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HOW LARGE IS THE WEALTH EFFECT ON HONG KONG'S CONSUMPTION? EVIDENCE FROM A HABIT FORMATION MODEL OF CONSUMPTION

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Abstract

This paper first investigates whether there is a cointegration relationship between Hong Kong's consumption and wealth using the latest cointegration tests that allow for structural breaks. Our tests show there is only limited empirical support for the existence of a cointegration relationship between consumption and wealth (including both housing and financial wealth). These test results thus cast doubt on the validity of the estimates based on the cointegration result. We then estimate a structural equation linking consumption and wealth derived from a habit formation consumption model. Our estimates show that the short run and the long run marginal propensities to consume out of a one Hong Kong dollar increase in total wealth are about 0.14 and 0.6 cents, respectively. These values are much smaller than those previously estimated using the cointegration approach. The housing wealth effect in Hong Kong is also relatively small compared to estimates for the United States obtained using a similar habit formation specification.

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Executive Summary:

- *Previous estimates of Hong Kong's wealth effect on consumption are mostly based on an empirical framework that requires a stable long-run relationship between consumption and income and wealth. However, to provide reliable estimates, this framework - cointegration analysis - requires some strong theoretical assumptions and empirical prerequisites. Theoretically, it assumes changes in other important macroeconomic variables that may also have direct impact on consumption and wealth in the long run (e.g., productivity growth, population growth, and steady state interest rate) do not affect the stability of the relationship. Empirically, the relationship between consumption and wealth could be disrupted by severe economic shocks, leading to a rejection of a stable cointegration relationship.*

- *We first test for the cointegration relationship between consumption and wealth based on our empirical findings that both income and wealth are nonstationary. Our various cointegration tests indicate that there is strong evidence against the existence of a stable relationship between Hong Kong's consumption and wealth measures.*

- *We then adopt a structural equation specification derived from a habit formation consumption model in order to estimate the marginal propensity to consume (MPC) out of wealth. Our estimates indicate that the short run and the long run MPCs for Hong Kong are much smaller than those previously estimated using the cointegration approach.*

- *Specifically, the short-run MPCs out of the housing and financial wealth are about 0.0011 and 0.0016, respectively, implying next quarter's consumption would increase by 0.11 and 0.16 cents as a result of an increase of one Hong Kong dollar in housing and financial wealth.*

- *The estimated long-run MPCs out of the housing and financial wealth are about 0.005 and 0.007, respectively, implying an increase of next year's consumption of 0.5 and 0.7 cents from an increase of one Hong Kong dollar in the housing and financial wealth.*

- *Compared with the results for the US using a similar estimation framework, Hong Kong's wealth effect on consumption appears to be quite small, possibly reflecting high volatilities in Hong Kong's asset prices.*

I. INTRODUCTION

A positive wealth effect associated with rising asset prices since the second quarter of 2003 in Hong Kong has often been used to explain the relatively strong consumption growth, as growth in real wages over this period has been moderate. Although the wealth effect has important implications for consumption and economic growth, its size remains an open empirical question.

Previous studies of the wealth effect in Hong Kong have mostly applied a cointegration approach. For example, estimates by Lai and Lam (2002) and Cutler (2004) using this approach put Hong Kong's marginal propensity to consume (MPC) out of *housing* wealth at around 0.07 and 0.03, respectively, which implies that a one Hong Kong dollar increase in housing wealth will lead to an increase of about 7 to 3 cents in consumption.[1] The cointegration approach, however, requires some strong theoretical assumptions and empirical prerequisites. Theoretically, it assumes the cointegration relationship between consumption and wealth is not affected by changes in some important macroeconomic variables such as steady state interest rate, productivity growth, population growth, and tax changes (Carroll *et al*, 2006). Therefore, it may suffer from the omitted variable bias. Empirically, the relationship may be potentially disrupted by severe shocks to the economy. Indeed, the latter is particularly troublesome for Hong Kong as the economy has undergone several severe economic shocks since 1997, including the 1997-98 Asian financial crisis, the collapse of external demand in 2001-2002 because of the burst of the IT bubble, the subsequent effect of the September 11 terrorist attack in 2001, and the 2003 SARS epidemic. Because of these shocks, Hong Kong's asset markets have experienced a boom-bust cycle and a prolonged deflation. The existence of potential structural breaks may have complicated the implementation of the cointegration methodology, thus casting doubt on the validity of the cointegration estimates over the full sample (1984 – 2006).

These theoretical and empirical considerations thus require an updated analysis of the wealth effect on consumption in Hong Kong. In particular, the cointegration relationship between consumption and wealth needs to be checked for robustness with estimation techniques that allow for structural breaks.

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[1] Note that the housing wealth in Lai and Lam (2002) is measured differently from that in Cutler (2004). The former authors use the real property prices, whereas Cutler uses gross housing wealth minus loans to purchase residential properties and subsidised flats. In this paper we also use the Cutler definition. Please also see footnote 3 for the definition of financial wealth. Cutler's estimate of MPC out of the financial wealth is 0.01.2, or 1.2 cents from an increase of one Hong Kong dollar in wealth.

Given the theoretical drawbacks of the cointegration approach, this paper also estimates a structural equation derived from a habit formation consumption model to investigate the wealth effect on consumption. It is hoped that this alternative approach will help us obtain a more reliable range of estimates of the wealth effect in Hong Kong.

The rest of the paper proceeds as follows. Section II describes the available data on consumption in Hong Kong and conducts unit root tests robust to structural breaks. Section III conducts cointegration tests between consumption and wealth again allowing for structural breaks. Section IV derives a structural equation linking consumption and wealth from a habit formation consumption model and discusses empirical findings. Section V concludes.

II. CONSUMPTION DATA AND UNIT ROOT TESTS

Data description

Data on aggregate private consumption expenditure are available for 6 major components: services, durables, non-durables, food, resident consumption abroad, and non-resident consumption in domestic market.[2] Most of these components exhibit some trend behaviour, although the exact nature of these trends is difficult to identify and is even harder to predict, particularly after 1997 (Figures 1 – 7). Labour income is constructed using real average payroll per person engaged (in constant 1999 HKD price) multiplied by total number of employed persons. Wealth variables include both financial and housing wealth.[3] As all of these data series are subject to strong seasonality, they are seasonally adjusted using the X12-ARIMA process. The series are in quarterly frequency spanning from 1984 Q1 until 2006 Q4.

