Reconsidering the Consumption and Income Dynamic in the United Kingdom with the Dual Adjustment Approach

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ABSTRACT

This study attempts to analyse the relationship between household consumption expenditure and income from 1970 to 2020 in United Kingdom. We used the Engle-Granger Cointegration Analysis and the Dual Adjustment Approach to investigate the co-movements of consumption and expenditure.

Our results provide evidence on the existence of co-trending between household expenditure and income levels. Further, we found evidence for singular adjustment and against dual adjustment in the UK for the given period. That is, we found negligible difference between the effects of permanent and transitory income on household expenditure. Our findings suggest that Dynamic Keynesian Consumption Function may be valid for the UK. However, there is also evidence on the weak version of Permanent Income Hypothesis and hence there is room to research further for weak version of Permanent Income Hypothesis to provide a stronger theoretical explanation. Our findings lend support for monetary and fiscal interventions in macroeconomic policy making.

Keywords: Household Consumption Expenditure, Income, Cointegration, Dual Adjustment, Permanent Income Hypothesis, United Kingdom

ÖZ

Bu çalışma, Birleşik Krallıkta 1970-2020 dönemi için hane halkı tüketim harcamaları ile hane halkı geliri arasındaki ilişkiyi analiz etmeyi çalışmaktadır. Tüketim ve harcamanın ortak hareketlerini modellemek için Engle-Granger Eşbütünleşme Analizi ve İkili Uyarlama Yaklaşımını kullandık.

Sonuçlarımız, hane halkı harcamaları ile gelir seviyeleri arasında ortak bir eğilimin olduğuna dair kanıt sağlamaktadır. Ayrıca, belirli bir dönem için Birleşik Krallıkta tekil uyarlanmayı destekleyen ve ikili uyarlanmaya karşı kanıtlar bulduk. Bulgularımız, kalıcı ve geçici gelirin hane halkı harcamaları üzerindeki etkileri göz ardı edilebilir bir fark olduğuna işaret etmektedir. Bulgularımız, Dinamik Keynesyen Tüketim Fonksiyonunun Birleşik Krallık için geçerli olabileceğini düşündürmektedir. Bununla birlikte, Sürekli Gelir Hipotezinin zayıf versiyonu hakkında da kanıtlar vardır ve bu nedenle, daha güçlü bir teorik açıklama sağlamak için Sürekli Gelir Hipotezinin zayıf versiyonu için daha fazla araştırmaya yer vardır. Bulgularımız, makroekonomik politika yapımında parasal ve mali müdahaleleri desteklemektedir.

Anahtar Kelimeler: Hane halkı Tüketim Harcamaları, Gelir, Eşbütünleşme, İkili Uyarlanma, Sürekli Gelir Hipotezi, Birleşik Krallık

DEDICATION

To My Family

ACKNOWLEDGEMENT

I would like to express my sincere gratitude toward Prof. Dr. Mustafa İsmihan for his supervision, advice and guidance throughout the work. His contributions have been seminal in my development as a researcher and his support has reignited my passion and curiosity for economics.

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LIST OF SYMBOLS AND ABBREVIATIONS

AIH	Absolute Income Hypothesis
ADF	Augmented Dickey Fuller
APC	Average Propensity to Consume
ARDL	Autoregressive Distributed Lag
Co-HP	Common Hodrick Prescott Trend
DAH	Dual Adjustment Hypothesis
DHSY	Davidson, Hendry, Srba and Yeo's Equilibrium Correction Model
EG-CI	Engle-Granger Cointegration Analysis
FCE	Final Consumption Expenditure
GDP	Gross Domestic Product
GLM	Generalized Linear Model
HP	Hodrick Prescott
I (0)	Stationary at Level
I (1)	Stationary at First Difference
I (2)	Stationary at Second Difference
MPC	Marginal Propensity to Consume
NPISH	Non-Profit Institutions Serving Households
OLS	Ordinary Least Squares
PIH	Permanent Income Hypothesis
QRLM	Quantile Regression, Linear Models
R^2	Coefficient of Determination
SAH	Singular Adjustment Hypothesis
SPIH	Strong Permanent Income Hypothesis

