The Relationship Among Consumption, Income, Stock Wealth And Housing Wealth: Evidence From Canada

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Abstract

This paper uses data from Statistics Canada to examine the relationship among disposable income, housing wealth, stock market wealth and consumption. Estimation is based on a vector error correction model, which investigates not only the dynamic responses of the variables for permanent shocks, but also for transitory shocks. The empirical evidence shows that both income and wealth have a positive and significant impact on consumption. The effect of housing wealth on consumption is substantially higher than the effect of stock market wealth. Moreover, there is a bi-directional Granger causality between disposable income, wealth and consumption.

1. Introduction

This paper is inspired by the recent work of Alexander Ludwig and Torsten SlØk (2004), but with Canadian data. The objective of the study is to examine the relationship among disposable income, housing wealth, stock market wealth and consumption. My analysis is based on a linear multivariate model with the assumptions that consumption, disposable income and wealth share a common trend. I apply two econometric techniques in this paper. First, I carry out the cointegration test (suggested by Johansen, 1988) based on a vector error correction model to study the link between disposable income, two wealth components and consumption. The econometric method provides an opportunity to take into account the dynamic responses of all the variables in the analysis, and allows the different reaction of consumption in response to permanent shocks from the reaction to transitory shocks. Second, based on a multivariate vector autoregressive model, I apply the MWALD test to analyze the Granger causal relationship between these variables.

The analysis uses the data from 1961 to 2003 from Statistics Canada's Database (CANSIMII). When using the housing price index as a proxy for housing wealth in the cointegration test, I obtain inconsistent coefficient estimates in terms of my expectations. I had supposed that there is a positive relationship between housing wealth and consumption, while the empirical evidence supports a negative relationship between those two variables. The existence of a correlation between wealth and consumption can partly explain the unexpected results. As residential structure net of mortgages stands for housing wealth, I substitute it for the housing price index in the subsequent tests. The empirical evidence shows a significantly positive relationship between consumption, disposable income and the two wealth components. Particularly, the elasticity of consumption with respect to changes in housing wealth is substantially larger than the elasticity of stock market wealth. This finding is in line with those of Pichette (2004).

Moreover, to find out the different effects of wealth on durable consumption and on non-durable consumption, I apply the cointegration test by substituting consumption of non-durable goods and services for total consumption in the regression. The results indicate a more important long-run impact of wealth on consumption of durable goods, compared to the impact of non-durable goods and services. To verify the robustness of the results for the whole period, I further use the original quarterly data from 1990 to 2003 as a sub-sample, and reach a conclusion consistent with the results for the whole period. Finally, the MWALD tests support the hypothesis of the existence of Granger causality between income, wealth and consumption in both directions, and it helps to explain the linkage among the variables.

The structure of this paper is as follows. Section 2 presents a brief discussion of the related theories and the results from previous empirical studies. Section 3 introduces the econometric methodology used in the paper. Section 4 describes the data set used in my study. Section 5 reports the results of the empirical analysis in details. Finally, Section 6 gives a short conclusion and analyzes some limitations of the study.

2. Literature Review

The simple model of a consumption function with income and wealth is used in this paper, and it is motivated by many traditional theories. Some traditional macro-economic theories analyze the interaction between income, wealth and consumption, and most of them imply that household income and wealth are the only determinants of private consumption. One representative of these theories is the permanent income theory of Friedman (1957), and the other is the life cycle theory of Modigliani (1963).

The permanent income theory presents a model of an aggregate consumption function with household income and wealth. It illustrates the relationship between permanent income and consumption of non-durable goods and services, where permanent income is assumed to be composed of human wealth and non-human wealth. The permanent income hypothesis asserts that consumption responds to permanent changes in income, while it much less responds to transitory fluctuations in income. In other words, permanent changes in income are more likely to increase long-run consumption than temporary changes in income. Additionally, the theory implies that there is a linear relationship between consumption and income (Friedman, 1957).

In the life cycle model of consumption, it is assumed that current income changes systematically as households move through their life cycle. Moreover, the theory implies that private consumption depends on lifetime income, and that households try to smooth their consumption regardless of changes in current income (Modigliani, 1963).

The traditional consumer theories suggest that the appropriate measure of human wealth focuses on labor income, and private consumption focuses on consumption of non-durable goods and services. Based on the components of income in the permanent income theory, Macklem (1994) develops a measure of human wealth and non-human wealth. Labor income measures human wealth, and household's net asset measures non-human wealth in market value. Housing wealth and stock market wealth are frequently regarded as the two main components of non-human wealth, and represent non-financial wealth and financial wealth respectively in households' portfolios. It is commonly supposed that housing wealth may have similar effects on the real economy as stock market wealth.

There are several different selections for critical variables (consumption, income, as well as wealth) in those empirical studies. In the early wealth-effect empirical studies, most researchers have examined the relationship between consumption and total wealth, and they use expenditures on non-durable goods and services as a proxy for consumption (Blinder and Deaton, 1985). However, due to the dramatic rise and fall of stock prices in recent years, a number of researchers are particularly interested in the effect on consumption of stock market wealth, and most of them use total consumption rather than consumption of non-durable goods and services in their tests. Although Romer (1990) suggests that stock market crashes are more likely to postpone consumption of durable goods, rather than consumption of non-durable goods and services, there is no distinction in most studies between non-durable and durable consumption, and many researchers use total consumption in studying the stock market wealth effect. On the other hand, private disposable income is frequently used in empirical studies, rather than only labor income as suggested by the permanent income hypothesis. It is supported by an extended view of the life-cycle theory (Attanassio, 1999), which implies that total income is more sensitive than labor income in the economy. Mankiw (2000) also asserts that households are generally more myopic than the suggestion in the life-cycle theory. In other words, households will easily change their consumption with their current income. Housing wealth and stock market wealth, two main components of non-human wealth, are frequently used as a proxy for private wealth in studying the wealth effect on consumption.

The fact that wealth, income and consumption share a common trend is assumed in most wealth effect studies. It implies that the stock market wealth and housing wealth are positively related to consumption. At this respect, Ludwig and SlØk (2002) give a number of reasons for the positive effect of these two wealth components on consumption. Both the increase in the value of households' stock market wealth and that of their housing wealth have direct positive effects on consumption, which they called the realized wealth effect. Moreover, since a rise in prices is a signal of increasing future prosperity, there exists an unrealized wealth effect in stock market prices and housing prices that results in households' higher current consumption, with the expectation that they are "wealthier" than they were before. For stock market wealth, liquidity constraint effects, stock option value effects and other factors also allow households to increase their consumption. However, some factors for housing wealth have negative impacts on private consumption. There are, for example, budget constraint effects for rentiers, and liquidity constraint effects and substitution effects for future buyers. These effects may work in the opposite direction and force households to lower private consumption according to higher housing prices. Hence, a higher value of stock market wealth may lead to higher private consumption, while the effect of higher housing prices on private consumption is hard to determine.

In theories, not only the positive wealth effect on consumption is assumed, but also the similar responsiveness of consumption to stock market wealth and to housing wealth is expected. The significant rise and fall of stock prices and the increase of housing prices from 1990 lead to an increasing amount of empirical studies, which concentrate on the relative importance of these two wealth components on consumption. [1]

However, the effect of stock market wealth on consumption is found to be substantially different from the effect of housing wealth in most empirical studies. A number of factors have been put forward for their different effects on consumption (Dvornak and Kohler, 2003). First, these two wealth components may have different liquidity. It is obvious that transaction costs for changing stock market wealth is much lower than that of housing wealth. It leads to a relatively smaller wealth effect for housing, which implies that the marginal propensity to consume (MPC)[2] out of stock market wealth should be higher than the MPC out of housing wealth. Second, housing wealth tends to be held by households at all income levels, while stock market wealth is highly concentrated by a relatively small group of wealthier households. High-income households are often thought to have a lower propensity to consume out of wealth, so they are less likely to consume the increased stock market wealth. In this case, changes in stock market wealth may lead to lower changes in consumption, compared with changes in housing wealth. Third, changes in stock prices are likely to be viewed as transitory, while increases in housing prices are more likely to be permanent. According to the permanent income theory, households might be more likely to modify their consumption according to changes in housing wealth. Hence, changes in housing wealth might have a larger impact on consumption than changes

[1] Such as Boone et al. (1998) and Mehra (2001) for the United States.
[2]The marginal propensity to consume (MPC) measures by how many dollars consumption increases if wealth increases by one dollar. Elasticities measure by how many percent consumption increases if wealth increases by one per cent. Elasticities can be converted into MPCs by multiplying by the ratio of consumption to wealth.

in stock market wealth. Finally, households may not accurately assess their wealth or they may not be sensitive to the changes of the value of their wealth. Therefore, the changes of either component of wealth will not lead to a significant change of private consumption. Thus, the effect of housing wealth on consumption is different from the effect of stock market wealth, and it is determined by many different factors. Furthermore, it is worth noting that applying different methodologies is an important reason to reach different results in empirical studies.