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[2] Note that the non-resident consumption in domestic market is excluded from the total consumption as the domestic wealth effect should have little influence on non-resident consumption in Hong Kong.

[3] Given the flow of funds data are not available for Hong Kong, financial wealth is defined as notes and coins held by non-banks plus deposits from customers and total stock market capitalisation less credit card advances. Housing wealth is calculated using gross housing wealth minus loans to purchase residential properties and government subsidised flats. The definition of the data, however, does not allow us to differentiate between non-resident holdings of assets in Hong Kong and resident holdings of assets abroad.

Unit roots tests with structural breaks

Unit root is a common problem in macroeconomic time-series and often impedes proper inference making. As a first step, we test for the presence of unit roots in our series. Given the presence of potential structural breaks, the usual diagnostic tests used for investigating the hypothesis of unit root in the data may no longer be reliable. Therefore, this section applies recent unit root test techniques that allow for unknown breakpoints. The techniques are applied to both disaggregated and total consumption data for Hong Kong.

The idea that structural changes could lead to the erroneous conclusion of a unit root in data series was first demonstrated by Perron (1989). Zivot and Andrews (1992) (henceforth ZA) extended the Perron (1989) test by allowing for one breakpoint to be determined endogenously as part of the test procedure. Lumsdaine and Papell (1997) (henceforth LP) built upon the ZA methods and allowed for two endogenously determined structural breaks. Under these two tests, the null hypothesis is that a unit root exists. The alternative hypothesis is that there is one (or two) unknown structural break(s). The rejection of the null hypothesis implies that structural breaks are present, but it does not guarantee the stationarity of the series (see Nunes, Newbold, and Kuan, 1997, Vogelsang and Perron, 1998, and Lee and Strazicich, 2001). In order to discuss the tests used in this paper clearly, consider the following baseline model featuring both two level shifts and two trend shifts

$$\Delta y_t = m + bt + ay_{t-1} + \sum_{j=1}^{2} q_j DU_{jt} + \sum_{j=1}^{2} d_j DT_{jt} + \sum_{p=1}^{k} f_p \Delta y_{t-p} + e_t \quad (2.1)$$

for $t = 1, \ldots, T$, where $\sum_{p=1}^{k} f_p \Delta y_{t-p}$ is a lag polynomial of known order *k*, which is set as a maximum of $k_{\max} = 8$. In this paper, the optimal lag (*k*) is determined by the minimum *t*-statistic method, which implies looking at whether the last augmented term is significant, using the asymptotic normal value of 1.645 at 10% level of significance. DU_{jt} and DT_{jt} are the indicator dummy variables for a level (mean) shift and a trend (slope) shift, respectively, occurring at break times T_{Bj} with $j = 1,2$. More explicitly:

$$DU_{jt} = \begin{cases} 1 & \text{if } t > T_{Bj} \\ 0 & \text{otherwise} \end{cases} \text{ for } j = 1,2 \text{ and}$$

$$DT_{jt} = \begin{cases} t - TB_j & \text{if } t > T_{Bj} \\ 0 & \text{otherwise} \end{cases} \text{ for } j = 1,2 .$$

This is the general model considered by Lumsdaine and Papell (1997). If one assumes one break only ($j = 1$), then the model and test reduce to the Zivot and Andrews (1992) specification. Moreover, if the breakpoint is determined exogenously, then this is the Perron (1989) test. Following the taxonomy of Perron (1989), three broad types of model specification can be distinguished: Model (A) features a level (intercept) shift; model (B) allows for a shift in the trend (slope); and model (C) allows for both types of shifts to take place.[4] It is generally acknowledged in the literature that macroeconomic time series are best represented by model (A) and model (C). For simplicity, this paper adopts model (C) for all time-series as it is the more general form of the model that encompasses the two possible types of breakpoints. As Lumsdaine and Papell (1997) point out, the literature in this field has yet to tackle the issue of model selection for these specific tests.

The null and the alternative hypothesis testing model (2.1) can be expressed as

$$H_0 : a = 0$$
$$H_a : a < 0 \text{ with break(s)}$$

similar to the typical ADF test. The estimation strategies for breakpoints (T_{Bj}) are similar across the different tests. A sequence of one-sided t statistic testing the null hypothesis $a = 0$ is computed over all possible combinations of breakpoint dates. The reported break dates are determined at places where the sequence is minimised. As it is conventionally done for these endogenous break tests, the endpoints are "trimmed". As a result, the search interval for breakpoints requires elimination of the first and last 10% of the data.

The results are presented in table 1. The traditional ADF test does not reject the null of a unit root against the alternative hypothesis of stationarity for all key variables used in this analysis. Overall, the ZA and LP tests also support the null hypothesis and reject the alternatives of one or two breaks. When examining the date of structural changes, we find that they occur mostly around the Asian

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[4] Note that the model presented in equation (2.1) is a (C) model.

financial crisis (1997 – 1998) and the sharp collapse of external demand during 2001 – 2002, which was mostly due to the burst of IT bubble and the terrorist event of 11 September 2001. The SARS epidemic, however, does not seem to be detected in any of the consumption series (see table 2 for chronology of events).

For two of the variables the test results are slightly ambiguous. The null of unit roots for the log of private consumption expenditure of food (PCE-food) and non-residents (PCE-non-residents) is rejected in favour of the alternative hypothesis of two breaks with the LP test. Both PCE-food and PCE-non-residents appear to be affected by the 1997 Asian financial crisis. PCE-food appears to be affected by events in 1992 and PCE-non residents are potentially affected by the 1987 stock market crash. However, the null of a unit root against the alternative of one structural break is not rejected for any of the two series using the ZA test.

Our test results for the key variables used in the paper can be summarised as follows. First, total private consumption expenditure appears to have a unit root consistently across the different tests. The potential break dates also correspond to some extent to those significant dates found in the housing wealth variable. Furthermore, these dates tend to correspond roughly to the Asian financial crisis and the sharp collapse of external demand during 2001 – 2002. Second, the rest of the explanatory variables all have a unit root against the alternative of structural breaks. For example, labour income's potential break dates are related to the Asian financial crisis years. One of the potential break points for financial wealth also corresponds to the time of the global economic downturn, whereas the potential break dates for the real interest rate are related to the 1987 stock market crash and the Asian financial crisis.