SIC	Schwartz Version of Info Criterion
u	Disturbance Term
UK	The United Kingdom
WPIH	Weak Version of Permanent Income Hypothesis

Chapter 1

INTRODUCTION

In advanced economies, the estimation of trends is the central inquiry for formulating economic policies. This is one of the important reasons to divide macroeconomic variables into transitory and permanent (trend) components. For instance, economic shocks, like lockdowns from pandemic or a supply shock from prominent trading partner, may create economic disruptions the next day but are likely to oscillate back to their permanent (trend) components after their initial effects dwindle. Hence, it is vital to distinguish between trends and transitory (cyclical) components of time series variables to formulate a policy on.

This study attempts to examine the co-movements between household consumption expenditure and household income from 1970-2020 in United Kingdom by utilizing dual adjustment approach. The United Kingdom (UK) is a high-income country with GDP per capita at 41,125 US $ (2020). UK has a population of 67 million and 2.76 trillion US $ GDP[1]. Household consumption is the largest component of GDP in the UK, ranging between 60-75% each year between 1970-2020. Moreover, the UK is a free-market economy hosting a diverse range of goods and services in various sectors such as finance, commerce, energy, industry, and agriculture. The UK has a stable and well documented economy that allows for a reliable database for our research.

[1] United States Dollar (current)

Therefore, we sourced the data from World Development Indicators database of World Bank.

In this study, in addition to the Dynamic version of Keynesian consumption model, we also consider the weak and strong versions of the Permanent Income Hypothesis (PIH) for the UK to better understand the consumption-income dynamics by distinguishing between permanent and transitory income. In doing so, we use the Dual Adjustment Approach to investigate the different co-movements of permanent and transitory components (İsmihan, 2019).

This thesis covers five chapters. Chapter 2 presents a concise literature review, Chapter 3 covers the methodology of the research, Chapter 4 provides the data, empirical results, and interpretations of the findings. Chapter 5, draws conclusions, addresses shortcomings and points for further research.

Chapter 2

LITERATURE REVIEW

The first part of this chapter concerns itself with the studies of various scholars and economists who have worked on the relationship between consumption and income. Then it goes further in providing the condensed overview of empirical studies on the topic.

2.1 Theoretical Background

Economic theory widely agrees the positive correlation of income and consumption, but distinctions emerge on what types of income are related to consumption and to what extent causality between the two variable exists.

2.1.1 The Keynesian Consumption Function

John Maynard Keynes' study, the *General Theory of Employment, Interest and Money*, was a ground-breaking work that set the stage for more proactive macroeconomic policy making. Keynesian macroeconomic thought flourished after the dominant thinking of the time, *laissez-faire* economics of the Cambridge School led by early neo-classical economists like Alfred Marshall and Irving Fischer, failed to provide a comprehensive policy for the 1929 Wall Street crush and the Great Depression that followed it. In his treatise, on the dynamics of consumption, Keynes argued that consumption in each period is determined by the absolute income in the same period and the marginal propensity to spend that income (Keynes, 1936). This is called the Keynesian Consumption Function and can be expressed as:

$C_t = a + b\ Y_t$

where, C is consumption, a is autonomous consumption, b is the Marginal Propensity to Consume (MPC), t is period and Y is the income level. The four properties of the function are as follows:

First, aggregate consumption is a stable function of household income. Second, the MPC is defined as $0 < MPC < 1$. Third, the average propensity to consume (APC), which is C/Y, decreases as income increases. Fourth, the MPC decreases or remains constant as income increases.

This is part of a larger theoretical framework that combines the psychological elements of agent behaviour, wage rigidity and lags in free-market economy to put forward the idea of using fiscal tools to offset the effects of downward cyclical turns. This was, at the time, contrary to Cambridge school of thought which trusted the classical view of uninterrupted free markets. Figure 1 represents a graphical illustration of the Keynesian Consumption Function theory.