As mentioned above, a common trend between consumption and wealth is assumed and tested for in most empirical studies of the wealth effect on consumption. However, the results of the tests are not always consistent with the assumption above. Lettau and Ludvigson (2004) found a significant effect from total wealth on consumption, and most studies reached the same conclusions. However, when studies concentrated on the relative responsiveness of consumption to stock market wealth and to housing wealth, they find different results. For example, Case, Quigley, and Shiller (2001) show that housing wealth has a larger effect on consumption than stock market wealth does, while Dvornak and Kohler (2003) illustrate the opposite results, which shows the stronger linkage between stock market wealth and consumption relative to housing wealth. On the other hand, Tan and Vass (2003), show that the housing wealth effect is insignificant when it is jointly estimated with stock market wealth, although there is a positive relationship between consumption and one of the two wealth components respectively.

Case, Quigley, and Shiller (2001) employed a quarterly panel data of US states and an annual panel data of 14 countries to investigate the empirical relationship between wealth and consumer spending, focusing in particular on the role of housing wealth and stock market wealth in explaining the changes of consumption. They suppose that prices is a good proxy for wealth and calculate the aggregate value of housing wealth by a housing price index, homeownership rates and the total number of households. The results of their studies show that they have difficulty in finding a significant housing wealth effect by using aggregate level data, since there may be multicollinearity of the two wealth components. When using a panel of US states, Case et al. report a higher coefficient estimate for housing wealth than for stock market wealth from most of their specifications.

Pichette (2004) focuses on Canada, and the long-run relationship between wealth and consumption is studied by means of a multivariate cointegration analysis using quarterly data from 1965 to 2003. Following Macklem (1994), she defines stock wealth as stocks held by persons and unincorporated business, housing wealth as residential structures net of mortgages, and uses real expenditure on non-durable goods and services as a proxy for total consumption. In her study, she applies an advanced econometric method called vector-error-correction model (VECM) (the method was suggested to use by Lettau, Ludvigson, and Barczic 2001) to investigate the reaction of consumption to both permanent and transitory shocks. Her finding is that the effect of stock market wealth on consumption is substantially different from the effect of housing wealth. This result is consistent with that of Case, Quigley, and Shiller (2001). The marginal propensity to consume out of housing wealth is significantly larger than the especially small and statistically insignificant marginal propensity to consume out of stock market wealth.

The two studies above found a more important impact on consumption of housing wealth, compared with the impact of stock market wealth, while Nikola Dvornak and Marion Kohler (2003) reach opposite conclusions. Following Case, Quigley and Shiller (2001), they use a state-level panel to estimate the effects of changes in wealth components on private consumption in Australia. They use total consumption, including expenditure of both durable goods and non-durable goods, rather than consumption of non-durable goods in the tests. Additionally, they employed several econometric methods to analyze the robustness of their results. The methods include dynamic OLS estimator for panels, mean group estimators based on a seemingly unrelated regression (SUR) model for state-specific wealth effects and instrumental variables. Similar to Case et al. (2001), they use state-level data, and find that the stock market wealth effect on consumption is estimated to be higher than the housing wealth effect for Australia, which is different from Case's finding that the housing wealth effect is larger than the stock market wealth effect.

A similar conclusion is reached by Ludwig and SlØk (2002) when they use data for 16 OECD countries to quantify the different impact of stock and housing prices on consumption. Their results show that there is a significant short-run adjustment from income, stock prices and housing prices on consumption, and the estimated elasticity of housing prices on consumption is remarkably larger than the elasticity of stock market prices for the combined samples of all countries. Particularly, the effect of housing prices on consumption is found to be ambiguous. Their findings in 2004 confirm this uncertain result.

They again used a panel of 16 OECD countries quarterly data from 1960 to 2000, and apply the panel data technique for cointegrated panels to study the relationship between total consumption and two wealth components. The econometric technique for cointegrated panels is the pooled mean group (PMG) estimator proposed by Pesaran et al. (1999). They use price indices as proxies for stock market wealth and housing wealth, and retrieve quarterly data on housing prices by interpolating annual data. Their results support the hypothesis of a long-run relationship between stock market prices and private consumption, but it is unclear whether the elasticity of consumption to housing wealth is different from the elasticity of stock market wealth. Moreover, they cannot support the hypothesis of a positive effect of housing wealth on consumption, and find a significantly negative coefficient estimate on housing prices for the first sample period (1960-1984).

On another hand, Girouard and Bl'ondal (2001) also fail to find consistent results across the OECD countries. In some countries, the housing wealth effect is higher, while in some countries, the stock wealth effect is higher. In the rest of the countries, neither the housing wealth effect nor the stock market wealth effect was significant. Another related case is that of Tan and Voss (2003), who find a significant stock market wealth effect, but an insignificant housing wealth effect in Australia.

The empirical studies above show several different results. Even in the case that both studies used the same data or in the case both studies use the same method, the conclusions are different from each other. In this paper, based on the results of the previous studies, I expect to find a positive relationship between consumption, income and wealth; and a higher long-run responsiveness of consumption to housing wealth than that with respect to stock market wealth. I also make two other hypotheses: one is the significant short-run adjustment from income, stock wealth and housing wealth on consumption; and the other is the bi-directional Granger causality between disposable income, wealth and consumption.

3. Methodology

In the early studies, the commonly used econometric methodology was a simple error correction model. Recently, Lettau, Ludvigson, and Barczi (2001) investigate the dynamic responses of the variables in their studies by introducing the vector error correction model (VECM). VECM is a more advanced econometric method, which allows permanent shocks to be distinguished from transitory shocks.

Based on the results of the previous empirical studies, I assume that consumption, disposable income, stock wealth and housing wealth share a common trend. I analyze the long-run relationships for time-series data by carrying out the cointegration test, which is introduced by Granger (1981) and developed by Engle and Granger (1987).

The cointegration method investigates the long-run co-movements among series with unit roots. Therefore, the first step is to test whether the data are difference-stationary or not by applying both the augmented Dickey-Fuller (ADF) test and the DF-GLS test (Elliott, Rothenberg and Stock, 1996). If all the series are shown to have a unit root, the second step is to test cointegration among those series by applying the Johansen test (1988,1995), which is particularly appropriate for multivariate models that exhibit several significant cointegrating vectors. Finally, I apply the MWALD test proposed by Toda and Yamamoto (1995) to investigate the Granger causality relationship in both directions between the groups of four variables.

3.1 Unit Root Tests

The following discussion outlines the two unit root tests used in the empirical action.

3.1.1 The Augmented Dickey-Fuller (ADF) Test[3]

I use the traditional ADF method to test the presence of a unit root, which was proposed by Dickey and Fuller(1979). The ADF test constructs a parametric correction for higher-order correlation of the residuals by assuming that the series follows an AR(p) process and adding lagged difference terms of the dependent variables to the right–hand side of the regression:

(3-1) $\Delta y_t = \gamma y_{t-1} + \beta_1 \Delta y_{t-2} + \ldots\ldots + \beta_2 \Delta y_{t-p} + \varepsilon_t$

The null and alternative hypotheses are written as

H_0: $\gamma = 0$; H_1: $\gamma < 0$

In this regression, Dickey and Fuller (1979) have shown that the distribution of the t-statistic under the null hypothesis is nonstandard, and it is independent of the

[3] See Eviews 4.1 unit root tests introduction.

number of lagged first differences included in the ADF regression. The critical values for the test depend on whether or not a constant (or/ and a trend) are included in the regression. [4]

3.1.2 The DF-GLS Test [5]

I also employ the DF-GLS technique to test unit roots, which is more powerful than the ADF test. Elliott, Rothenberg and Stock (1996) provided a modified version of the ADF tests by using GLS approach to detrend explanatory variables prior to running the regression. As noted above, I may elect to include a constant, or a constant and a trend, in my ADF test regression. For these two cases, the DF-GLS ratio follows a Dickey-Fuller distribution in the constant case only, while the asymptotic distribution differs when both a constant and a trend are included. The Eviews 4.1 program provides critical values for the DF-GLS test from MacKinnon's (1991) simulations for the non-constant case and from Elliott, Rothenberg and Stock (1996) for the case with a constant and trend.

