (Case et al., 2005; Dvornak & Kohler, 2007). Secondly, housing serves as an asset as well as providing housing services for households. When housing prices rise, the housing wealth of homeowners will also increase. At the same time, the cost of housing services will also increase (Poterba, 2000). By referring to Buiter's model (2007), it claimed that the increase in housing prices leads to higher housing consumption costs, and results in an offset on the wealth effect of non-housing consumption. In other words, housing wealth is not real wealth. Similarly, from the results of their model, Sinai and Souleles (2005) discovered that for homeowners that live in the same house for a long period of time, the housing provides a perfect hedge for the fluctuations in rental and housing prices. Despite the magnitude of these fluctuations, changes in housing prices do not give rise to any real wealth effect on non-housing consumption.

Moreover, as housing assets are mortgaged or remortgaged as collateral, if the previous home equity loan limitation is relaxed due to the increase in the housing price, then it is possible that it will influence non-housing consumption (Aladangady, 2017). Thirdly, the redistribution effect between homeowners and non-homeowners might greatly offset the housing wealth effect on consumption. Sinai and Souleles (2005) claimed that the increase in housing wealth in relation to various characteristics of the household would have a greater influence on the redistribution effect than on consumption. Thus, an increase in housing prices will not increase the consumption ability of the homeowner. Instead, the consumption expenditures of renters and possible home buyers might need to be regulated or even reduced.

However, Attanasio et al. (2009) found that house prices are incapable of explaining consumption, and in any case have the same impact on consumption across age groups and homeownership status groups. These findings do not lend support to the hypothesis of a wealth effect but instead favor the common factor hypothesis. In addition, the effect of the growth of housing prices on consumption does differ across age groups, but it is the young group that benefits the most, a result that is contrary to the wealth hypothesis. In concluding, these au-

thors claimed that the co-movement of housing prices and consumption is likely to be caused by productivity growth, and that the longer life horizon of the young group will lead them to consume relatively more as a result of the increasing housing prices. The impact of housing prices is either not explicitly considered or is based on a measure of realized house price gains. Having home equity is necessary to be able to access the living space. But if households compromised the investment motive at the initial house purchasing stage, then it is not just actual changes in house prices that should matter, but also individual expectations regarding to future house price movements.

In giving consideration to Chinese ethnic regions, Gan (2010) applied a large panel dataset that tracked the housing wealth and credit card spending of 12,793 individuals in Hong Kong to study the relationship between housing wealth and household consumption. His study identified a significant effect of housing wealth on consumption, and found that a pure wealth effect could explain only part of the sensitivity whereby households with multiple houses have much stronger consumption responses. In regard to China, Chen et al. (2009) demonstrated that there was a unique long-run cointegration relationship between household consumption, disposable income, financial wealth and housing wealth in urban China. Moreover, they identified housing wealth as being the only factor that would restore the long-run equilibrium relationship when the cointegrated system was disturbed by an external shock. Based on their own findings, Yang et al. (2018) discovered that the sustained increase in household wealth and the housing-ownership rate in China were accompanied by a decrease in the consumption rate. Chen et al. (2018) evaluated the longitudinal data from the China Family Panel Studies (CFPS) survey, and finds that the housing wealth effect on household consumption in China is much larger than has been shown for developed economies.

In Taiwan, Hsueh (2000) tested the relationship between the housing price, tenure choice and saving behavior in Taiwan. The empirical results indicated that the increase of housing prices may result from different behavioral motives. In terms of one behavioral motive, the increase in housing prices with respect to income seemed to be the cause of the wealth effect and a lower savings ratio. Chen et al. (2010) investigated the impacts of house prices on aggregate consumption. Their finding indicated that the change in durable consumption in response to changes in house prices was positive and statistically significant. The response became more pronounced when the collateral constraint was bounded. However, in relatively sharp contrast, Chen and Wang (2011) investigated household consumption and other influences through both the prices of stocks and housing prices. The results indicated that household consumption tends to rise with an increase in stock wealth, particularly among the middle-aged or elderly, whereas the changes in housing prices do not have a significant influence on the total household consumption.

Nevertheless, the influence on the total consumption of different groups has a significant distribution effect, and the rise in housing prices has a significant negative distribution effect on the younger group and house renting group.

Peltonen et al. (2012) analyzed the relationship between consumption and several wealth components for a panel of 14 of the main emerging economies. In regard to the housing wealth effect, the results were not found to be statistically significant in terms of there being a housing wealth effect on consumption in China and Taiwan, but they were statistically significant for Hong Kong and Singapore. However, consumption in all Chinese ethnic regions was responsive to the changes in equity prices in both the short run and long run. Lin et al. (2019) claimed that in Taiwan, the rising house prices had a negative effect on consumption. The finding indicated that high housing prices trigger the crowding-out effect on consumption and in turn contribute to sluggish economic growth.

As the theoretical effect of changes in housing prices on consumption expenditure appears to be undetermined, the relationship between house prices and consumption should be investigated empirically. For previous studies on analyzing the hypothesis of housing wealth effect, often two paths of consumption data will be obtained. One is through survey data that collected by individual or housing survey data published by government or institutions. The other path is the general aggregate domestic consumption expenditure figures that published by the statistical bureau of the government. For the former path, the collection of survey data would have substantial difficulty for individual to perform, and published hosing survey data are often outdated. For this paper, the latter path was applied, which the general aggregate domestic consumption figures were obtained to examine with the changing of housing price. In which, variables such as age groups, homeownership status groups, mortgage (or home equity) were not in consideration in this paper.

2. Methodology

2.1. Empirical model

Housing wealth is influenced by the liquidity constraint, and the common factor hypothesis. As for the liquidity constraint, by considering the dual characteristics of housing, it provides residential services and also serves as collateral for a mortgage. The collateral constraint is bounded when the level of household net worth is lower. Furthermore, due to rising of disposable income and/or housing prices, the effect will reduce the collateral constraint and increase consumption.

As regards to the common factor hypothesis, this suggests that a high degree of relationship between housing wealth and consumption might be influenced by other unobserved macroeconomic factors. For example, expectation on the increase of future income might increase the desire to acquire more housing equity. Simultaneously, in-

crease in housing equity demand would increase housing prices, which bring along the increase of consumption. Therefore, observation on the relationship between asset wealth and consumption expenditure would become positively related (Attanasio & Weber, 1994; Calomiris et al., 2013; Campbell & Mankiw, 1990). Furthermore, Calomiris et al. (2013) emphasized that by setting the same period of disposable income, housing wealth, and stock; it would cause endogeneity problem and led to inconsistent estimate. By taking all the above into consideration, the empirical model of the micro-variable consumption function that we adopt is represented by the following equation:

$$\Delta \ln ct = f\left(\Delta \ln HWt, \Delta \ln SWt, \Delta \ln yt, rt\right). \qquad (1)$$

The ct notation refers to consumption per capita in period t. It can be expressed for each of the main categories or sub-categories of consumption. The rt notation refers to the average loan interest rate in period t and yt to disposable income per capita in period t. HWt is the housing index in period t. SWt refers to the Taiwan Stock Exchange Weighted Index in period t. By collecting and processing these data, we are able to examine the relationship between the main categories and sub-categories of consumption, disposable income, the average loan interest rate, housing wealth, and stock wealth.