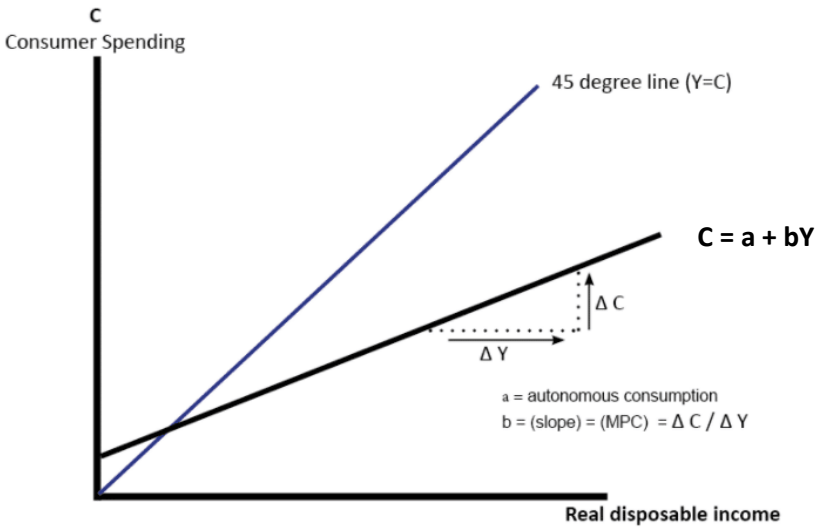

Figure 1: The Keynesian Consumption Function[2]

[2] This figure is adapted from: https://www.economicshelp.org/blog/2812/economics/consumption-function-definition/

2.1.2 Milton Friedman's Permanent Income Hypothesis

Friedman, in *A Theory of the Consumption Function*, argued that aggregate consumption depends on the permanent component of income and, consumption is unaffected by the transitory changes in income (Friedman, 1957). In other words, Friedman argues that households have a long-term, calculated, rational perception of their income, referred as permanent income, and calibrate their consumption according to that perceived permanent income. Contrary to Keynes, Friedman views any transitory rises and falls in actual income to be relatively ignorable in aggregate consumption. Furthermore, Friedman incorporates wealth accumulation and interest rates to additional to MPC as a coefficient of income. By doing so, Friedman's consumption function incorporates real interest rates and dynamics of consumer wealth into the consumption function. This helps encompass a wider time frame for consumption function both extending back into past (adoptive expectations); contrary to Keynes definition that encompasses only a single period for the variables This is known as the strong Permanent Income Hypothesis (SPIH) and had been developed as a criticism of Keynesian thinking, particularly about fiscal stimuluses. The breakdown of permanent and transitory components can be expressed as:

$Y = Y_P + Y_T$

$C = C_p + C_T$

where, P is permanent component, T is transitory component, Y is income, C is consumption. Rearranging into the Keynesian function:

$C_P + C_T = a + b\ (Y_P + Y_T)$

When assuming no relationship between transitory and permanent components (and when transitory components are unrelated), a version of Friedman's PIH can be stated as follows:

$C_P = a + b\ Y_P$

There are underlying assumptions that APC is constant, MPC coefficient of transitory income is zero. Friedman is part of the Chicago School which redevelops a neoclassical model that bring "adaptive expectations" into account, arguing market dynamics and monetary policies as a better tool for policy making. Acknowledging he shortcomings of early neoclassical thinking, Chicago school argues for more communicative and forward guiding monetary policy making. This, in return, like a self-fulfilling prophecy, results in actualization of expectations. This is also an alternative to discretionary policy approaches adopted after the WWII following the publishing of the Phillips Curve (Phillips, 1958). Figure 2 represents a graphical illustration of the permanent income hypothesis (Note that in this figure long-run version of PIH is given as $C_P = kY_{P)}$.