Since the results of the DF-GLS test may be different from those of the ADF test in the case with only a constant and in the case with both a constant and a trend, I apply the unit root test by selecting the constant and trend terms for the series in levels and by selecting the constant term for the series in first differences. The optimal lag

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[4] In practice, if the series exhibits a trend (either deterministic or stochastic), we should include both a constant and a trend in the regression. If the series has a nonzero mean and does not contain a trend, we simply need include a constant in the regression. In the case that the series seems to fluctuate around a zero mean, we need include neither a constant nor a trend in the regression (Hamilton, 1994).

[5] See Eviews 4.1 unit root tests introduction.

length for each series in both the ADF test and the DF-GLS test is selected according to the Schwarz Information Criterion (SIC).

3.2 The Johansen's Cointegration Test

Johansen's procedure requires rewriting a vector auto-regression (VAR) model of order k:

(3-2) $X_t = \mu + A_1 X_t + \ldots\ldots + A_k X_{t-k} + \varepsilon_t$

where X_t is an n-vector of non-stationary I(1) variables, A_i is an n×n matrix of parameters, μ is an n-vector containing deterministic terms, and ε is a vector of residuals assumed to be independently and identically distributed. Equation (3-2) can be transformed into the following model known as VECM (vector error correction model):

(3-3) $\Delta X_t = \Pi X_{t-1} + \Sigma_{i=1}^{K-1} \Gamma_i \Delta X_{t-i} + \mu + \varepsilon_t$

where $\Pi = -I + A_1 + \ldots\ldots + A_K$,

and $\Gamma_i = -I + A_1 + \ldots\ldots + A_i$, i= 1,......k-1.

The Γ_i represents the matrix of the traditional first-difference coefficients which reflect the short-run dynamics of the model. The matrix of coefficients Π captures the information about the long-run relationships among the n variables in the equation. Johansen's method can determine the number of roots that are statistically different from zero. The rank r of the matrix Π indicates the number of cointegrating vectors. Granger's representation theorem states that if Π has a reduced rank r $(0<r<n)$, there exist n×r matrices α and β such that $\Pi = \alpha\,\beta$. The r columns of β are the cointegrating

vectors such that βX_t is stationary, while n-r represents the number of common stochastic trends. Each factor of α represents the speed of adjustment for each variable. The larger the value of the factor in α, the faster the variable adjusts. If Π has full rank (r=n), all the time series are themselves stationary. On the other hand, if Π has a rank of zero (r=0), equation (3-3) can be rewritten as a VAR in first differences, and there is no stationary long-run relationship among the series. Therefore, Johansen's method can not only tests the presence of a cointegrating relationship, but also examines the relative adjustment speed of each series to the steady state.

We can use the trace statistics to identify the number of cointegrating vectors r. The null hypothesis is that there are at most r cointegrating vectors, while the alternative is that there are less than r cointegrating vectors. The statistic is as follows:

(3-4) $\lambda_{trace} = -T\, \Sigma_{i=r+1}^{n} \ln(1-\lambda_i)$

where λ_i is the characteristic root of matrix Π (for i=1,2,...) and T is the number of observations. This test can determine the number of roots that are statistically different from zero. [6]

Another method to determine r is the maximum eigen value statistic. In this test, the null hypothesis is that there exist r cointegrating vectors, against the alternative that there are r+1 cointegrating vectors. The statistic is as follows:

(3-5) $\lambda_{max} = -T \ln(1- \lambda_{r+1})$

The critical values of both statistics are provided by Osterwald-Lenum (1992). It should be noted that the specifications of the alternative hypothesis for these two tests

[6] The test will begin from r=0, until we cannot reject the null hypothesis that there are r cointegrating vectors.

are different and may lead to different results. Moreover, the results of cointegration tests are very sensitive to the choice of lag length for the VECM. It is important to select an appropriate number of lags to construct the error correction model. In this paper, the lag length is selected by applying six different criteria in the unrestricted VAR model. If a different lag length is selected according to different criteria, I follow the result of the AIC criterion, which is frequently used in the literature.

3.3 VAR Pairwise Granger Causality Test: the MWALD Test

I apply multivariate Granger-Causality tests to explore the short-run dynamics of the series. The MWALD test was suggested by Toda and Yamamoto (1995). It is an appropriate method to examine the pair-wise Granger causality relationship among non-stationary series, and we do not need to know whether the series included in the test are cointegrated or not. Therefore, I should construct an unrestricted VAR in levels for MWALD test.

Toda and Yamamoto (1995) proved that when a VAR model with a lag order of k+d is estimated by the multivariate least squares, the Wald statistic for zero restrictions on the parameters of a k-order VAR has an asymptotic Chi-square distribution with k+d-1 degrees of freedom.[7]

In this paper, the augmented VAR model is written as:

$$(3\text{-}8)\quad \begin{bmatrix} lcon_t \\ linc_t \\ lhou_t \\ ltse_t \end{bmatrix} = \mathrm{A}_0 + \mathrm{A}_1 \begin{bmatrix} lcon_{t-1} \\ linc_{t-1} \\ lhou_{t-1} \\ ltse_{t-1} \end{bmatrix} + \mathrm{A}_2 \begin{bmatrix} lcon_{t-2} \\ linc_{t-2} \\ lhou_{t-2} \\ ltse_{t-2} \end{bmatrix} + \ldots\ldots + \mathrm{A}_m \begin{bmatrix} lcon_{t-m} \\ linc_{t-m} \\ lhou_{t-m} \\ ltse_{t-m} \end{bmatrix} + \begin{bmatrix} e_{con} \\ e_{inc} \\ e_{hou} \\ e_{tse} \end{bmatrix}$$

[7] Where K is the optimal lag length for the unrestricted VAR in levels and D is the maximum order of integration of variables in the system.

where m is equal to the sum of K and D. The null hypothesis is that a particular variable in the right-hand vector does not Granger cause the selected one in the model.[8] In the case that the p-value is less than the level of significance, the null hypothesis of no Granger causality should be rejected. In this paper, I set 10% as the level of significance in the MWALD test.

4. The Data

The data are retrieved from Statistic Canada's database (CANSIMII). Since I do not have access to monthly data for some variables, I use quarterly data from 1961 to 2003 in my study. Aggregate consumption, consumption of non-durable goods and services, aggregate disposable income and total population are obtained in quarterly frequency data directly from CANSIMII. In this paper, I use consumption, disposable income, housing wealth and stock wealth.[9]

Following Ludwig and SlØk (2004), I first use the Housing Price Index (HPI) as a proxy for housing wealth, and the Toronto Stock Exchange composite 300 (TSE) as a proxy for stock wealth. My results are not in line with their findings. Alternatively, I use residential structures net of mortgages (Pichette 2004) as a proxy for housing wealth in the subsequent tests. I also use consumption of non-durable goods and services as a proxy for consumption to investigate wealth effect on consumption of non-durable goods and services.

The original data for housing price index, TSE and consumer price index are

[8] It means that the coefficients of the lagged values of a particular variable are jointly zero in the model for the present value of one of other variables.
[9] Consumption, disposable income and housing wealth are in per capita values.

monthly data, while residential structure and mortgage are annual data. I transformed the different frequency data into quarterly data using Eviews 4.1.

Since these variables are calculated by current prices, I first deflated these series by the consumer price index.[10] Per capita aggregate consumption (CON), per capita consumption of non-durable goods and services (UNCON), per capita disposable income (INC) and per capita housing wealth (HOU), HPI and TSE are transformed by taking natural logarithms.[11] Logs of all variables have been taken, and therefore the coefficients estimated from log variables reflect the estimated elasticities of consumption in changes of the other variables.