III. ARE INCOME AND WEALTH COINTEGRATED?

The Gregory – Hansen cointegration test

Once unit roots have been identified in the series, the next step is to test for cointegration relationships between consumption and income and wealth. The cointegration analysis focuses on total private consumption expenditure as well as its three subcomponents: durables, non-durables, and services. In addition to the familiar Johansen test, we also provide results based on the test proposed by

Gregory and Hansen (1995).[5] Gregory and Hansen (1995) test the null of no cointegration against the alternative of cointegration with an unknown structural break, which is similar to the unit root literature that allows one or two structural breaks. The optimal lag structure in both the Johansen (1988) and the Gregory and Hansen (1995) tests is set using the Akaike (1974) Information Criterion.

As presented in Table 3(a), the Gregory-Hansen test shows that the null of *no cointegration* is not rejected for all series against the alternative hypothesis of cointegration with one break point. As for the break dates estimated from the Gregory-Hansen test, we find that they roughly correspond to those estimated from the unit root test with breaks. The Asian financial crisis seems to be the break point for all data series. The subsequent cointegration tests and estimations are then carried out over the full sample and samples before and after the financial crisis.

A word of caution is warranted, however. Splitting the sample into a pre- and post- 1997 samples reduce the number of observations available for carrying both inferences and estimations (54 and 38 respectively). Therefore, both tests and estimation results are likely to suffer from small sample biases. It is therefore advised to take these results with this issue in mind.

The Johansen cointegration test

Next, the Johansen (1988) tests are conducted for the Hong Kong consumption – wealth relationship under the assumption of no structural break, illustrated in the following equation:

$$C_t = a + b^{y} LY_t + b^{prop} W_t^{Prop} + b^{fin} W_t^{Fin} + u_t \quad (3.1)$$

where LY_t is the log of real labour income; W_t^{Prop} is the log of housing wealth; and W_t^{Fin} is the log of financial wealth. C_t represents the log of the real consumption components such as total PCE, durables, non-durables, and services.

The test results suggest that the evidence of whether there is a cointegration relationship between consumption and wealth is rather mixed. The trace statistic tends to favour the existence of one cointegrating relationship for

[5] Gregory and Hansen (1995) test is conducted using RATS 6.3 and Johansen's cointegration test using EViews 5.1.

total PCE, durables, non-durables. However, the maximum eigenvalue statistics consistently show that there is no cointegration relationship for total PCE, durables, and non-durables. The results, however, consistently show that there is a cointegration relationship for PCE-services and wealth (see table 3 (a)).

Turning to the pre-1997 samples, we also find that there is no strong cointegration relationship, except for PCE services based on the trace statistic. The evidence for the post-1997 period is mixed as well. The trace statistic indicates that there are cointegrating relationships for PCE-durables, non-durables and Total PCE. All the results are illustrated in Table 3 (b).

The Phillips – Ouliaris – Hansen test for cointegration

The ambiguity in the cointegration results is cross-checked using another cointegration testing technique, the Phllips-Ouliaris-Hansen test (POH). This test was proposed by Phillips and Ouliaris (1990) and Hansen (1990). The test first obtains the residuals from Equation (3.1) and then conducts an ADF test on its lag(s) with no trend and no constant term in the following form

$$\hat{u}_t = r\hat{u}_{t-1} + \sum_{p=1}^{k} f_i \Delta\hat{u}_{t-p} + e_t \qquad (3.2)$$

If the residuals are non-stationary, it implies that there is no cointegration. Alternatively put, the coefficient in equation (3.2), r, should be unity or very close to one. In the case of cointegration or when the residuals are stationary, coefficient r should be smaller than one. For illustrative purposes, the residuals $\hat{u}_t$ are plotted in Figures 8 – 11. One can observe that the error terms do not exhibit the patterns of stationary processes as they would be expected in a cointegration case. Furthermore, the errors tend to grow large and negative around the periods of known instabilities in Hong Kong, which mostly correspond to the endogenously estimated breakpoints by the Gregory and Hansen (1995) cointegration test.

Table 4 also presents the ADF test for spurious cointegrating regression. These tests require a new set of critical values and they are derived by Phillips and Ouliaris (1990) and Hansen (1990).[6] The statistics shown in table 4 all indicate that the *null of no cointegration* cannot be rejected for all sample periods, except for the equations involving PCE-Durables and PCE-Services for the full sample period and the post-1997 period, respectively. Note that for the pre-1997 period, the estimate of r is much larger than for the full sample and the pre-1997 sample. These test results thus provide us with further evidence that the total and disaggregated private consumption expenditure series may not be cointegrated with income and wealth.

Indeed, our cointegration test results seem to differ from those presented by Cutler (2004). Three factors may have attributed to the differences. The first two are statistics and data related. The third one is theoretical. First, the private consumption expenditure series (PCE) was revised in its entirety in 2003, mainly due to the refinement of consumption expenditure of non-residents in the domestic market.[7] Without making any changes in the overall GDP, this revision has adjusted private consumption expenditure (PCE) upwards and exports of services downwards.[8] Secondly, this paper uses a longer time-series than the one used in Culter (2004). It adds 29 quarters. As it is well known, cointegration analysis usually tends to perform better in a long span of time series data. Therefore, our test should offer more reliable results than those of Cutler. Thirdly, as argued by Carroll *et al* (2006), the cointegration relationship among consumption, income, and wealth is bound to be influenced some other important macroeconomic variables, for example, steady state interest rate, productivity growth, population growth, and tax rates. Thus, if there is any change in one of these variables, the cointegration relationship among consumption, income, and wealth may also change. Therefore, it may be difficult, if not impossible, to find a stable long-run relationship between consumption and wealth.

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6 The critical values are also available from Hamilton (1994), Table B.9.