2.2. Vector error correction model (VECM)

This paper uses time series analysis to test the interaction between consumption and economic factors that are incorporated with the hypotheses of the wealth effect, liquidity constraint, and common-factors. The specific aim is to generalize univariate methods while considering a multivariate system of equations. We seek to understand the interrelationships among economic variables in the formulation of a more structured economic model.

Since most of the overall economic changes are related to non-stationary time series, before constructing the vector error correction model, a unit root test must be performed on the research variables to determine whether these time series are stationary. If the test results are non-stationary, the method then commonly used is to eliminate the non-stationary condition by taking the first-level differences, but it may eliminate the long-run equilibrium information implied by the data themselves, and only the short-run information is retained, resulting in an excessive difference problem in the regression model. In such circumstances, it is preferable to use the Johansen cointegration test method to confirm whether there exists a long-run equilibrium relationship between the variables. If there is such a cointegration relationship, then the vector error correction model must be used in the analysis. The advantage of this model is that it includes a short-run adjustment and long-run equilibrium relationship, whereby the dynamic relationship between the variables can be better described. According to the above steps, such a relationship will determine whether the hypotheses of the

wealth effect, liquidity constraint, and common-factors are accepted or not, and whether the consumption behavior under an escalation in housing prices will be affected. Since the unit root, optimum lag orders, and Johansen cointegration test, have been widely adopted; this paper does not describe them in detail. Our focus is mostly on the Vector Error Correction Model (VECM).

The original vector autoregression model (VAR) does not take the cointegration relationships into account. If the variable system has a unit root $I(1)$ in sequences and there is no cointegration relationship, then the differential VAR model can be used. However, if there is a cointegration relationship, the differential VAR model ignores the long-run equilibrium relationship, and the cointegration error term must be added to form a vector error correction model. The vector error correction model can fully describe the dynamic adjustment process between the time series in the system by considering the long-run information contained in the error correction term (ECT) and the difference variable term representing the short-run dynamics. According to the "Granger representation theorem" proposed by Engle and Granger (1987), the cointegration and error correction models provide the mutually sufficient and necessary conditions, in that the error correction model can be used to describe the long-run and short-run dynamic adjustment processes between the variables. When an exogenous impact occurs, a short-run imbalance occurs between the variables, which are adjusted by the vector error correction model, and the short-run imbalance gradually adjusts to the long-run equilibrium state through the error correction term.

The regression equation for the VECM is as follows:

$$\Delta X_t = \alpha_0 + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{i-1} + \alpha \beta' X_{t-1} + \varepsilon_t, \qquad (2)$$

where: Δ represents the first level difference; X_t is an $m \times 1$ random vector time series; $\Gamma_1, \Gamma_2, \ldots, \Gamma_{p-1}$ is an $m \times m$ parameter matrix, where p represents the optimal lag period; α and β are both $m \times r$ matrice, where α is the loading matrix of the cointegration relationship. If the absolute value of each element becomes larger, it means that the adjustment to the equilibrium level takes place more rapidly in the unbalanced condition, and is referred to as the adjustment coefficient matrix. β refers to the cointegration matrix of the long-run equilibrium relationship. It allows the non-stationary random vector X_{t-1} to pass the linear combination $\beta' X_{t-1}$ to become a stationary series, and ε_t is the error term vector.

3. Data and sample statistics description

3.1. Data

For previous studies on analyzing the hypothesis of housing wealth effect, often two paths of consumption data will be obtained. One is through survey data that collected by individual or housing survey data published by government or institutions. The other path is the general aggregate domestic consumption expenditure figures that published by the statistical bureau of the government. For

this paper, the latter path was applied, which the general aggregate domestic consumption figures were obtained to examine with the changing of housing price.

The data used in this paper include the main categories and sub-categories of consumption, disposable income, the average loan interest rate from five banks, the housing index, and the stock index. The source for the data on the main categories and sub-categories of consumption, disposable income, and the stock index is the data archive of the Taiwan Economic Journal Database (TEJ). The average loan interest rate for the five banks is extracted from the publicly-available data provided by the Central Bank of the Republic of China (Taiwan), and the housing index is extracted from the Sinyi Residential Property Prices Index compiled by Sinyi Realty[13].

For consumption data, this paper considers the influence of the wealth effect and liquidity constraint on consumption. The consumption categories are divided into the main categories of consumption (total consumption, durable goods consumption[14], and non-durable goods consumption[15]) and sub-categories of consumption (1. durable goods consumption: furniture and housing appliances purchase and maintenance, transportation, and communication; and 2. non-durable goods consumption: housing services and utilities, clothing and accessories, food and non-alcoholic beverages, alcoholic beverages and cigarettes, leisure/cultural tourism, restaurants and hotels, medical and insurance, and other). Afterwards, the figure is then divided by the population in that year to obtain a per capita figure.

Definition of disposable income is total income less all non-consumption expenditures, which is equivalent to the net pay for the income. The figure is then divided by the population in that year to obtain the per capita figure. Definition of average loan interest rate for the five banks is extracted from the publicly-available data provided by the Central Bank of the Republic of China (Taiwan) Definition of the Taiwan Housing Index is the Sinyi Residential Property Prices Index is formulated by the Sinyi Research Center for Real Estate. The calculation is based on the transaction prices of completed and pre-owned houses. The base year is set at 2001 = 100. The data for the Taiwan Stock Exchange Weighted Index (TAIEX) are published by the Taiwan Stock Exchange Corporation. For the main categories of consumption, samples of quarterly figures from 2007Q1 to 2018Q1 are extracted. A total of 45 observations are extracted from the data sources. Details of the data sources are shown in Table 1.

Taiwanese data are adopted in this paper. The reason is that the current housing environment in Taiwan corre-

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[13] The Housing Price Indicator is measured in index points and is calculated on a quarterly basis by Sinyi Realty Inc.

[14] From the Report on National Income and Production of the US Bureau of Economic Analysis, the definition of durable goods consumption is the sum of furniture, household equipment and appliances, transportation and communication expenditures.