5. Empirical Results

Following the model introduced by Ludwig and SlØk (2004):

(5-2) $C_t = \alpha_0 + \alpha_1 YD_t + \alpha_2 WH_t + \alpha_3 WS_t + \varepsilon_t$[12].

The econometric model used is the vector error correction model (VECM). After applying the unit root tests on all series, first I use the variables suggested by Ludwig and SlØk (2004)(LCON, LINC, LHPI and LTSE) in their study and carry out Johansen's cointegration tests. However, my result is inconsistent with theirs. Thus, I use residential structures net of mortgages as a proxy for housing wealth (Pichette 2004), and substitute LHOU for LHPI in the test.

[10] Except for TSE, since one company's stock price is mainly determined by its current and potential earning ability.

[11] I obtained per capita aggregate consumption (CON), per capita consumption of non-durable goods and services (UNCON), per capita disposable income (INC) and per capita housing wealth (HOU) through dividing aggregate consumption, consumption of non-durable goods and services, aggregate disposable income and residential structure net of mortgages by total population.

[12] Where, C stands for consumption, YD stands for disposable income, WH stands for housing wealth and WS stands for stock market wealth.

Furthermore, to distinguish the wealth effect on consumption of durable goods from the effect on consumption of non-durable goods and services, I also estimate the model with consumption of non-durable goods and services and find significantly different effects on these two types of consumption.

The transformed quarterly housing wealth data may not contain more information than the original annual data. Hence, I use the original quarterly data of residential structure and mortgages from 1990 to 2003 as a sub-sample to verify the robustness of tests for the whole period.

5.1 The Results of Unit Root Tests

The results of the ADF tests are reported in Table 1. Since the level series contain an observable trend from Figure 1, first I test the presence of a unit root in levels including both a constant and trend in the regression. I include a constant term in the regression in testing the series in first differences. According to the results, the null hypothesis of the presence of a unit root in levels cannot be rejected for all series at both the 10% and 5% level of significance. On the other hand, the null hypothesis of the unit root for all series in first difference is rejected at least at the 10% level.

The results of the DF-GLS test are presented in Table 2. The table shows that all series in levels are also non-stationary. Compared with the results of the ADF test for the series in first difference, the null hypothesis indicating the presence of a unit root for LINC in first difference can be rejected at the 5% level. However, I cannot reject the null hypothesis of a unit root for disposable income (LINC) in first differences.

The rest of the series in first differences are stationary. Although the DF-GLS test is considered to be more powerful than the ADF test, the t-statistic for disposable income in first differences is only slightly larger than the critical value at the 10% level in the DF-GLS test, and can be proved to be stationary in the ADF test. Hence, I follow the result of the ADF test, and disposable income follows an I (1) process.

5.2 Results of Johansen's Cointegration Test

As mentioned in the earlier section, the asymptotic distributions of the λ_{max} and λ_{trace} statistics depend on whether at least one of series in the model contains a deterministic trend. In Figure 1, series in levels exhibit a trend and I include a constant in the cointegration equation. Figure 2 shows no trend in the series in first differences, and coupled with the results of unit root tests, I decide not to include a trend in the cointegration equation.

First, I use the same model and the same variables (LCON, LINC, LHPI and LTSE) as Ludwig and SlØk (2004) to study the long-run co-movement among consumption and the other variables. Tables 3.1 to 3.5 summarize the results of the Johansen's test. Unfortunately, my result of the long-run relationship is not consistent with the conclusion drawn by Ludwig and SlØk (2004). The most striking difference is that consumption is negatively related with housing wealth, while they conclude that consumption is positively related with housing wealth. Some important facts below can partly explain this unexpected result.

One possible source of the inconsistency could be the selection of a different econometric method and data. Ludwig and SlØk (2004) employed the pooled mean group (PMG) method to test a group of 14 OECD countries, while I apply Johansen's test to study only Canada. Moreover, they retrieved annual data of HPI, and transformed it into quarterly data, while I obtained monthly data and transformed it into quarterly data. The different frequency original data will lead to slightly different results, but the different methods may lead to opposite results in some cases. Because of the correlation between the price index and wealth series in their study, they even find a negative coefficient estimate on housing prices for the first sample period from 1960 to 1984, and cannot prove the positive effect of changes in housing prices on consumption in the no common factors case. In this paper, the results of Granger causality tests show that consumption Granger causes housing wealth, which implies that house purchasing is the main part of durable consumption, and an increase in house purchasing will lead to an increase in housing wealth. It proves the existence of a correlation between consumption and wealth. This correlation might lead to the unexpected result.

Another possible source of the unexpected result could be that HPI is not an appropriate indicator of housing wealth in a single-country case. First, HPI is a price index, while housing wealth is measured in values. HPI only reflects the effect of housing prices and inflation, but cannot reflect the effect of some important factors, such as mortgages and household's behavior. Hence, the housing price index cannot exactly represent housing wealth. Some evidence also shows a negative relationship between consumption and HPI. The increase of the housing price index or housing prices might encourage households to invest in residential assets to pursue high returns, rather than to increase consumption. Another explanation of the negative effect of HPI on consumption is that, as housing prices increase, the potential house purchasers will probably reduce their current consumption and save more. In addition, there is some evidence showing that changes of HPI may have no effect on consumption at all. One fact is that, according to the *1999 Survey of Financial Security* published by Statistics Canada (Canada 2003), about two-thirds of the households have their own houses, and most of them just use their houses for dwelling purposes. Increasing housing prices do not affect their consumption. Another fact is that, an increase in housing prices in some special areas in Canada leads to the increase of HPI, while for the rest of the country, the real price of housing might remain constant. Hence, housing wealth in most of the areas may only increase slightly, and the effect on consumption would be very limited.

The reasons above could partly explain the result, which is not in line with my expectations. Hence, following Pichette (2004), I use residential structure net of mortgages as a proxy for housing wealth, and substitute LHOU for LHPI in the Johansen test.

Tables 4.1 to 4.5 summarize the results of the Johansen cointegration test for LCON, LINC, LHOU and LTSE. According to Table 4.1, the optimal lag length is found to be six in the unrestricted VAR model. This indicates that a five lag length should be included in the VECM estimate.

Tables 4.2 and 4.3 present the results of the cointegration tests for the variables.

For the trace statistics, I can reject the null hypothesis of no long-run relationship between consumption and the other three variables at the 5% level of significance, and can not reject the null hypothesis of having one or less than one cointegrating vector at either level of significance. For the maximum eigen-value statistics, I can reject the null hypothesis of no cointegrating vector at the 1% level of significance, and cannot reject the null hypothesis of having one cointegrating vector at both 1% and 5% level of significance. These two statistics indicate that, one cointegrating vector lies among the variables. In other words, there exists a long-run relationship among consumption, disposable income, housing wealth and stock wealth.

Next, I investigate the long-run dynamics among the variables by estimating the coefficients of the cointegrating vector (β). I normalize the cointegration equation on LCON (the logarithmic of per capita consumption), and obtain the estimated coefficient of the cointegrating vector. The cointegrating vector can be written as follows:

(5-2) LCON=0.391821LINC+0.440312LHOU+0.123733LTSE+0.397639

Since the variables are transformed into logarithmic forms, the values of the coefficients show the long-run elasticities of consumption to disposable income, housing wealth and stock wealth respectively.

The existence of a cointegrating vector indicates that all variables in the test contribute to the long-run steady state more or less. However, there may be the case that one or more variables do not come into the common trend. Therefore, it is essential to examine the robustness of the above results.

Tables 4.3 to 4.4 summarize test results of imposing zero restrictions on the composition of the cointegrating vector. Table 4.3 reports the signs of the coefficients in each possible three-variable model that includes LCON. Compared with the signs of the four-variable model, the content of the table backs up the above outcome. According to the table, the sign of log of per capita disposable income is always positive when either of two variables (LHOU and LTSE) is deleted from the model. That means disposable income is positively related with consumption. I can reach the same conclusions for LHOU and LTSE.