7 In line with the recommendations for tourism statistics stipulated by the World Tourism Organisation, HKTB replaces the previous set of data on "tourism receipts" by a more comprehensive set of data entitled "Tourist Expenditure Associated to Inbound Tourism". The data coverage of this series is more comprehensive than the previous one, particularly with regards to the expenditure profile of same-day in-town visitors whose arrivals have been growing very rapidly in recent years.

8 See *Hong Kong Gross Domestic Product*, Third quarter 2003.

To summarise, the cointegration test results presented above do not seem to offer much support to the notion that the Hong Kong income and wealth data are cointegrated, that is, that they have a stable long-term relationship. Given this empirical uncertainty, it would be useful to use a different empirical framework to investigate the wealth effect in Hong Kong.

IV. HABIT FORMATION APPROACH TO ESTIMATING THE WEALTH EFFECT

The model

Muellbauer (1988) extends the classical approach to consumption modelling by allowing habit formation, where the habit stock, h_s enters the consumer utility function. A representative consumer's objective function is therefore as follows:

$$MaxE_t\left[\sum_{s=t}^{T}(1+r)^{s-t}U(C_s,h_s)\right],$$

subject to an intertemporal budget constraint

$$W_{t+1}=(1+r)[W_t-C_t]+Y_{t+1}$$

where W_t is wealth, Y_t labour income, C_t consumption, r real interest, and r discount rate or rate of intertemporal substitution. The representative consumer derives her consumption from both income and wealth. In addition, habit stock is assumed to evolve according to

$$h_{t+1}=(1-l)h_t+l(C_t-h_t)$$

where l is a constant. Following Muellbauer (1988), we further assume a specific utility function of the form

$$U(C,h)=\frac{(C-ch)^{1-r}}{1-r}$$

where c is a parameter that attaches the importance of habits h to consumption; if c is zero, habits are no longer useful to influence consumption.

This habit-formation formulation of the consumption function allows one to exploit an empirical feature that aggregate consumption growth responds slowly to shocks. This slow response to shocks is consistent with excessive consumption smoothness of aggregate consumption found in the US data (Carroll and Sommer, 2003).[9] It can be derived that growth in consumption one period ahead is statistically related to growth in consumption today (Dynan, 2000, Sommer, 2002, and Carroll and Slacalek, 2006). The equation for consumption growth can be written as[10]

$$\Delta \log C_{t+1} = V + c\Delta \log C_t + e_{t+1} \quad (4.1)$$

The importance of habits can be estimated from the serial correlation parameter in consumption growth of Equation (4.1). The residual term, e_{t+1}, contains the effects of all shocks on consumption, including those from the wealth effect.

Estimating the wealth effect

To estimate the marginal propensity to consume (MPC) out of wealth, equation (4.1), written in the form of growth rate of consumption, will need some adjustments.[11] As discussed in Carroll *et al* (2006), even if we use a lagged wealth variable ($\Delta \log W_{t-1}$) as the only instrumental variable in the first stage of regression to estimate $\Delta \log C_t$, the interpretation of this regression relationship will be between growth rate of wealth and growth rate of consumption. However, this problem can be resolved by using a ratio of a change in consumption to an initial level of consumption (in this case of quarterly data, five quarters lagged level of consumption is used) and a ratio of a change in wealth to the same initial level of *consumption*. Algebraically, the expressions of these two variables are as follows:

[9] Liu and Pauwels (2007) shows that Hong Kong's consumption is much less smooth than US one. However, this does not necessarily imply that habit formation model does not apply to Hong Kong consumers. As will be shown later, parameter c should be smaller than the one estimated from the US data.

[10] See Carroll (2007) for a detailed derivation of this equation.

[11] Note that the marginal propensity to consume (MPC) is defined as ?c/?w, which is simply the ratio of ∂C_t and ∂W_{t-1}.

$$\partial C_t = (C_t - C_{t-1})/C_{t-5} \ ,$$
$$\partial W_{t-1} = (W_{t-1} - W_{t-2})/C_{t-5}$$

Then, the first stage of regression of the following equation

$$\partial C_t = a_0 + a_W \partial W_{t-1} \quad (4.2)$$

gives us a direct estimate of MPC out of wealth in quarter t-1. Note that the MPC is not out of contemporaneous wealth and this setup will allow us to discuss the one quarter ahead or short-term MPC direction from the specification. Furthermore, to estimate the MPC from both housing and financial wealth separately, we can rewrite equation (4.2) as

$$\partial C_t = a_0 + a_{FW} \partial W_{t-1}^F + a_{HW} \partial W_{t-1}^H \quad (4.3)$$

where superscripts *"F"* and *"H"* represent financial and housing wealth, respectively.

Once regressions of equation (4.2) or (4.3) pass all the standard tests of instrument validity, equation (4.1) can be modified and estimated using instrumental variables in the form below.

$$\partial C_{t+1} = g + c\partial C_t + x_{t+1} \quad (4.4)$$

After some algebraic approximation, the long-run MPC can be expressed as

$$MPC_n^{LR} = \frac{a_n}{c(1-c)} \quad (4.5)$$

where subscript *n* represents total wealth {W}, housing wealth {HW}, or financial wealth {FW}.[12]

[12] The long-run MPC here reflects the medium-run dynamics of consumption over the course of a few years (Carroll, *et al* 2006). Note that as the amount of long-run wealth may be endogenous with respect to consumption choices, there may not be a meaningful interpretation of long-run MPC, short of a cointegration relationship between consumption and wealth. Therefore, we use four-quarters as the long run and one quarter as the short run.

Estimation strategy

Following the general procedures suggested by Carroll *et al* (2006), we estimate equations (4.2), (4.3) and (4.4) in 4 steps:

1. Estimate equation (4.4) using instrumental variables to obtain c . The instrumental variables used to forecast $E_{t-1}\partial C_t$ are housing and financial wealth and their lags, expected unemployment rate, and real interest rate.

2. Given the single lag of the wealth measure is a bit too sensitive to instruments estimates, the wealth measure is reconstructed using the information obtained on c . The wealth measure is redefined as

$$\bar{\partial} W_{t-1} = (\Delta W_{t-1} + c\Delta W_{t-2} + c^2 \Delta W_{t-3} + c^3 \Delta W_{t-4}) / C_{t-5} \ .$$

3. Estimate Equation (4.2) with $\bar{\partial} W_{t-1}$ using other instrument sets to obtain the estimate of the short-run MPC.