[15] Non-durable goods consumption is all personal consumption less durable goods consumption.

sponds to the prerequisite conditions for conducting such a study, which include, first, a rapid escalation in housing prices within a relatively short period of time; second, a high homeownership rate and low mortgage rate within the region; and, third, a society that as a whole is affected by the negative impacts of high housing prices. Following descriptive statistical and empirical analyses have been conducted.

3.2. Descriptive statistical analysis

Tables 2 and 3 present the descriptive statistics of the series that include the mean, medium, maximum value,

minimum value, standard deviation, skewness, kurtosis, Jarque-Bera normality test and the number of observations. We also provide a descriptive analysis of the main categories of consumption in Table 2 and Figures 1, 2, 3, and 4. The results also show that the skewness statistics for most of the series are significantly skewed. Furthermore, except in the case of the average interest rate (RI) and stock index (SI), the kurtosis statistics are less than three and the Jarque-Bera statistics reject the null hypothesis showing that the rest of the series are light-tailed and not normally distributed.

Table 1. Main and sub-categories of consumption: variable data sources (source: Taiwan Economic Journal Database (TEJ), Central Bank of the Republic of China (Taiwan), Sinyi Research Center for Real Estate)

Abbreviation	Variables	Data source
(A) Main-categories of consumption and other variable data		
TCPP	Total consumption per capita	TEJ
DCPP	Durable goods consumption per capita	TEJ
NDCPP	Non-durable goods consumption per capita	TEJ
DIPP	Disposable income per capita	TEJ
RI	Average loan interest rate	Central Bank
HI	Housing index	Sinyi Realty
SI	Stock index	TEJ
(B) Sub-categories of durable goods consumption		
FHAMPP	Furniture and home appliances Maintenance per capita	TEJ
TRSPP	Transportation per capita	TEJ
CPP	Communication per capita	TEJ
(C) Sub-categories of non-durable goods consumption		
HSUPP	Housing service and utilities per capita	TEJ
CAPP	Clothing and accessories per capita	TEJ
FNABPP	Food and non-alcoholic beverages per capita	TEJ
ABCPP	Alcoholic beverages and cigarettes per capita	TEJ
LCTPP	Leisure/Cultural tourism per capita	TEJ
RHPP	Restaurants and hotels per capita	TEJ
MIPP	Medical and insurance per capita	TEJ
OPP	Other per capita	TEJ

Table 2. Descriptive statistics for main categories of consumption, and disposable income, the average interest rate and housing and stock indexes

	TCPP	DCPP	NDCPP	DIPP	RI	HI	SI
Mean	113136.28	18255.37	94881.02	138742.28	1.47513	233.156	8310.912
Median	113113	18771	94077	135507	1.3838	244.19	8377.9
Maximum	131317	20863	111130	167838	2.7332	297.78	11103.79
Minimum	95514	14945	79126	112046	1.0096	151.72	4247.97
Std. Dev.	9638.52	1667.76	8242.01	15325.66	0.5173	53.57	1330.24
Skewness	0.0784	−0.4506	0.1639	0.1283	1.4209	−0.3521	−0.6502
Kurtosis	1.9115	1.9013	2.0768	1.8641	3.6678	1.5031	4.4038
Jarque-Bera	2.2673	3.7866	1.7994	2.5425	15.9789	5.1315	6.8661

Notes: 1. Currency unit: NTD for TCPP, DCPP, NDCPP, and DIPP; 2. The Jarque-Bera test statistic, $JB = N \left(6^{-1}S^2 + 4^{-1}(K-3)^2 \right)$, where S denotes the skewness and K represents the kurtosis, was proposed by Jarque and Bera (1987) to test the normality of a series. The null hypothesis H_0: $JB = 0$ indicates that the series is normally distributed, whereas H_1: $JB > 0$ rejects the null hypothesis of a normal distribution.
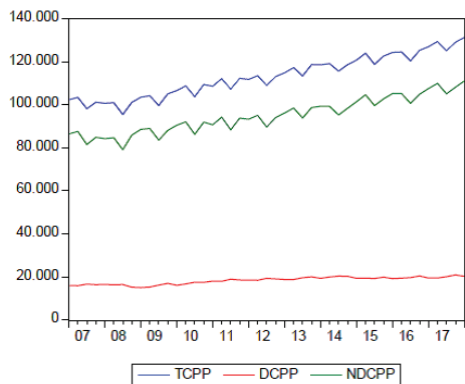
Figure 1. Main categories of consumption
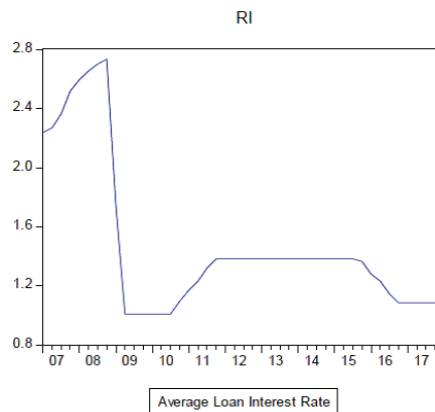

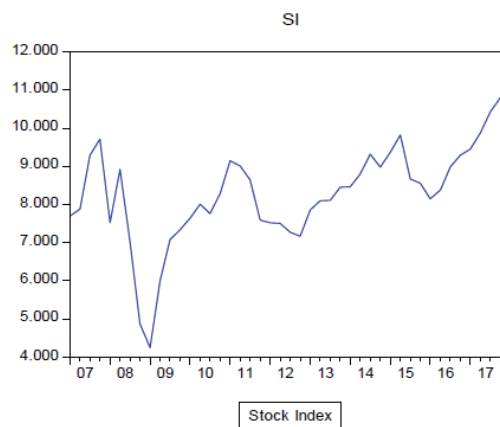Figure 2. Average loan interest rate

Figure 3. Housing index

Figure 4. Stock index

Table 3. Descriptive statistics for sub-categories of durable goods and non-durable goods consumption

	Sub-categories of durable goods consumption		
	FHAMPP	TRSPP	CPP
Mean	4292.289	10741.71	3221.28
Median	4252.00	11202.00	3234.00
Maximum	4978.00	12537.00	3520.00
Minimum	3823.00	8075.00	2928.00
Std. Dev.	281.7565	1312.87	174.0147
Skewness	0.5318	−0.4771	0.0593
Kurtosis	2.6185	1.9443	1.7224
Jarque-Bera	2.3942	3.7968	3.0869