To find out which variables actually contribute to this long-run steady state, I again use exclusion restriction tests on each variable in the model. Table 4.4 illustrates the results of the cointegration restriction test on the components of the cointegrating vector. In this case, the likelihood-ratio statistic has a chi-square distribution with seven degrees of freedom. Based on Table 4.4, the chi-square statistic with a restriction of no disposable income is 12.11447, and the null hypothesis that LINC has no contribution to the cointegrating relation can be rejected at the 1% level of significance. This result indicates that disposable income contributes to the common trend. I can also reject the same null hypothesis for the other three variables at the same level of significance. Therefore, there not only exists a long-run steady state among consumption, disposable income, housing wealth and stock market wealth; all four variables contribute to the common trend. An interpretation of the above result is that, the long-run co-movement of disposable income, house wealth and stock market wealth may contribute to the long-run co-movement of consumption.

Since the coefficients of the vector reflect the elasticities of consumption to the other three variables, it obviously shows that the elasticity of consumption with respect to housing wealth is significantly larger than the elasticity of consumption to stock wealth. The results from my long-run relationship analysis are in line with the viewpoint of governor Greenspan (2001), who suggests that the marginal propensity to consume out of housing wealth might be higher than the marginal propensity to consume out of stock wealth.

As mentioned in the earlier section, the speed of adjustment (α) measures how fast the variables adjust during the transition to the long-run equilibrium. The values of the adjustment speeds in the vector error correction model are shown in terms of the following order: LCON, LINC, LHOU and LTSE.

(5-3) $\alpha = (-0.145322, -0.196417, -0.012442, 1.151317)$.

The magnitude of those values indicates the absolute speed of adjustment for each variable. According to the value of α, it is obvious that the speed of adjustment for stock market wealth is the fastest, while the adjustment speed for housing wealth is the slowest in all variables.

Regarding the sign of adjustment speed of consumption (-0.145322), the plus sign indicates the same deviation from the long-run equilibrium, while the minus sign indicates the opposite deviation from the steady state. The values –0.196417 and -0.012442 respectively measure the adjustment speeds of LINC and LHOU to the steady state from the opposite deviation. On the other hand, the value of 1.151317 measures the adjustment speed of LTSE to the steady state from the same deviation.

Table 4.5 reports the results of the cointegration restriction tests on the speed of adjustment. The chi-square statistics are statistically significant for LCON, LINC and LTSE at the 5% level of significance. The null hypothesis for LHOU cannot be rejected even at the 10% level of significance. The results show that TSE adjusts quickly to the long-run equilibrium, and housing wealth appear to be weakly exogenous to the system. Thus, there is a significant short-run adjustment from income, stock prices and housing prices on consumption.

The overall results of the cointegration test for consumption, disposable income, house wealth and stock income are consistent with other findings. As expected, consumption is significantly related with disposable income, housing wealth and stock wealth. The value of the estimated elasticity of consumption to disposable income is significantly positive and less than one, as suggested by the life-cycle model (Modigliani 1963). Another remarkable result is that the effect of housing wealth on consumption is more important than that of stock wealth. It is in line with the findings of Pichette (2004) and Case et al. (2001).

In order to examine the difference between the impact of stock wealth on consumption of durable goods and the impact on consumption of non-durable goods, I use the consumption of non-durable goods and services to carry out a new cointegration test. The log value of per capita consumption of non-durable goods and service (LUNCON) is verified to follow an I(1) process. The results of the test including LUNCON are presented in Tables 5.1 to 5.5. I only compare the values of the coefficients of the cointegrating vector (β) to the above one. The values of β

are listed as the following order: LUNCON, LINC, LHOU, LTSE and constant:

(5-4) $\beta = (1,-0.435818, -0.419917,-0.119015, 0.056127)$.

Comparing with the coefficients of the cointegrating vector of LCON,LINC,LHOU and LTSE (β =(1,-0.391821,-0.440312,-0.123733,-0.397639)), I find that disposable income has more effect on the consumption of non-durable goods and services, while the change of stock market wealth and the change of housing wealth have more effect on total consumption. It supports the hypothesis that there is a more important wealth effect on consumption of durable goods than that of non-durable goods and services. Poterba and Samwick (1995) reached the same conclusion with US data.

Because of the limitation of quarterly data of housing wealth for the whole period, I carry out the Johansen test to verify the robustness of the results for the whole period by using the quarterly data of residential structure net of mortgages from 1990 to 2003 as a sub-sample. The results of sub-sample test are shown in Tables 6.1 to 6.5. Compared with the results for the whole period, the significant difference is that the housing wealth effect on consumption in the sub-period (-0.796852) is obviously larger than that in the whole period (-0.440312), and the stock wealth effect on consumption in the sub-period (-0.133795) is slightly higher than that in the whole period (-0.123733).

Some factors may explain why elasticities have increased over time. Most households own their houses in Canada, and mortgage deregulation in the recent years improved the effect of housing wealth on consumption as housing prices significantly increased. Another reason may be that housing wealth as a component of household wealth in the sub-period is larger than before, and the increased housing wealth may play a more important role in households' consumption. It is true that the significant rise and fall of stock market prices in the sub-period led to huge capital gains and capital losses. However, a relatively small proportion of households own stocks, and then the change of effect on consumption from stock wealth in the sub-period is very small. It also partly explains the result that the relatively smaller effect of stock wealth on consumption than the effect of housing wealth.

5.3 VAR Pairwise Granger Causality

Although many researchers study the long-run relationship between consumption, income and wealth, they rarely investigate the causality relationship among those variables. It is usually assumed that a change in income and wealth causes a change in consumption. The purpose of carrying out an MWALD test in this paper is not only to prove Granger causality among those variables, but also to investigate if the reverse Granger causality relationship exists.

The optimal lag length for the unrestricted VAR in levels (k) is six for each variable, and the maximum order of integration in the system (d) is one. Therefore, I estimate the VAR with a lag length of seven. The Wald statistics for each variable has a Chi-square distribution with six degrees of freedom.

Table 7 illustrates the results of MWALD test. The null hypothesis that the coefficients of the lagged values of disposable income, housing wealth and TSE in the equation of consumption are zero can be rejected at the 5% level of significance.

Interestingly, the null hypothesis that the coefficients of the lagged values of consumption appearing in the two equations of disposable income and housing wealth are zero can also be rejected at the 10% level of significance respectively. The results above show that disposable income, housing wealth and stock wealth all Granger cause consumption as most researchers suppose. Moreover, the appealing finding is the existence of causality in the reverse direction, which means that consumption also Granger causes disposable income and housing wealth. Post-Keynesian theory of the Godley type indicates that the increase in the propensities to consume will lead to a temporary increase in disposable income and wealth, and lead to a lower steady state. Hence, the view of this post-Keynesian theory may be inconsistent with empirical evidence, which shows that the expansion of consumption can lead to a permanent increase in disposable income and wealth.

6. Conclusions

This paper uses time series data to analyze the interaction between disposable income, housing wealth, stock market wealth and consumption in Canada.

When I use a housing price index as a proxy for housing wealth in the cointegration test, the estimated elasticity of consumption in changes of housing wealth is negative, and the outcome is inconsistent with expectations. The positive relationship between consumption and housing wealth can be verified when residential structure net of mortgages is used as a proxy for housing wealth. I further investigate the different effects on two components of consumption, durable consumption and non-durable consumption. The empirical evidence shows a more important long-run impact of wealth in consumption of durable goods than the impact of wealth on consumption of non-durable goods and services, while the effect of income on consumption of durable goods is lower than the effect on non-durable goods and services. Finally, Granger causalities between disposable income, housing wealth and consumption go in both directions.

My analysis therefore can be contrasted with that of Dvonak and Kohler (2003), who find a lower impact of housing wealth for a panel of Australian states, as well as both Case et al. (2001) and Pichette (2004), who find a substantially higher impact of housing wealth. The evidence regarding the relative importance of housing wealth compared to stock market wealth is robust across different specifications in my study.