4. Calculate the long-run MPC from equation (4.5).

Empirical results

The estimation results for equation (4.4) are presented in Table 5. In the first stage of the regression, we forecast $E_{t-1}\partial C_t$ by experimenting with different sets of instrumental variables (either total wealth or its disaggregates, housing and financial wealth, expected increases and decreases in unemployment rates, and real interest rate). Following our findings on potential breaks in the data series of consumption and wealth, we also present the subsample results, namely, the period before the 1997-98 Asian financial crisis (1987 Q4-1997 Q2) and after (1997 Q3 – 2006 Q4).[13] For the sample period as a whole (1987 Q4-2006 Q4), we find the habit formation parameter, c , is estimated at a tight range of 0.60 to 0.61, which is within the range of what has been found for the US economy (Carroll *et al*, 2006), though it appears to be much lower than that for the New Zealand economy,

[13] To avoid the distortion of 1987's stock market crash on financial wealth, we use the sample period starting from 1987 Q4 instead.

also a small open economy (Liu, 2007). For the period before the 1997-98 financial crisis, c is estimated at a range of 0.61 to 0.75. It appears that c becomes larger as more instruments are used to forecast $E_{t-1}\partial C_t$. For the period after the financial crisis, c is estimated to be in a range of 0.46 to 0.52. Note that the habit formation parameter in the post-crisis period is much smaller than that in the pre-crisis period, suggesting consumers may have deviated from their consumption habits owing to large uncertainties caused by severe economic shocks.

After obtaining c, we can then construct $\bar{\partial} W_{t-1}$ as defined in Step 2 of the estimation strategy. The results for Equations (4.2) and (4.3) are presented in Table 6. For the whole sample, the range of the marginal propensity to consume at t out of total wealth at t-1 is 0.0014-0.0015. This implies a one Hong Kong Dollar increase in total wealth will lead to an increase in consumption in the next quarter by 0.14-0.15 cent. When splitting the total wealth into housing and financial wealth, we find that the MPC out of wealth is mostly derived from financial wealth, which is 0.0016. The MPC out of housing wealth is found to be at 0.0011. However, the coefficient is not statistically significant . For the period before the 1997-98 Asian financial crisis, we find that the marginal propensity to consume out of wealth is small and not statistically significant, so are the MPCs for financial and housing wealth. Also note that, the adjusted R^2 for each of the regression specification is negative, suggesting that wealth variables have little power to explain consumption. This may also imply that consumers made their consumption decisions exclusively from their expected income or permanent income during this period of rapid income growth. Financial and housing wealth may not have factored into consumption decision. For the period after the financial crisis, the MPC out of total wealth at t-1 is at a range of 0.0018 and 0.002, which is larger than those for the whole sample period. The MPCs out of the financial and housing wealth are larger, both at 0.0028, although the housing wealth is never statistically significant.

Although we are able to get statistically significant MPCs out of the total wealth and financial wealth in some cases, we have not been able to obtain any statistically significant MPC estimates for housing wealth.[14] This means that the MPC out of the housing wealth is highly uncertain. Perhaps, the boom-bust nature of the property market in Hong Kong may have contributed to this effect. Different from what is found in Carroll *et al* (2006), the extra variables such as the

[14] We also experiment the specification by include housing or financial wealth alone in the equation. The results are quite similar.

expected unemployment rate and real interest rate have little explanatory power for consumption in Hong Kong and real interest rate often has a wrong sign.

The right panel of Table 6 also presents the calculated long-run MPC using equation (4.5). For the sample as a whole, next year's MPC out of the total wealth now is 0.006. This implies one dollar increase in wealth now will lead to an increase of consumption of 0.6 cent, about a 0.45 cent higher than the short-run MPC. Our estimates also show that the estimated MPCs out of total wealth are about twice as large as those before the financial crisis. Similarly, the MPCs out of financial and housing wealth are also larger in the post-crisis period than in the pre-crisis period.

V. CONCLUDING REMARKS

This paper first examines whether there exists a cointegration relationship between consumption and wealth using test techniques that allow for the presence of structural breaks for an extended data set that spans from 1984 to 2006. Our test results show that there is only limited evidence to suggest there is a cointegration relationship between consumption and wealth in Hong Kong, thus casting doubt on the validity of the estimates of the wealth effect obtained using the cointegration approach. We then apply a structural approach to estimating the wealth effect based on a habit formation model. The advantages of the structural approach are twofold: First, the estimation equation is derived from a habit formation consumption model. Therefore, it has a strong theoretical footing. Second, our estimates are empirically sound, as they are dependent on the results of cointegration tests.

Our findings using this approach show that the short-run MPC out of total wealth is about 0.0014, implying next quarter's consumption is 0.14 cent from a one Hong Kong dollar increase in total wealth. Translating the MPC measures into elasticity, we find that one percentage point increase in housing and financial wealth will lead to an increase of 0.05 percentage point in consumption of the next quarter (Table 7). The long-run MPC out of total wealth is about 0.006, implying next year's consumption is 0.6 cent from a one Hong Kong dollar increase in the total wealth. Similarly, if translating the MPC measures into the elasticity measures, we find that a one percentage point increase in total wealth will lead to an increase of 0.06 percentage point in consumption next year (Table 7).

Compared with the previous results, our estimates appear to be much smaller than those obtained from the cointegration approach. They are also smaller than estimates obtained for the US results using the same specification (Table 7). For example, it appears our long-run elasticity out of total wealth (0.064) is less than half of the estimate (0.15) found in Cutler (2004).[15] Given the evidence against the existence of cointegration between consumption and wealth in Hong Kong, our estimates based on the structural approach are perhaps more reliable than previous estimates as a gauge to the size of the wealth effect on consumption in Hong Kong.

[15] As indicated by the note in Table 7, only Cutler' s results is comparable with ours because both papers use the same data definitions for financial and housing wealth, whereas other estimates are based on different definitions for financial and housing wealth.