	Sub-categories of non-durable goods consumption							
	HSUPP	CAPP	FNABPP	ABCPP	LCTPP	RHPP	MIPP	OPP
Mean	15548.16	3854.22	12054.27	2079.68	7445.97	7128.64	3581.55	13452.16
Median	15450.00	3813.00	11952.00	2076.00	7396.00	7251.00	3522.00	12721.00
Maximum	17327.00	4731.00	14761.00	2589.00	8461.00	8844.00	4268.00	17156.00
Minimum	13713.00	3357.00	10028.00	1808.00	6430.00	5325.00	3147.00	11137.00
Std. Dev.	947.6807	328.01	1510.93	158.6374	477.1902	1085.68	288.1142	1668.72
Skewness	0.0130	0.5524	0.2677	1.1096	0.0171	−0.2015	0.3666	0.8726
Kurtosis	1.9369	2.7452	1.7129	5.5157	2.2070	1.7009	2.2606	2.6447
Jarque-Bera	2.1201	2.4109	3.6436	21.1021	1.1810	3.4687	2.0332	5.9476

Notes: 1. Currency unit: New Taiwan Dollar (NTD); 2. The Jarque-Bera test statistic, $JB = N\,(6^{-1}S^2 + 4^{-1}\,(K-3)^2)$, where S is the skewness and K represents the kurtosis, was proposed by Jarque and Bera (1987) to test the normality of a series. The null hypothesis H_0: JB = 0 indicates that the series is normally distributed whereas H_1: JB > 0 rejects the null hypothesis of a normal distribution.

A descriptive analysis of the sub-categories of durable goods consumption and non-durable goods consumption is provided in Table 3 and Figures 5 and 6, with the results showing that the skewness statistics for most of the series are significantly skewed. Except for ABCPP that is fat-tailed, the kurtosis statistics show that the rest of the series are light-tailed. The Jarque-Bera statistic rejects the null hypothesis, which is that all of the series are not normally distributed.

4. Empirical results and discussion

4.1. Unit root test results

The traditional regression model assumes that the time series data are stationary, and thus non-stationary data will result in spurious regression. In this paper, the seasonality of the data is adjusted from an OLS regression that includes the intercept, time trend, time trend squared, and a seasonal dummy variable. The results obtained from the
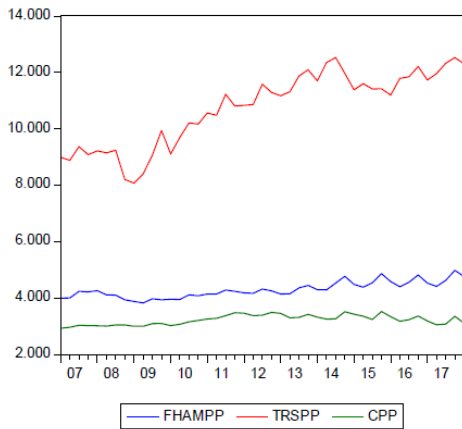
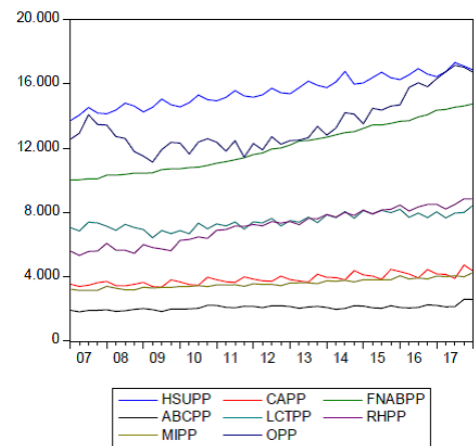Figure 5. Sub-categories of durable goods consumption

Figure 6. Sub-categories of non-durable goods consumption

Table 4. Test for unit roots

Unit root tests	ADF		PP		KPSS	
	Level	First difference	Level	First difference	Level	First difference
1. Main categories of consumption and data variables						
TCPP	−0.6024	−2.9169*	−0.3183	−16.7662***	0.8362***	0.2752
DCPP	−0.8725	−7.2601***	−1.0916	−8.6794***	0.7516***	0.5000**
NDCPP	−0.7881	−3.4205**	−0.9312	−18.2221***	0.8352***	0.1810
DIPP	−0.5949	−5.2215***	−0.7734	−9.2287***	0.7992***	0.2183
RI	−2.5080	−3.5129**	−2.1317	−5.5220***	0.0803***	0.0769
HI	−1.9047	−2.8638*	−1.7281	−4.0586***	0.7597***	0.4277*
SI	−3.0417**	−5.3072***	−2.3800	−6.5210***	0.4649**	0.1323
2. Sub-categories of durable goods consumption						
FHAMPP	−0.6945	−3.5862**	−1.2439	−9.5896***	0.7548***	0.1783
TRSPP	−0.9862	−7.2692***	−1.1137	−8.2081***	0.7357**	0.1627
CPP	−1.6337	−1.9724	−2.5064	−8.0755***	0.4507*	0.3558*
3. Sub-categories of non-durable goods consumption						
HSUPP	−1.2878	−17.0166***	−1.7668	−12.5996***	0.8636***	0.4678**
CAPP	0.1025	−20.2143***	−3.3992**	−30.1738***	0.8327***	0.1240
FNABPP	0.2813	−8.0548***	0.3557	−8.0272***	0.8555***	0.1752
ABCPP	−0.6087	−2.6509*	−1.2713	−8.6257***	0.7806***	0.2318
LCTPP	−0.4999	−2.5278	−2.5959	−17.0497***	0.7445***	0.1881
RHPP	−3.2512**	−2.4181	−0.7894	−15.5552***	0.8216***	0.1420
MIPP	0.2539	−12.7848***	0.4778	−21.8698***	0.8611***	0.3988*
OPP	0.3132	−4.4421***	−0.4881	−8.9434***	0.6119**	0.2687

Note: *, ** and *** denote statistical significance at the 10%, 5%, and 1% significance levels.

consumption data are time-related with seasonality. By taking logarithms and differencing all of the data, seasonal adjustments are made to the log values of the consumption data. Unit root tests are conducted for levels and first differences for each of the series. Furthermore, ADF, PP and KPSS tests are adopted to examine the existence of a unit root in the series. The series will be $I(0)$ if it is level stationary and $I(1)$ if it is stationary for the first difference.

The null hypothesis for the AFD test and PP test is that the series contains a unit root at a certain significance level. From Table 4, the results of the ADF test indicate a failure to reject the null hypothesis in levels except for SI and RHPP, but the stationary series for the first differences of all variables except for CPP, LCTPP, and RHPP are accepted. As for the PP test, the results indicate a failure to reject the null hypothesis in levels except for CAPP, but the stationary series for the first differences of all variables are accepted. In the case of the KPSS test, the null hypothesis is that the series will be stationary around a deterministic trend and the alternative hypothesis is that the series will be difference stationary. The results of the KPSS test match most of the results of the ADF and PP tests.