There are still some limitations in my study. One is the limitation of quarterly data for the whole period. Hence, to verify the robustness of the results for the whole period, I use quarterly data from 1990 to 2003 as a sub-sample, which are retrieved directly from CANSIMII. The results of tests for the sub-sample are consistent with those for the whole period. In addition, since both disposable income and wealth are the explanatory variables for consumption, there might be some correlation between wealth and disposable income that would weaken the quality of my results. Checking on this, I find that the correlation coefficient between disposable income and housing wealth is only 0.039917 while the correlation coefficient between disposable income and stock wealth is 0.034431. Hence, there is not an apparent problem for correlation.

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Data Sources

Variables	Period	Frequency	Series number	Resources	Scaling factor
Aggregate consumption	1961-2003	Quarterly	V498087	CANSIMII	Millions
Disposable income	1961-2003	Quarterly	V498186	CANSIMII	Millions
Housing price index	1961-2003	Monthly	V735586	CANSIMII	Units
TSE	1961-2003	Monthly	V7668	CANSIMII	Units
Consumer price index	1961-2003	Monthly	V735319	CANSIMII	Units
Total population	1961-2003	Quarterly	V1	CANSIMII	Units
Residential structures	1961-2003	Annually	V55464	CANSIMII	Millions
Mortgages	1961-2003	Annually	V33482	CANSIMII	Millions
Consumption on non-durable goods	1961-2003	Quarterly	V498090	CANSIMII	Millions
Consumption on services	1961-2003	Quarterly	V498091	CANSIMII	Millions
Residential structures	1990-2003	Quarterly	V20682579	CANSIMII	Millions
Mortgages	1990-2003	Quarterly	V20682593	CANSIMII	Millions

Figure1. Series of the Log

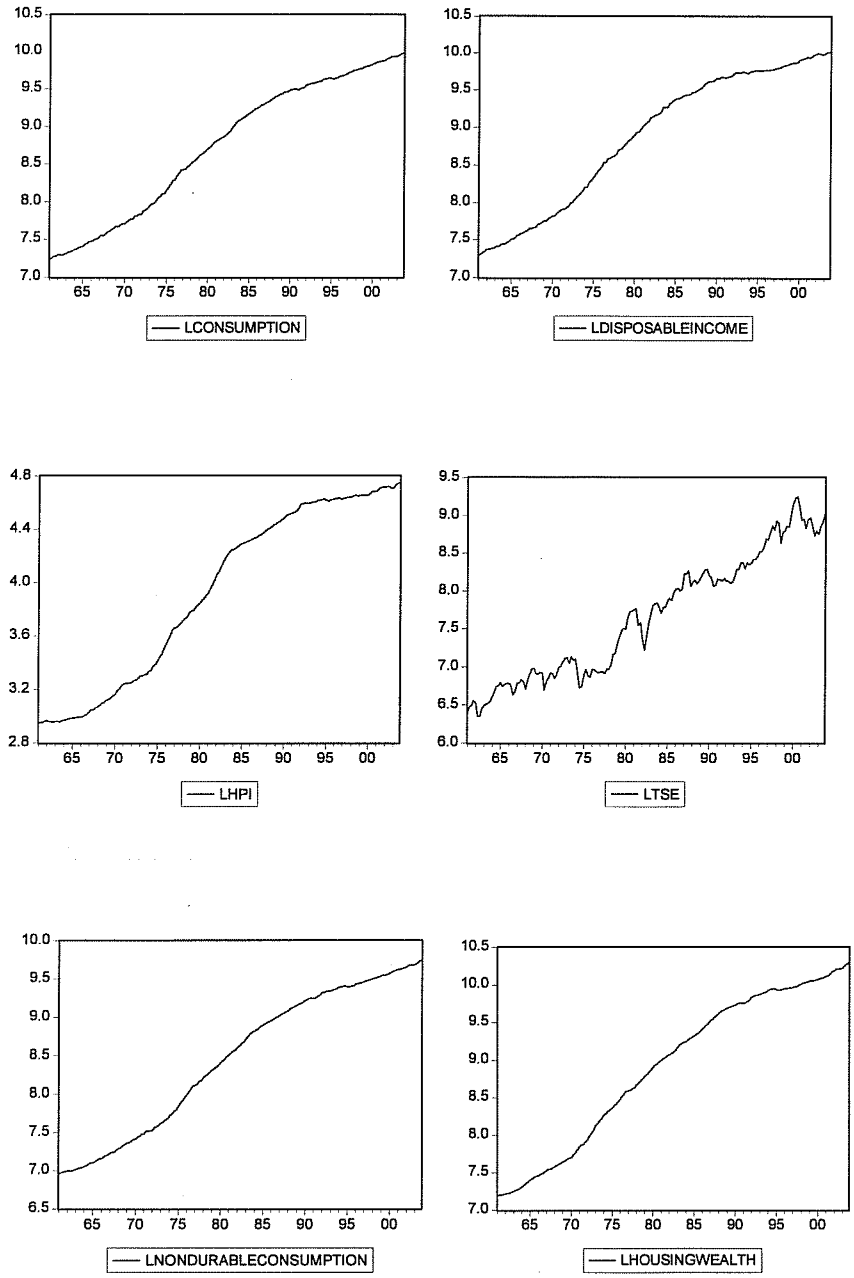

Figure 2. Series of the Log of the Variables in First Difference

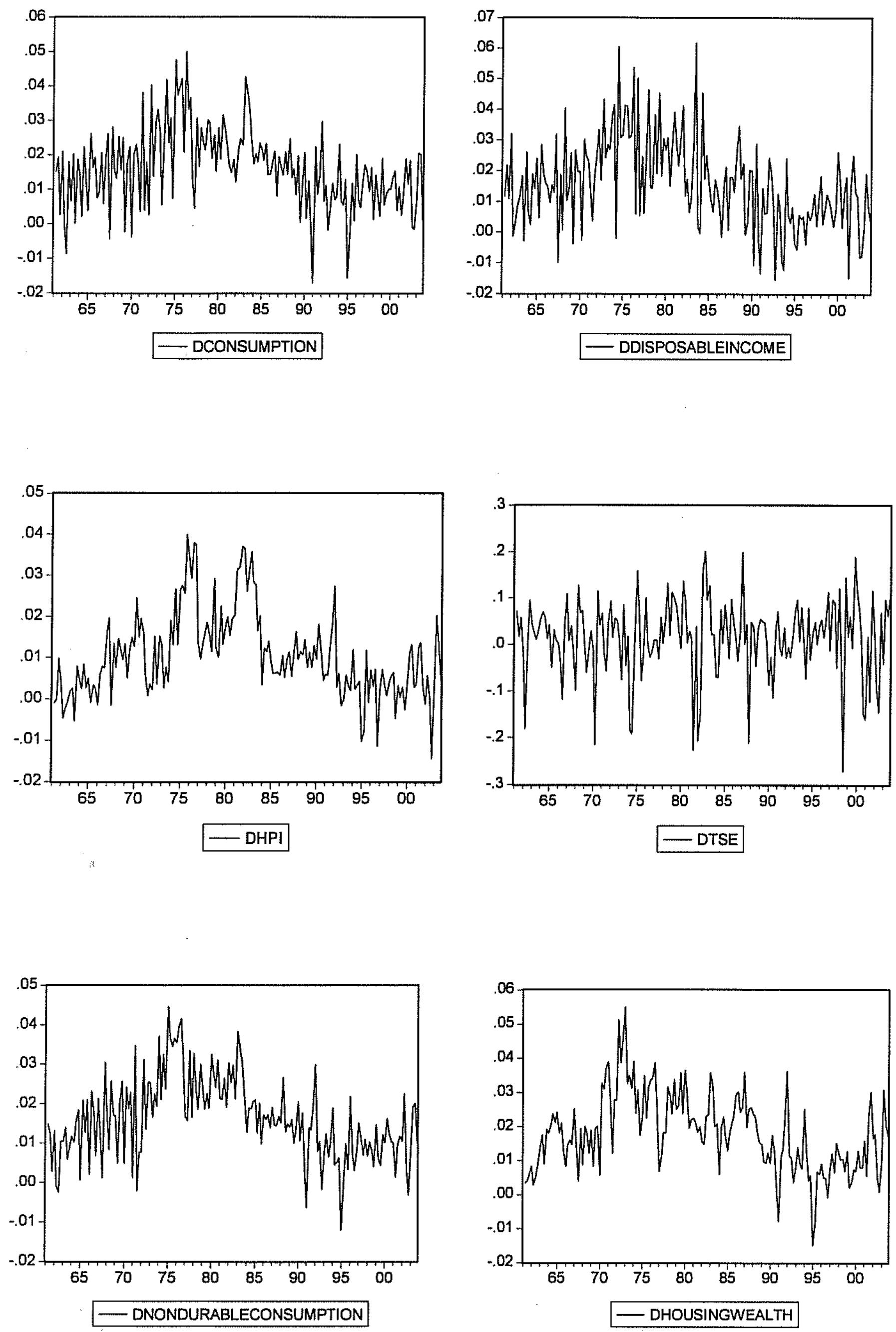

Table 1. Augmented Dickey Fuller (ADF) Unit Root Test Results

Log of Variables	Lag Length	Level	Lag Length	First Difference
Consumption	3	-0.081890	2	-3.825668*
Disposable income	0	1.717715	3	-3.066395**
HPI	2	-0.579567	1	-3.948860*
TSE	0	-3.129382	0	-11.69102*
Housing wealth	2	0.294274	1	-14.46685*
Non-durable consumption	2	0.073911	1	-14.46352*