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Table 1: Unit root test results

	Variables	No break ADF k	Stat	One Break ZA k	Tb	Stat	Two Breaks LP k	Tb	Stat	
PCE	Food	1	-2.216	5	1997 Q4	-4.35	5	1992 Q2 1997 Q3	-7.07	**
	Durables	1	-1.989	0	1997 Q3	-4.55	3	1992 Q2 1997 Q4	-6.04	
	Non-Durables	5	-2.127	4	1997 Q2	-3.91	7	1995 Q3 2002 Q3	-5.82	
	Services	0	-2.19	0	1994 Q1	-3.81	3	1989 Q1 1992 Q4	-5.09	
	Abroad	0	-0.711	3	1995 Q4	-3.69	3	1991 Q3 1997 Q3	-4.95	
	Non-residends	1	-2.714	1	1997 Q1	-4.42	0	1987 Q2 1997 Q2	-8.99	***
	Total	0	-1.324	3	1993 Q1	-4.37	4	1995 Q1 2002 Q3	-5.61	
Explanatory variables	Labour Income	3	-2.316	8	2000 Q2	-4.10	7	1997 Q4 1999 Q3	-6.31	
	Financial Wealth	3	-2.646	3	1992 Q4	-4.03	3	1993 Q1 2002 Q2	-5.58	
	Housing Wealth	3	-1.625	2	1997 Q3	-3.87	2	1996 Q2 2002 Q2	-6.06	
	Real interest rate	4	-2.925	7	1988 Q1	-3.92	8	1988 Q1 1996 Q4	-5.17	

Notes: 1) All variables are in log. {*,**,***}=Statistical significance at {10,5,1} percent.
2) ZA test CV for model (C) -5.57, -5.08 and -4.82 at the 1%, 5% and 10% level respectively.
3) LP test CV for model (C) -7.34, -6.82 and -6.49 at the 1%, 5% and 10% level respectively.

Table 2: Policy and economic events calendar

Date	Events
1987	Wall street Stock Market Crash
1989	Tiananmen Square Incident
1992	Strengthening China's opening policy
1994	China - Macromanagement
1997-1998	Asian Financial Crisis
2000	IT Bubble Burst
2001	September 11 Terrorist Attack
2003	SARS

Table 3 (a): Cointegration test results for the period 1984 Q1 – 2006 Q4

		No break							One break		
		Johansen's cointegration tests							Gregory-Hansen		
	Variables	*k*	*Rank =*	Trace Stat	0.05 CV	*Rank =*	Max Eig. Stat	0.05 CV	*k*	Tb	Stat
PCE	Durables	2	0	68.20	63.88	**0**	32.10	32.12	0	1997 Q3	-5.27
			1	36.10	42.92						
	Non-Durables	3	0	65.71	63.88	**0**	25.89	32.12	4	1996 Q2	-4.24
			1	39.82	42.91						
	Services	2	**0**	62.28	63.87	**0**	30.77	32.12	2	1995 Q2	-4.39
	Total	3	0	66.81	63.87	**0**	28.10	32.12	4	1996 Q4	-5.47
			1	38.71	42.92						

Notes: 1) Bold font indicate significance at the 5% level.
2) GH test critical values at the 5% level is -6.41 and -6.17 at the 10% level.
3) The Johansen' s tests include a trend and a constant.

Table 3 (b): Cointegration test results for two subsample periods

		Johansen's cointegration tests						
	Variables	*k*	*Rank =*	Trace Stat	0.05 CV	*Rank =*	Max Eig. Stat	0.05 CV
		1984 Q1 - 1997 Q2						
PCE	Durables	2	**0**	53.39	63.88	**0**	26.65	32.12
	Non-Durables	2	**0**	53.01	63.88	**0**	23.64	32.12
	Services	2	0	74.80	63.88	**0**	31.94	32.12
			1	42.86	42.92			
	Total	2	**0**	60.37	63.88	**0**	27.86	32.12
		1997 Q3 - 2006 Q4						
PCE	Durables	1	0	65.05	63.88	**0**	25.50	32.12
			1	39.55	42.92			
	Non-Durables	1	0	79.54	63.88	0	36.48	32.12
			1	43.06	42.92	**1**	25.29	25.82
			2	17.77	25.87			
	Services	1	**0**	61.47	63.88	**0**	25.95	32.12
	Total	1	0	68.17	63.88	**0**	29.76	32.12
			1	38.40	42.92			

Notes: 1) Bold font indicate significance at the 5% level.
2) The Johansen' s tests include a trend and a constant.

Table 4: Phillips-Ouliaris-Hansen test for cointegration

	Variables	ADF				ADF			ADF			
		?	*k*	Stat		?	*k*	Stat	?	*k*	Stat	
		1984 Q1 - 2006 Q4				*1984 Q1 - 1997 Q2*			*1997 Q3 - 2006 Q4*			
PCE	Durables	0.80	0	-3.29	*	0.79	0	-2.62	0.81	7	-1.16	
	Non-Durables	0.80	4	-3.10		0.96	4	-0.49	0.52	1	-2.68	
	Services	0.86	1	-2.13		0.92	1	-1.38	0.52	0	-3.63	**
	Total	0.74	6	-2.72		0.94	6	-0.88	0.87	6	-0.58	

Notes:
1) {*,**,***}=Statistical significance at {10,5,1} percent.
2) The standard errors are based on the asymptotic critical values, which are available in Hamilton (1994), table B.9.
3) The ADF model is: $\hat{u}_t = r\hat{u}_{t-1} + \sum_{p=1}^{k} f_i \Delta\hat{u}_{t-p} + e_t$

Table 5: Consumption Growth Momentum and the Long Run MPC

$$\partial C_{t+1} = g + cE_{t-1}\partial C_t + x_{t+1}$$

Sample period	Variables used to forecast $\mathbf{E}_{t-1} J C_t$	Consumption Growth Momentum Coefficient c	Total W	Implied Long-Run MPC out of Financial W^F	Housing W^H
1987Q4-2006Q4	$J W$	0.60 ***	0.006		
		(0.07)			
	$J W$, *umr*	0.60 ***	0.006		
		(0.07)			
	$J W^F$, $J W^H$	0.61 ***		0.007	0.005
		(0.07)			
	$J W^F$, $J W^H$, *umr*	0.61 ***		0.001	0.010
		(0.07)			
1987Q4-1997Q2	$J W$	0.61 ***	0.004		
		(0.19)			
	$J W$, *umr*	0.58 ***	0.005		
		(0.18)			
	$J W^F$, $J W^H$	0.73 ***		0.004	0.003
		(0.14)			
	$J W^F$, $J W^H$, *umr*	0.75 ***		0.007	-0.001
		(0.12)			
1997Q3-2006Q4	$J W$	0.46 ***	0.008		
		(0.06)			
	$J W$, *umr*	0.52 ***	0.007		
		(0.08)			
	$J W^F$, $J W^H$	0.46 ***		0.011	0.011
		(0.06)			
	$J W^F$, $J W^H$, *umr*	0.52 ***		0.004	0.021
		(0.08)			