4.2. Test for cointegration

The unit root test results indicate that all series are $I(1)$ stationary time series. Then, the cointegration ranks are estimated by adopting the Johansen methodology (Johansen, 1988, 1991; Johansen & Juselius, 1990). The Johansen approach derives two likelihood estimators for the cointegration rank that are based on a trace test and a maximum eigenvalue test. The rank can be formally tested with the trace and the maximum eigenvalue statistics. The information criterions are often used as a guide of model selection to find a balance between measure of goodness of fit and parisimonious specification of the model. For this paper, SIC (Schwarz Bayesian Criterion) is used to determine the optimal lag to ensure that the residue is due to the white noise series. The trace statistic either rejects the null hypothesis of no cointegration among the variables or does not reject the null hypothesis. The maximum eigenvalue statistic tests the null hypothesis of r cointegrating relations against the alternative. We start by testing H0: $r = 0$. If it is rejected, we repeat the process for H0: $r = 1$, and continue to repeat it. When a test is not rejected, we stop testing and the value of r will be the commonly adopted estimate of the number of cointegrating relations.

The results in Tables 5, 6, and 7 all show that the null hypothesis of no cointegration is rejected against the alternative of a cointegrating relationship in the model. In other words, there are cointegrating relationships between the variables for all data series of the main categories and sub-categories of consumption. The long-run equilibrium relationship between the variables is statistically significant. In addition, the results indicate that there is a linear relationship included in between the variables. Under the hypotheses of the housing wealth effect, liquidity constraint, and common factors, such a linear relationship

Table 5. Johansen test for cointegration for main categories of consumption

Trace test			Maximum eigenvalue test		
Hypothesized No. of CE(s)	Trace statistic	0.05 critical value	Hypothesized No. of CE(s)	Max-eigen statistic	0.05 critical value
(A) Total consumption per capita (TCPP)					
None *	110.6089	69.81889	None *	55.27031	33.87687
At most 1 *	55.33855	47.85613	At most 1 *	32.96198	27.58434
At most 2	22.37658	29.79707	At most 2	15.52726	21.13162
At most 3	6.849319	15.49471	At most 3	5.589800	14.26460
At most 4	1.259520	3.841466	At most 4	1.259520	3.841466
(B) Durable goods consumption per capita (DCPP)					
None *	104.5120	69.81889	None *	52.12579	33.87687
At most 1 *	52.38619	47.85613	At most 1 *	27.63145	27.58434
At most 2 *	24.75474	29.79707	At most 2 *	12.44412	21.13162
At most 3	12.31062	15.49471	At most 3	8.246838	14.26460
At most 4 *	4.063780	3.841466	At most 4 *	4.063780	3.841466
(C) Non-durable goods consumption per capita (NDCPP)					
None *	109.8603	69.81889	None *	53.24256	33.87687
At most 1 *	56.61775	47.85613	At most 1 *	31.55823	27.58434
At most 2	25.05952	29.79707	At most 2	16.48318	21.13162
At most 3	8.576339	15.49471	At most 3	6.515963	14.26460
At most 4	2.060375	3.841466	At most 4	2.060375	3.841466

Notes: 1. The Trace test and Max-eigenvalue test point to two cointegrating eqn(s) at the 0.05 level for TCPP and NDCPP, and three cointegrating eqn(s) at the 0.05 level for DCPP; 2. *denotes rejection of the hypothesis at the 0.05 level; 3. **MacKinnon-Haug-Michelis (1999) p-values.

Table 6. Johansen test for cointegration on sub-categories of durable goods consumption

Trace test			Maximum eigenvalue test		
Hypothesized No. of CE(s)	Trace statistic	0.05 critical value	Hypothesized No. of CE(s)	Max-eigen statistic	0.05 critical value
(A) Furniture and home appliance maintenance per capita (FHAMPP)					
None *	110.8333	69.81889	None *	53.37960	33.87687
At most 1 *	57.45368	47.85613	At most 1 *	31.14771	27.58434
At most 2	26.30597	29.79707	At most 2	16.58056	21.13162
At most 3	9.725413	15.49471	At most 3	7.109425	14.26460
At most 4	2.615988	3.841466	At most 4	2.615988	3.841466
(B) Transportation per capita (TRSPP)					
None *	107.2627	69.81889	None *	51.18704	33.87687
At most 1 *	56.07565	47.85613	At most 1 *	28.05421	27.58434
At most 2 *	28.02144	29.79707	At most 2 *	14.57744	21.13162
At most 3	13.44400	15.49471	At most 3	9.222787	14.26460
At most 4 *	4.221210	3.841466	At most 4 *	4.221210	3.841466
(C) Communication per capita (CPP)					
None *	105.2810	69.81889	None *	53.53329	33.87687
At most 1 *	51.74769	47.85613	At most 1 *	30.62155	27.58434
At most 2	21.12614	29.79707	At most 2	12.64630	21.13162
At most 3	8.479835	15.49471	At most 3	7.055601	14.26460
At most 4	1.424235	3.841466	At most 4	1.424235	3.841466

Notes: 1. The Trace test and Max-eigenvalue test point to two cointegrating eqn (s) at the 0.05 level for FHAMPP and CPP, and to three cointegrating eqn(s) at the 0.05 level for TRSPP; 2. * denotes rejection of the hypothesis at the 0.05 level; 3. **MacKinnon-Haug-Michelis (1999) p-values.

Table 7. Johansen test for cointegration on sub-categories of non-durable goods consumption

Trace test			Maximum eigenvalue test		
Hypothesized No. of CE(s)	Trace statistic	0.05 critical value	Hypothesized No. of CE(s)	Max-eigen statistic	0.05 critical value
(A) Housing services and utilities per capita (HSUPP)					
None *	103.1267	69.81889	None *	50.64745	33.87687
At most 1 *	52.47929	47.85613	At most 1 *	31.22215	27.58434
At most 2	21.25713	29.79707	At most 2	15.78990	21.13162
At most 3	5.467233	15.49471	At most 3	5.138903	14.26460
At most 4	0.328330	3.841466	At most 4	0.328330	3.841466
(B) Clothing and accessories per capita (CAPP)					
None *	95.73034	69.81889	None *	46.99889	33.87687
At most 1 *	48.73145	47.85613	At most 1 *	28.39688	27.58434
At most 2	20.33457	29.79707	At most 2	14.12120	21.13162
At most 3	6.213372	15.49471	At most 3	5.119216	14.26460
At most 4	1.094157	3.841466	At most 4	1.094157	3.841466
(C) Food and non-alcoholic beverages per capita (FNABPP)					
None *	119.6521	69.81889	None *	50.89899	33.87687
At most 1 *	68.75306	47.85613	At most 1 *	37.07650	27.58434
At most 2	31.67655	29.79707	At most 2	18.93933	21.13162
At most 3	12.73722	15.49471	At most 3	8.872254	14.26460
At most 4 *	3.864970	3.841466	At most 4 *	3.864970	3.841466