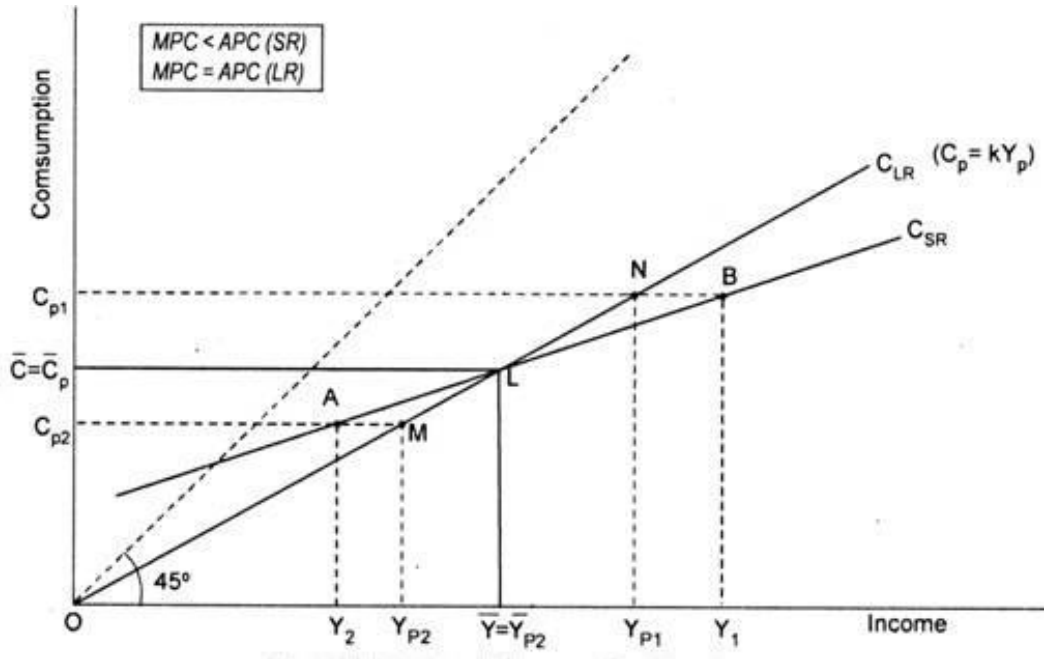

Figure 2: Friedman's Permanent Income Hypothesis[3]

[3] This figure is taken from: https://www.economicsdiscussion.net/consumption-function/permanent-income-hypothesis-subject-matter-reconciliation-and-criticisms-consumption-function/14473

2.1.3 Franco Modigliani's Life Cycle Hypothesis

Modigliani is another prominent scholar in criticism of the Keynesian hypothesis. Modigliani argues that consumption of an agent depends on lifetime income instead of current income, this is known as the Life Cycle Theory (Modigliani and Brumberg, 1954). Life Cycle Theory outlines three factors for household expenditure: individuals capital returns, the value of durables and wage income. In other words, theory incorporates breaks down income into capital and labour income where each income component has different MPC coefficient. This can be expressed as:

$$C = aY_R + cY_L$$

Where C is aggregate consumption, a is MPC for wealth returns, Y_R is wealth returns, c is MPC for wage income and Y_L is wage income. Modigliani then incorporates working lifetime and overall life, MPC parameters are removed by assuming all that is earned will be consumed, with no heritage income coming or going from agents. This can be expressed as follows:

$$C= (Y_R + RY_L)/T$$

where R is total working time and T is total lifetime. Figure 3 represents a graphical illustration of the life cycle theory.