Notes:
1) Standard errors are in parentheses. {*,**,***}=Statistical significance at {10,5,1} percent.
2) *umr* is the actual unemployment rate.
3) The long-run MPCs are calculated from the formula $\alpha_n/\chi(1-\chi)$ where α_n is the corresponding next-quarter MPC estimated in Table 6.
4) Standard errors for all equations are heteroskedasticity and serial-correlation robust.

Table 6: Short-Run Effect of Wealth on Consumption

$$\partial C_t = a_0 + a_1 \overline{\partial} W_{t-1} + a_2 \overline{\partial} W^F_{t-1} + a_3 \overline{\partial} W^H_{t-1} + a_4 umr\_exp_{t-1} + a_5 r_{t-1}$$

	Next-Quarter Effect of $1 Change in Wealth			Extra Variables		
	Total	Financial	Housing	Expected unemployment rate	Real interest rate	Adjusted R-squared
Sample period	$\overline{\partial} W_{t-1}$	$\overline{\partial} W^F_{t-1}$	$\overline{\partial} W^H_{t-1}$	umr_exp_{t-1}	r_{t-1}	$\overline{R}^2$
1987Q4-2006Q4	0.0014 **					0.10
	(0.0006)					
	0.0015 ***			-0.0403	-0.0382	0.10
	(0.0003)			(0.1375)	(0.0671)	
		0.0016 **	0.0011			0.16
		(0.0008)	(0.0018)			
		0.0003	0.0023	-0.0323	0.0698	0.17
		(0.0009)	(0.0019)	(0.1019)	(0.0765)	
1987Q4-1997Q2	0.0009					-0.01
	(0.0010)					
	0.0011			-0.6675 *	0.0441	-0.02
	(0.0009)			(0.3895)	(0.1163)	
		0.0008	0.0005			-0.04
		(0.0016)	(0.0026)			
		0.0014	-0.0001	-0.7069 *	0.0421	-0.05
		(0.0013)	(0.0019)	(0.3982)	(0.1215)	
1997Q3-2006Q4	0.0020 ***					0.26
	(0.0007)					
	0.0018 ***			0.3352 *	0.0500 **	0.30
	(0.0004)			(0.1806)	(0.0215)	
		0.0028 **	0.0028			0.28
		(0.0011)	(0.0023)			
		0.0010	0.0051	0.1858	0.1327 **	0.33
		(0.0019)	(0.0035)	(0.2573)	(0.0584)	

Notes:
1) Standard errors in parentheses. Symbols *,**,*** are statistical significance level at 10,5,1 percent, respectively.
2) Coefficients on wealth variables reflect MPCs in the quarter following a wealth change: For example, the coefficient 0.0014 in the first row implies that a one dollar increase in wealth in the previous quarter will lead to a 0.14 cent increase in consumption in the current quarter.
3) Given the flows of fund data are not available for Hong Kong, financial wealth is defined as notes and coins held by non-banks plus deposits from customers plus total stock market capitalisation less loans as well as credit card advances. Housing wealth is calculated using gross housing wealth minus loans to purchase residential properties and subsidised flats. *UMR_EXP* is the anticipated unemployment rate predicted by using output gap, while *r* is one-month HIBOR deflated by consumption price.
4) The wealth and consumption variables were normalized by the level of consumption expenditures at *t*- 4 to correct for the long-term trends in consumption and wealth.
5) The equations without the extra variables exhibited serial correlation and so standard errors for those equations are corrected for serial correlation using the Newey–West procedure with 4 lags.