Trace test			Maximum eigenvalue test		
Hypothesized No. of CE(s)	Trace statistic	0.05 critical value	Hypothesized No. of CE(s)	Max-eigen statistic	0.05 critical value
(D) Alcoholic beverages and cigarettes per capita (ABCPP)					
None *	113.1602	69.81889	None *	48.99732	33.87687
At most 1 *	64.16287	47.85613	At most 1 *	30.91414	27.58434
At most 2	33.24873	29.79707	At most 2	18.90013	21.13162
At most 3	14.34860	15.49471	At most 3	10.25779	14.26460
At most 4 *	4.090810	3.841466	At most 4 *	4.090810	3.841466
(E) Leisure/cultural tourism per capita (LCTPP)					
None *	103.3774	69.81889	None *	50.80898	33.87687
At most 1 *	52.56839	47.85613	At most 1 *	30.17337	27.58434
At most 2	22.39502	29.79707	At most 2	11.27654	21.13162
At most 3	11.11849	15.49471	At most 3	8.482753	14.26460
At most 4	2.635735	3.841466	At most 4	2.635735	3.841466
(F) Restaurants and hotels per capita (RHPP)					
None *	121.1042	69.81889	None *	60.80334	33.87687
At most 1 *	60.30086	47.85613	At most 1 *	34.48504	27.58434
At most 2	25.81583	29.79707	At most 2	13.53118	21.13162
At most 3	12.28465	15.49471	At most 3	8.811056	14.26460
At most 4	3.473592	3.841466	At most 4	3.473592	3.841466
(G) Medical and insurance per capita (MIPP)					
None *	106.3455	69.81889	None *	50.16392	33.87687
At most 1 *	56.18157	47.85613	At most 1 *	34.61639	27.58434
At most 2	21.56518	29.79707	At most 2	15.93433	21.13162
At most 3	5.630847	15.49471	At most 3	5.140320	14.26460
At most 4	0.490527	3.841466	At most 4 *	0.490527	3.841466
(I) Other per capita (OPP)					
None *	108.2520	69.81889	None *	49.21806	33.87687
At most 1 *	59.03395	47.85613	At most 1 *	32.44230	27.58434
At most 2	26.59166	29.79707	At most 2	17.45554	21.13162
At most 3	9.136113	15.49471	At most 3	7.432183	14.26460
At most 4	1.703931	3.841466	At most 4	1.703931	3.841466

Notes: 1. The Trace test and Max-eigenvalue test point to two cointegrating eqn (s) at the 0.05 level for HUSPP, CAPP, LCTPP, RHPP, MIPP, and OPP, and three cointegrating eqn(s) at the 0.05 level for FNABPP and ABCPP; 2. * denotes rejection of the hypothesis at the 0.05 level; 3. **MacKinnon-Haug-Michelis (1999) p-values.

has a detailed economic interpretation and is appropriate based on the initial assumptions of this paper. As the presence of cointegration between the variables for all the data series is statistically significant, the VECM can be applied. However, some data series indicate that there are multiple sets of cointegration variables. According to Sims (1980), in the circumstances where there are multiple sets of cointegration variables, just one set of cointegration variables should be adopted to maintain the simplicity of the VECM analysis.

4.3. Result from vector error correction model

The vector error correction model can fully describe the dynamic adjustment process between time series in the system by considering the long-run equilibrium and short-run dynamic adjustment process between variables. Under the hypotheses of wealth effect, liquidity constraint, and common-factors, variables for all data series of main categories and sub-categories of consumption were tested to examine the significance of the relationship with the escalation in housing prices.

In the case of the long-run equilibrium relationship, the escalation in housing prices was not significantly correlated with any of the main categories of consumption (refer to Appendix 1, Table A1). However, among the durable goods consumption sub-categories listed in Table 9, the communication consumption per capita (CPP) was found to be positively and significantly correlated with the escalation in housing prices. Among the sub-categories of non-durable goods consumption in Table 11, clothing and accessories

per capita (CAPP) and leisure/cultural tourism per capita (LCTPP) were positively and significantly correlated with the escalation in housing prices. There was no indication from the results of the consumption variables being significantly negatively correlated. As for the short-run dynamic adjustment, among the main categories of consumption in Table 8, the durable goods consumption per capita (DCPP) was found to be positively and statistically significant in terms of the relationship with the escalation in housing

prices. Among the sub-categories for the durable goods consumption in Table 10, the transportation consumption per capita (TRSPP) was found to be positive and statistically significant in terms of the relationship with the escalation in housing prices. However, among the sub-categories of non-durable goods consumption presented, there were no results for which the consumption variables were significantly and positively or negatively correlated with the escalation in housing prices (refer to Appendix 2, Table A2).

Table 8. Vector error correction model for main categories of consumption (short-term error correction)

	TCPP		DCPP		NDCPP	
	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Constant	−3.76E-08	[−2.36718]	−6.58E-08	[−0.31555]	−5.29E-08	[−2.08705]
TCPP(-1)	0.126020	[0.78978]				
DCPP(-1)			−0.545391	[−3.05839]		
NDCPP(-1)					0.035969	[0.21958]
DIPP(-1)	0.100110	[1.17204]	2.342566	[1.59858]	0.112144	[0.80441]
RI(-1)	−4.75E-08	[−2.13503]	4.20E-07	[1.19926]	−8.64E-08	[−2.44698]
HI(-1)	1.43E-05	[0.13640]	0.004141	[2.64354]	−2.44E-05	[−0.14713]
SI(-1)	−0.002382	[−2.16419]	0.027220	[1.46530]	−0.004272	[−2.43968]
CointEq	−0.028630	[−1.48764]	0.055768	[0.77260]	−0.036989	[−1.65819]

Notes: 1. The results are the estimates of the error correction for the short-run dynamic adjustment from the VECM model. DIPP, RI, HI, and SI represent the coefficients of the lags for TCPP, DCPP and NDCPP, respectively; 2. The t-statistics are presented beside the corresponding coefficients.

Table 9. Vector error correction model for sub-categories of durable goods consumption (long-term equilibrium relationship)

	FHAMPP		TRSPP		CPP	
	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Constant	−0.000207		−0.000101		0.000171	
DIPP(-1)	25.99145	[3.54728]	20.57118	[6.49185]	−129.7429	[−6.41137]
RI(-1)	3.24E-06	[1.75653]	2.26E-06	[2.83740]	−2.44E-05	[−4.89934]
HI(-1)	−0.010040	[−2.67064]	−0.015128	[−9.33191]	0.020831	[2.05562]
SI(-1)	−1.419215	[−9.40394]	−0.636703	[−10.1953]	3.328880	[8.36259]

Notes: 1. The results are the estimates of the cointegrating equation for the long-run equilibrium relationship from the VECM model. DIPP, RI, HI, and SI represent the coefficients of the lags for TCPP, DCPP and NDCPP, respectively; 2. The t-statistics are presented beside the corresponding coefficients.