Notes:

1 * indicates statistically significant at the 1 percent level, ** indicates statistically significant at the 5 percent level, *** indicates statistically significant at the 10 percent level;

2 Maximum lag lengths are 13.

3 The critical values are reported by Mackinnon (1996);

4 The appropriate lag length is selected based on the SICs.

Table 2. DF-GLS Unit Root Test Results

Log of Variables	Lag Length	Level	Lag Length	First Difference
Consumption	3	-0.653248	2	-3.794486*
Disposable income	7	-1.4915337	6	-1.469672
HPI	2	-0.989928	2	-2.138379**
TSE	0	-3.002295	0	-9.455845*
House wealth	2	-0.222005	1	-14.50441*
Non-durable consumption	2	-0.389925	1	-14.46275*

Notes:

1 * indicates statistically significant at the 1 percent level, ** indicates statistically significant at the 5 percent level, *** indicates statistically significant at the 10 percent level;

2 Maximum lag lengths are 13.

3 The critical values are supported by Mackinnon (1996) and Elliott, Rothenberg and Stock (1996);

4 The appropriate lag length is selected based on the SICs.

Table 3.1. VAR Lag Order Selection Criteria (Series in log Levels)

(Variables: LCON LINC LHPI LTSE)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	394.2623	NA	1.01E-07	-4.759297	-4.683690	-4.728604
1	1813.311	2751.570	3.73E-15	-21.86965	-21.49162*	-21.71618
2	1850.217	69.76054	2.90E-15	-22.12459	-21.44414	-21.84835*
3	1867.394	31.63190	2.86E-15*	-22.13895*	-21.15607	-21.73994
4	1882.305	26.73057*	2.90E-15	-22.12567	-20.84036	-21.60389
5	1896.723	25.14239	2.96E-15	-22.10637	-20.51864	-21.46181
6	1902.421	9.659643	3.37E-15	-21.98074	-20.09058	-21.21341
7	1909.347	11.40326	3.79E-15	-21.87009	-19.67750	-20.97998
8	1916.753	11.83058	4.24E-15	-21.76528	-19.27026	-20.75240

Table 3.2. Johansen's Cointegration Test Results for All Variables

Trace Test

Hypothesized No. of CE	H1	Trace Statistics	5% Critical value	1% Critical Value
r=0**	r>=0	83.74885	47.21	54.46
r<=1*	r>1	30.86460	29.68	35.65
r<=2	r>2	10.92080	15.41	20.04
r<=3	r>3	0.338957	3.76	6.65

Notes

1 The number of observations is 169;

2 Lag length in cointegration test is 2;

3 The critical values are reported by Osterwald Lenum(1992).

4 *(**) denotes rejection of the hypothesis at the 5%(1%) level;

5 Trace test indicates 2 cointegrating equation(s) at the 5% level and 1 cointegrating equation at the 1% level;

Max-eigenvalue Test

Hypothesized No. of CE	H1	Max-Eigen Statistics	5% Critical value	1% Critical Value
r=0**	r=1	52.88425	27.07	32.24
r=1	r=2	19.94380	20.97	25.52
r=2	r=3	10.58184	14.07	18.63
r=3	r=4	0.338957	3.76	6.65

Notes:

1 *(**) denotes rejection of the hypothesis at the 5%(1%) level;

2 Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels.

Table 3.3. Sign of the Coefficients

	LINC	LHPI	LTSE
All variables	+	-	+
Deleting one variable			
Without LINC		+	+
Without LHPI	+		+
Without LTSE	+	-	
Conclusion	+	-	+

Table 3.4. Cointegration Restriction Test Results

Long-Run Exclusion	Chi-square	P-value	Conclusion
Without LINC	20.64157	0.000006	Reject H0
Without HPI	32.73367	0.000000	Reject H0
Without TSE	0.998051	0.317783	Do not reject H0
Without LCON	4.939352	0.026252	Reject H0

Table 3.5. Results of Cointegration Restriction Test on the Speed of Adjustment

Cointegration restriction on the speed of adjustment	Chi-square	P-value	Conclusion
LCON	27.34848	0.000000	Reject H0
LINC	22.83318	0.000000	Reject H0
LHPI	28.00341	0.000000	Reject H0
LTSE	0.132351	0.716007	Do not reject H0

Table 4.1. VAR Lag Order Selection Criteria (Series in log Levels)

(Variables: LCON, LINC, LHOU, LTSE)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	407.6601	NA	8.55E-08	-4.922684	-4.847078	-4.891991
1	1781.200	2663.327	5.53E-15	-21.47805	-21.10001	-21.32458
2	1831.863	95.76669	3.62E-15	-21.90077	-21.22032*	-21.62453*
3	1854.436	41.56703	3.35E-15	-21.98093	-20.99805	-21.58192
4	1875.596	37.93245	3.15E-15	-22.04385	-20.75854	-21.52206
5	1889.338	23.96555	3.24E-15	-22.01632	-20.42859	-21.37176
6	1912.388	39.07252*	2.99E-15*	-22.10230*	-20.21213	-21.33496
7	1923.935	19.01047	3.17E-15	-22.04799	-19.85540	-21.15789
8	1938.782	23.71824	3.24E-15	-22.03393	-19.53891	-21.02105

Table 4.2. Johansen's Cointegration Test Results

Trace Test

Hypothesized No. of CE	H1	Trace Statistics	5% Critical value	1% Critical Value
r=0*	r>=0	52.79583	47.21	54.46
r<=1	r>1	17.48535	29.68	35.65
r<=2	r>2	8.388447	15.41	20.04
r<=3	r>3	1.886129	3.76	6.65

Notes:

1 The number of observations is 166.

2 Lag length in cointegration test is 5.

3 The critical values are reported by Osterwald Lenum(1992).

4 *(**) denotes rejection of the hypothesis at the 5%(1%) level.

5 Trace test indicates 1 cointegrating equation(s) at the 5% level.

Max-eigenvalue Test

Hypothesized No. of CE	H1	Max-Eigen Statistics	5% Critical value	1% Critical Value
r=0**	r=1	35.31048	27.07	32.24
r=1	r=2	9.096899	20.97	25.52
r=2	r=3	6.502318	14.07	18.63
r=3	r=4	1.886129	3.76	6.65

Notes:

1 *(**) denotes rejection of the hypothesis at the 5%(1%) level;

2 Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels.