Table 7: Comparison with previous studies

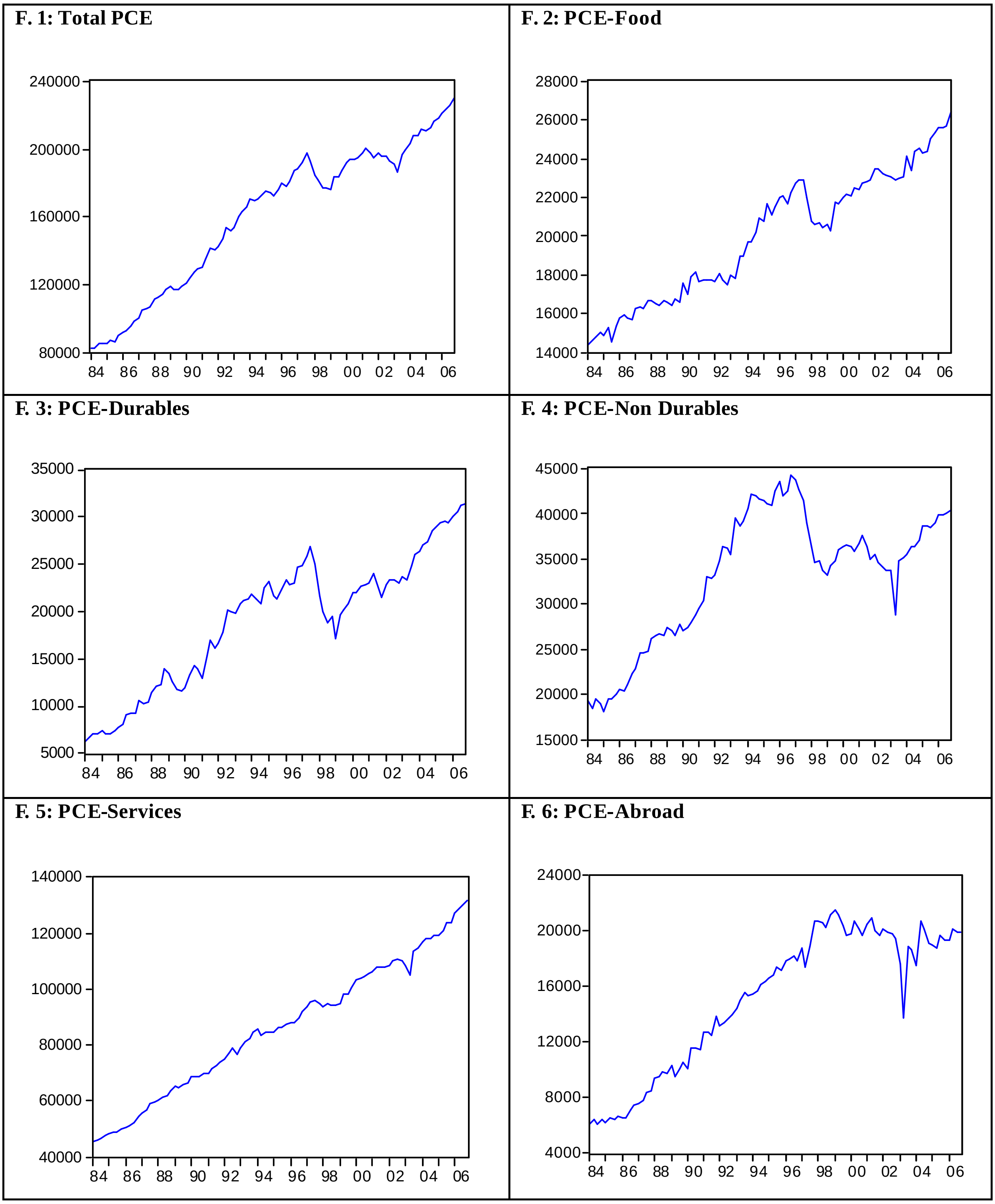
	Financial Wealth	Housing Wealth
Long run elasticity[1]		
Small forecasting model (2007)[2]	0.207	0.032
Cutler (2004)	0.085	0.071
Lai and Lam (2002)[3]	n.a.	0.140 - 0.170
This study (Habit formation)	*0.050*	*0.014*
Short run elasticity[1]		
Small forecasting model (2007)[2]	0.064	0.118
Cutler (2004)	0.020	0.070
Lai and Lam (2002)[3]	n.a.	0.150 - 0.170
Peng, *et al* (2001)[2]	0.024	0.100
This study (Habit formation)	*0.046*	*0.012*

Notes: 1) These elasticity estimates are calculated by multiplying the estimated marginal propensities to consume and wealth to consumption ratio. The wealth to consumption ratio is averaged over the sample period. The time frame of short-run wealth elasticity is over one quarter, while long-run wealth elasticity is over one year.

2) Financial wealth in the paper is proxied by the Hang Seng Index deflated by consumer price index, and housing wealth is proxied by the real property prices.

3) Housing wealth in the paper is proxied by the real property prices.

Figure 1 – 7: Plots of Private Consumption Expenditure, Total PCE and Its 6 components



F. 7: Residual series of regression with PCE-Non residents

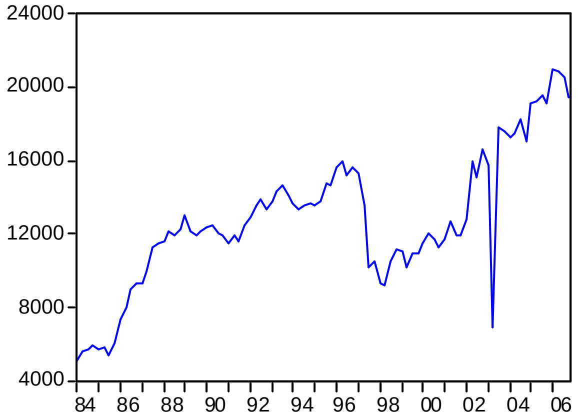
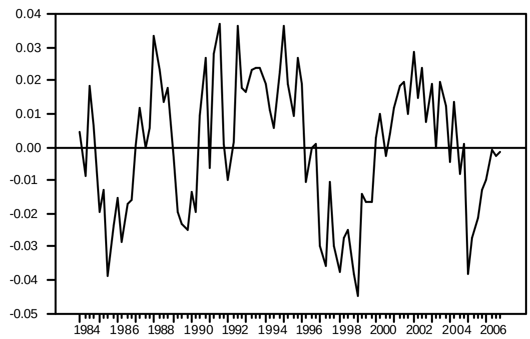
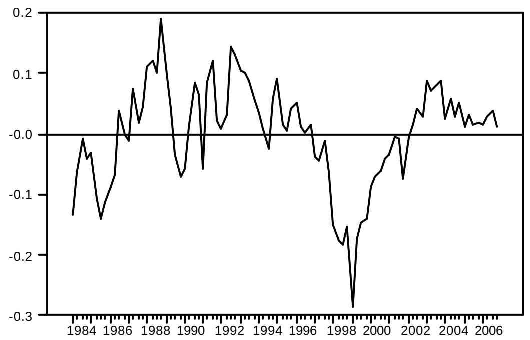


Figure 8 – 11: Plot of $\hat{u}_t$ from $\hat{u}_t = r\hat{u}_{t-1} + \sum_{p=1}^{k} f_i \Delta\hat{u}_{t-p} + e_t$

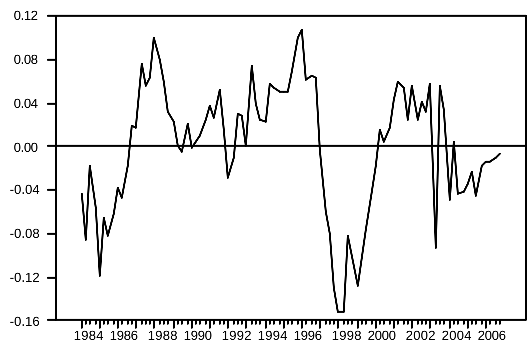
F. 8: Residual series of regression with Total PCE



F. 9: Residual series of regression with PCE-Durables



F. 10: Residual series of regression with PCE-Non Durables



F. 11: Residual series of regression with PCE-Services