Table 10. Vector error correction model for sub-categories of durable goods consumption (short-term error correction)

	FHAMPP		TRSPP		CPP	
	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Constant	−2.41E-07	[−0.49538]	2.89E-08	[0.05011]	7.32E-08	[0.08509]
FHAMPP(-1)	0.276143	[1.69449]				
TRSPP(-1)			−0.584978	[−3.42118]		
CPP(-1)					−0.117212	[−0.66380]
DIPP(-1)	6.667978	[1.99264]	4.708664	[1.18442]	−2.424607	[−0.46451]
RI(-1)	1.29E-06	[1.53980]	8.47E-07	[0.90960]	4.73E-07	[0.36686]
HI(-1)	0.000787	[0.22560]	0.012811	[2.94111]	0.008665	[1.34513]
SI(-1)	0.052019	[1.25133]	0.081081	[1.61053]	−0.026240	[−0.39876]
CointEq	0.022018	[0.94242]	0.074046	[1.10746]	0.012302	[0.81138]

Notes: 1. The results are the estimates of the error correction for the short-run dynamic adjustment from the VECM model. DIPP, RI, HI, and SI represent the coefficients of the lags for TCPP, DCPP and NDCPP, respectively; 2. The t-statistics are presented beside the corresponding coefficients.

Table 11. Vector error correction model for sub-categories of non-durable goods consumption (long-term equilibrium relationship)

	HSUPP		CAPP		FNABPP	
	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Constant	−5.79E-05		0.000382		−0.000287	
DIPP(-1)	4.255100	[3.14483]	−207.0962	[−5.89814]	71.21457	[5.32806]
RI(-1)	1.64E-06	[4.86362]	−2.66E-05	[−3.12456]	1.67E-05	[4.93524]
HI(-1)	−0.003677	[−5.33222]	0.047436	[2.71486]	−0.023260	[−3.32924]
SI(-1)	−0.191983	[−7.09737]	5.615458	[8.39269]	−1.941240	[−7.34410]
	ABCPP		LCTPP		RHPP	
	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Constant	−0.001330		1.67E-06		−0.000195	
DIPP(-1)	319.1512	[5.95922]	−31.10465	[−10.3410]	44.19811	[6.13016]
RI(-1)	4.91E-05	[3.74346]	−5.21E-06	[−7.05180]	9.25E-06	[5.01585]
HI(-1)	−0.114535	[−4.17867]	0.006723	[4.52115]	−0.027938	[−7.51507]
SI(-1)	−8.434761	[−8.21049]	0.554890	[9.34719]	−1.289968	[−9.00445]
	MIPP		OPP			
	Coefficient	t-statistics	Coefficient	t-statistics		
Constant	−0.000280		−0.000271			
DIPP(-1)	52.20370	[3.41002]	79.80521	[4.99603]		
RI(-1)	1.40E-05	[3.69696]	1.55E-05	[3.92190]		
HI(-1)	−0.024140	[−3.09166]	−0.021038	[−2.63411]		
SI(-1)	−2.392320	[−8.06525]	−2.558669	[−8.25733]		

Notes: 1. The results are the estimates of the cointegrating equation for the long-run equilibrium relationship from the VECM model. DIPP, RI, HI, and SI represent the coefficients of the lags for TCPP, DCPP and NDCPP, respectively; 2. The t-statistics are presented beside the corresponding coefficients.

The VECM results have shown that in the long-run equilibrium relationship, there is statistically significant and positive relationship with durable goods of communication-related consumption, and with non-durable goods consumption including clothing and accessories and leisure/cultural tourism. As for the short-run dynamic adjustment, positive and statistically significant relationship was found with the main consumption categories of durable goods. The positive relationship with durable goods consumption was mainly contributed by the transportation consumption sub-category. An interesting result based from the empirical analyses was that there were no consumption variables with significant negative relationship from the escalation in housing prices.

From the empirical analysis, the results indicated that there is a housing wealth effect in Taiwan's society. Over the course of the long-run equilibrium relationship, the society would increase its consumption preferences for communication-related durable goods, such as the purchase and maintenance of communication devices, as well as for non-durable goods, including personal clothing and accessories and participation in leisure/cultural tourism activities. As for the short-run dynamic adjustment, the society would consume more component categories of durable goods. Moreover, it was observed that transportation-related consumption, such as the purchase and maintenance of motor vehicles, accounted for a major part of the durable goods component.

From the current housing market in Taiwan, the government is aware on the housing unaffordability issue and negative effects in the society. In response, the government shifted the housing policy from motivating house purchase to house renting. The ideology was that even though the society was unaffordable to purchase a house, at least it could afford a suitable living environment through renting. Rental subsidizing policies and relevant law amendment have been implemented to improve the housing rental market. In relations to the results, it might be suggesting that housing purchase would not be a priority concern anymore. From homeowner's perspective, housing wealth allowed them to consume more since their asset wealth have increased. As for renter's perspective, the burden of owning a house has been relieved. As effect, the society has more disposable income and time to satisfy its own desire and interaction with other through engaging communication devices, purchasing personal clothing and accessories and participation in leisure/cultural tourism activities.

For real estate scientists and practitioners to implement relative strategic property management, it should be aware and cautious on the supply side of the housing market. As the society is encountering housing unaffordability yet the housing prices, vacancy rates, and homeownership rates remains high; it is suggesting that the reason of sustaining such three norms are the low loan interest rate. With the tightening of relevant property transaction regulation and

taxation and shifting the housing policy from motivating house purchase to house renting by the government, it would decrease on the purchasing demand side of housing market. Furthermore, under the current elastic equilibrium, any adjustment on the monetary policy will affect the housing market significantly. The relative strategic property management should incorporate risks of decreasing housing purchase demand into consideration.

However, despite of possible reasons, these categories of consumption would compensate the consumption figure in the GDP calculation and serve as evidence that housing prices were related to macroeconomic performance. Relevant authorities could focus on these categories of consumption by implementing relevant short-and long-term policies or subsidies on to encourage economic growth. Subsidies could focus on the industrial promotion of communication-related, personal clothing and accessories, and transportation-related consumptions for the society to encourage relevant consumption expenditures. Motivational policies and subsidies for the society to participate as well as for industries to invest in leisure/cultural tourism activities should also be implemented to encourage relevant leisure/tourism consumption expenditure.