Table 4.3. Sign of the Coefficients

	LINC	LHOU	LTSE
All variables	+	+	+
Deleting one variable			
Without LINC		+	+
Without LHOU	+		+
Without LTSE	+	+	
Conclusion	+	+	+

Table 4.4. Cointegration Restriction Test Results

Long-Run Exclusion	Chi-square	P-value	Conclusion
Without LINC	12.11447	0.000500	Reject H0
Without LHOU	21.37049	0.000004	Reject H0
Without LTSE	18.61855	0.000016	Reject H0
Without LCON	25.71860	0.000000	Reject H0

Table 4.5. Results of Cointegration Restriction Test on the Speed of Adjustment

Cointegration restriction on the speed of adjustment	Chi-square	P-value	Conclusion
LCON	11.46315	0.000710	Reject H0
LINC	10.57152	0.001148	Reject H0
LHOU	0.127537	0.721000	Do not reject H0
LTSE	7.233928	0.007154	Reject H0

Table 5.1. VAR Lag Order Selection Criteria (Series in log Levels)

(Variables: LUNCON LINC LHOU LTSE)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	358.0257	NA	1.57E-07	-4.317386	-4.241780	-4.286693
1	1819.979	2834.763	3.44E-15	-21.95096	-21.57293	-21.79750
2	1874.932	103.8745	2.14E-15	-22.42600	-21.74554*	-22.14976*
3	1896.462	39.64645	2.00E-15	-22.49344	-21.51055	-22.09442
4	1911.471	26.90695	2.03E-15	-22.48135	-21.19604	-21.95957
5	1931.441	34.82513	1.94E-15	-22.52976	-20.94203	-21.88520
6	1948.005	28.07862*	1.94E-15*	-22.53665*	-20.64648	-21.76931
7	1959.720	19.28646	2.05E-15	-22.48439	-20.29180	-21.59428
8	1974.129	23.01966	2.11E-15	-22.46499	-19.96997	-21.45211

Table 5.2. Johansen's Cointegration Test Results

Trace Test

Hypothesized No. of CE	H1	Trace Statistics	5% Critical value	1% Critical Value
r=0**	r>=0	65.61837	47.21	54.46
r<=1	r>1	22.85159	29.68	35.65
r<=2	r>2	11.70246	15.41	20.04
r<=3	r>3	3.264169	3.76	6.65

Notes:

1 The number of observations is 166;

2 Lag length in cointegration test is 5;

3 The critical values are reported by Osterwald Lenum(1992).

4 *(**) denotes rejection of the hypothesis at the 5%(1%) level;

5 Trace test indicates 1 cointegrating equation(s) at both 5% level and 1% level;

Max-eigenvalue Test

Hypothesized No. of CE	H1	Max-Eigen Statistics	5% Critical value	1% Critical Value
r=0**	r>=0	42.76678	27.07	32.24
r<=1	r>1	11.14913	20.97	25.52
r<=2	r>2	8.438287	14.07	18.63
r<=3	r>3	3.264169	3.76	6.65

Notes:

1 *(**) denotes rejection of the hypothesis at the 5%(1%) level;

2 Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% level and 1% level.

Table 5.3. Sign of the Coefficients

	LINC	LHOU	LTSE
All variables	+	+	+
Deleting one variable			
Without LINC		+	+
Without LHOU	+		+
Without LTSE	+	+	
Conclusion	+	+	+

Table 5.4. Cointegration Restriction Test Results

Long-Run Exclusion	Chi-squares	P-value	Conclusion
Without LUNCON	29.48343	0.000000	Reject H0
Without LINC	15.74800	0.000072	Reject H0
Without LHOU	24.99384	0.000001	Reject H0
Without LTSE	22.16701	0.000002	Reject H0

Table 5.5. Results of Cointegration Restriction Test on the Speed of Adjustment

Cointegration restriction on the speed of adjustment	Chi-squares	P-value	Conclusion
LUNCON	17.97643	0.000022	Reject H0
LINC	13.19595	0.000281	Reject H0
LHOU	1.934194	0.164300	Do not reject H0
LTSE	8.530366	0.003493	Reject H0

Table 6. the Results of Cointegration Test for 1990 to 2003

Table 6.1.1 Augmented Dickey Fuller (ADF) Unit Root Test Results

Log of Variables	Lag Length	Level	Lag Length	First Difference
Consumption	0	3.004777	0	-7.492547*
Disposable income	0	-1.844206	1	-6.985899*
TSE	0	-2.169204	0	-7.070802*
Housing wealth	0	-0.710324	0	-5.349938*

Notes:

1 * indicates statistically significant at the 1 percent level, ** indicates statistically significant at the 5 percent level, *** indicates statistically significant at the 10 percent level;

2 Maximum lag length is 10.

3 The critical values are reported by Mackinnon (1996);

4 The appropriate lag length is selected based on the SICs.

Table 6.1.2. DF-GLS Unit Root Test Results

Log of Variables	Lag Length	Level	Lag Length	First Difference
Consumption	0	-2.542276	0	-6.244103&*
Disposable income	0	-1.740537	2	-1.855094***
TSE	0	-2.104256	0	-6.930702*
Housing wealth	0	-0.723948	0	-5.351403*

Notes:

1 * indicates statistically significant at the 1 percent level, ** indicates statistically significant at the 5 percent level, *** indicates statistically significant at the 10 percent level;

2 Maximum lag length is 10.

3 The critical values are reported by Mackinnon(1996) and Elliott, Rothenberg and Stock (1996);

4 The appropriate lag length is selected based on the SICs.

Table 6.1. VAR Lag Order Selection Criteria For All Four Series in log Levels in

(Variables: LCON LINC LHOU LTSE)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	353.6538	NA	1.30E-11	-13.71192	-13.56040	-13.65402
1	625.3255	490.0743	5.78E-16	-23.73825	-22.98068*	-23.44876*
2	635.8114	17.27091	7.26E-16	-23.52202	-22.15837	-23.00093
3	650.5157	21.91237	7.88E-16	-23.47121	-21.50150	-22.71852
4	663.7782	17.68333	9.32E-16	-23.36385	-20.78809	-22.37958
5	705.2215	48.75674*	3.80E-16*	-24.36163*	-21.17980	-23.14575

Table 6.2. Johansen's Cointegration Test Results

Trace Test

Hypothesized No. of CE	H1	Trace Statistics	5% Critical value	1% Critical Value
r=0**	r>=0	60.59772	47.21	54.46
r<=1	r>1	21.25632	29.68	35.65
r<=2	r>2	5.230080	15.41	20.04
r<=3	r>3	0.279414	3.76	6.65

Notes:

1 The number of observations is 51;

2 Lag length in cointegration test is 4;

3 The critical values are reported by Osterwald Lenum(1992).

4 *(**) denotes rejection of the hypothesis at the 5%(1%) level;

5 Trace test indicates 1 cointegrating equation(s) at both1% and 5% level;

Max-eigenvalue Test

Hypothesized No. of CE	H1	Max-Eigen Statistics	5% Critical value	1% Critical Value
r=0**	r=1	39.34140	27.07	32.24
r=1	r=2	16.02624	20.97	25.52
r=2	r=3	4.950666	14.07	18.63
r=3	r=4	0.279414	3.76	6.65

Notes:

1 *(**) denotes rejection of the hypothesis at the 5%(1%) level;

2 Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels.

Table 6.3. Sign of the Coefficients

	LINC	LHOU	LTSE
All variables	+	+	+
Deleting one variable			
Without LINC		+	-
Without LHOU	+		+
Without LTSE	+	+	
Conclusion	+	+	+

Table 6.4. Cointegration Restriction Test Results

Long-Run Exclusion	Chi-square	P-value	Conclusion
Without LINC	0.845133	0.357933	Do not reject H0
Without LHOU	23.31338	0.000001	Reject H0
Without LTSE	12.41317	0.000426	Reject H0
Without LCON	12.46738	0.000414	Reject H0

Table 6.5. Results of Cointegration Restriction Test on the Speed of Adjustment

Cointegration restriction on the speed of adjustment	Chi-square	P-value	Conclusion
LCON	4.639018	0.031253	Reject H0
LINC	0.912721	0.339394	Do not reject H0
LHOU	9.158977	0.002475	Reject H0
LTSE	1.609559	0.204554	Do not reject H0

Table 7. Granger Causality Test Results for the Whole Period

(Variables: LCON LINC LHOU TSE)

Independent variables X	Dependent variables Y	Wald statistics	P-value	Causality X to Y
Disposable income	Consumption	12.894802	0.04474	YES
Housing wealth	Consumption	46.042743	0.00000	YES
TSE	Consumption	25.222031	0.00031	YES
Consumption	Disposable income	19.433005	0.00349	YES
Consumption	Housing wealth	12.187912	0.05791	YES
Consumption	TSE	8.1149598	0.22980	NO

Note: "YES" indicates significant causal relationship at the 10% level of significance; "NO" indicates no significant causal relationship.