Conclusions and suggestions

The purpose of this paper was to provide an empirical analysis on the role of house prices upon determining the consumption behavior in Taiwan. As housing prices escalated rapidly while disposable income has remained constant, the issue of unaffordability arises that is considered to be a negative aspect within society.

However, in a region with high rates of homeownership and low loan interest rates, under the hypothesis of a housing wealth effect, changes in housing prices should exert an influence on consumption expenditure, which will then further influence the performance of the economy. Initial assumption from the empirical analyses to examine whether the escalation in housing prices would, first, have no significant relationship with various categories of consumption, second, be positively and significantly correlated with specific categories of consumption that would compensate the economy, or, third, be negatively and significantly correlated with specific categories of consumption that would further intensify the negative impacts of the high housing prices.

From the empirical analysis, the results indicated that there is a housing wealth effect in Taiwan's society. Over the course of the long-run equilibrium relationship, the society would increase its consumption preferences for communication-related durable goods and non-durable goods of personal clothing and accessories and participation in leisure/cultural tourism activities. As for the short-run dynamic adjustment, the society would consume more component categories of durable goods that mainly contributed by the transportation-related consumption.

The results might be suggesting that housing purchase would not be a priority concern anymore From home-

owner's perspective, housing wealth allowed them to consume more since their asset wealth have increased. As for renter's perspective, the burden of owning a house has been relieved. The society has more disposable income and time to satisfy its own desire and interaction with other through engaging communication devices, purchasing personal clothing and accessories and participation in leisure/cultural tourism activities. However, for real estate scientists and practitioners to implement relative strategic property management, it should be aware and cautious on the supply side of the housing market. Any adjustment on the monetary policy will affect the housing market significantly. The relative strategic property management should incorporate risks of decreasing housing purchase demand into consideration.

Despite the possible reasons for the consumption preferences, it was statistically significant that there is housing wealth effect exists in Taiwan and these categories of consumption would compensate the consumption figure in the GDP calculation and serve as evidence that housing prices were related to macroeconomic performance. Therefore, when a region was experiencing negative impacts from high housing prices, relevant authorities could focus on these categories of consumption by implementing relevant short-and long-term policies or subsidies on to encourage economic growth.

A shortcoming of this paper is that the scope of the research region was restricted in order to meet prescribed conditions, namely, first, a rapid escalation in housing prices within a certain period of time, secondly, a high homeownership rate and low mortgage rate, and third, society as a whole was affected by the negative impacts of high housing prices. Future studies should examine regions with different conditions or detailed survey on individual household survey should be conducted in Taiwan to examine the housing wealth effect in the microeconomic level.

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Appendix 1

Table A1. Vector error correction model for main categories of consumption (long-term equilibrium relationship)

	TCPP		DCPP		NDCPP	
	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Constant	−8.70E-06		−4.82E-05		−1.07E-05	
DIPP(-1)	1.013767	[4.06410]	6.043673	[5.77020]	−1.321803	[3.71615]
RI(-1)	3.38E-07	[4.99315]	4.89E-07	[1.85899]	4.61E-07	[4.84642]
HI(-1)	−0.000763	[−5.77967]	−0.005507	[−10.2810]	−0.000883	[−4.69093]
SI(-1)	−0.038187	[−7.23006]	−0.216768	[−10.4464]	−0.051520	[−7.00551]

Notes: 1. The results are the estimates of the cointegrating equation for the long-run equilibrium relationship from the VECM model. DIPP, RI, HI, and SI represent the coefficients of the lags for TCPP, DCPP and NDCPP, respectively; 2. The t-statistics are presented beside the corresponding coefficients.

Appendix 2

Table A2. Vector error correction model for sub-categories of non-durable goods consumption (short-term error correction)

	HSUPP		CAPP		FNABPP	
	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Constant	−4.16E-07	[−4.91174]	−1.05E-06	[−1.17962]	−8.42E-07	[−5.74823]
HSUPP(-1)	-0.518396	[−3.77555]				
CAPP(-1)			−0.607420	[−3.77198]		
FNABPP(-1)					−0.130747	[−0.75372]
DIPP(-1)	0.114828	[0.25765]	8.855039	[1.57229]	−0.392974	[−0.66095]
RI(-1)	−5.82E-08	[−0.48773]	1.66E-06	[1.08953]	−1.31E-08	[−0.08792]
HI(-1)	0.000427	[0.79866]	0.009890	[1.43756]	5.41E-05	[0.06780]
SI(-1)	−0.000750	[−0.12548]	−0.011610	[−0.15285]	0.007171	[0.95238]
CointEq	−0.020206	[−1.01019]	−0.010537	[−0.98620]	−0.000576	[−0.21417]
	ABCPP		LCTPP		RHPP	
	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Constant	−3.14E-06	[−1.17970]	−3.62E-07	[−1.01567]	−1.02E-06	[−2.05989]
ABCPP(-1)	−0.164935	[−1.03153]				
LCTPP(-1)			−0.392609	[−2.05193]		
RHPP(-1)					0.181414	[1.24867]
DIPP(-1)	16.69633	[1.02668]	7.600382	[3.26919]	7.376369	[2.74974]
RI(-1)	3.59E-06	[0.86005]	4.36E-07	[0.81482]	8.70E-07	[1.31870]
HI(-1)	0.004538	[0.23494]	−0.000982	[−0.35179]	0.000140	[0.04317]
SI(-1)	−0.220755	[−1.02959]	−0.029270	[−1.07701]	−0.026047	[−0.78571]
CointEq	−0.005224	[−0.27152]	0.134401	[3.11942]	−0.014286	[−0.77652]
	MIPP		OPP			
	Coefficient	t-statistics	Coefficient	t-statistics		
Constant	−2.23E-06	[−3.31521]	−1.23E-07	[−0.26342]		
MIPP(-1)	−0.165690	[−1.01882]				
OPP(-1)			−0.373496	[−2.18269]		
DIPP(-1)	4.983281	[1.24286]	7.560219	[2.55246]		
RI(-1)	−1.08E-06	[−0.99684]	1.09E-07	[0.14140]		
HI(-1)	−0.005962	[−1.26592]	0.000594	[0.17282]		
SI(-1)	−0.001797	[−0.03246]	0.001817	[0.77866]		
CointEq	−0.004259	[−0.26646]	0.013681	[1.20339]		

Notes: 1. The results are the estimates of the error correction for the short-run dynamic adjustment from the VECM model. DIPP, RI, HI, and SI represent the coefficients of the lags for TCPP, DCPP and NDCPP, respectively; 2. The t-statistics are presented beside the corresponding coefficients.