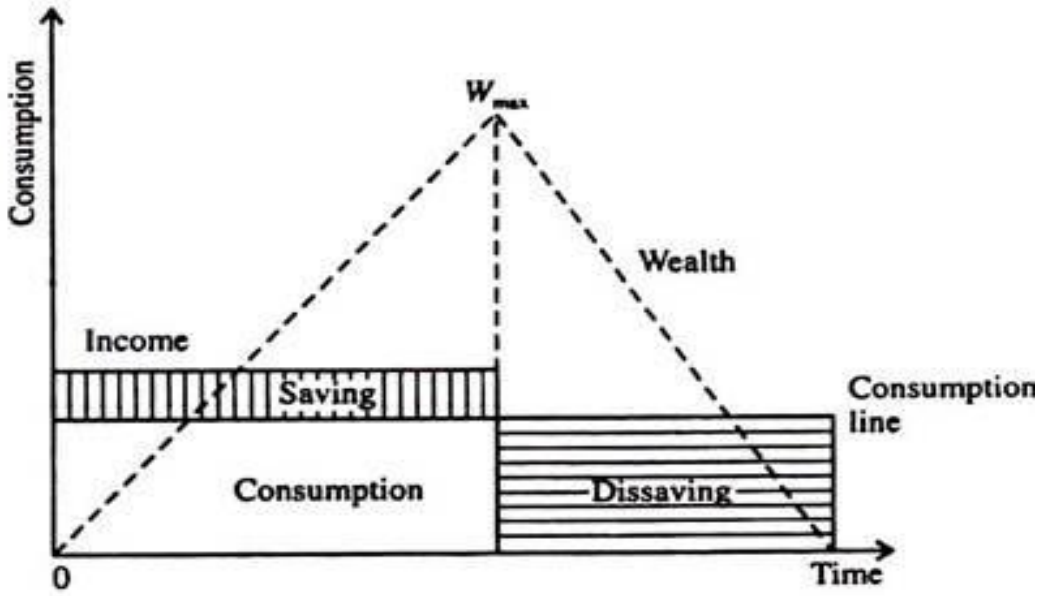

Figure 3: Modigliani's Life Cycle Theory[4]

The wealth side of the theory deserves a closer look. As wealth returns are highly influenced by asset prices and financial markets. It is worth noting that changes in prices of assets, such as stocks, housing, foreign reserves, are important parameters that may positively or negatively affect household consumption. These forms of capital returns, by nature, are not fixed and cannot be accurately forecasted. Moreover, asset prices are subject to speculative price bubbles, increasingly more under low interest rates, and counter the points for forming expectations around them. Finally, especially following the 2008 financial crisis, central banks began to have an unprecedented effect on financial and stock markets. As central banks have other objectives than preserving capital returns, this too is likely an important influencer of capital returns and income expectation on that returns.

[4] This figure is taken from: https://www.economicsdiscussion.net/consumption-function/top-4-types-of-hypothesis-in-consumption-with-diagram/16024

Finally, Life Cycle Hypothesis is in line with Friedman's emphasis on disregarding of current incomes and its relation to consumption in each period. Moreover, like Friedman, this theory assumes a perfectly rational economic agents with certain expectations on their future income levels. However, it is important to note that raw version of LCH assumes zero inflation, no inheritance, zero interest rate. Hence, despite having a different approach, PIH and LCH focuses on building models not on instinctive agent behaviours but more on agents with future expectations.

2.1.4 Robert Hall's Random Walk Hypothesis

Robert Hall is an important scholar in consumption function controversy. His work incorporates rational expectations, business cycles and wage stickiness into an intertemporal budget constraint. This is expressed as:

Period 1: $S=Y_1-C_1$

Period 2: $C_2=(1+r)\ S+Y_2$

Where S is savings, Y is income per period, C is consumption per period, and r is real interest rate.

Intertemporal constraint can be rewritten as:

For each period: $C_t=(1+r)\ Y_{t-1}-C_{t-1}+Y_t$

Where t is current period and t-1 is the previous period.

This means consuming a unit of income in t-1 results in foregoing 1+r multiplied unit of consumption. This implies consuming now is more expensive than consuming later if real interest rates are positive. Figure 4 represents a graphical illustration of the intertemporal budget constraint.

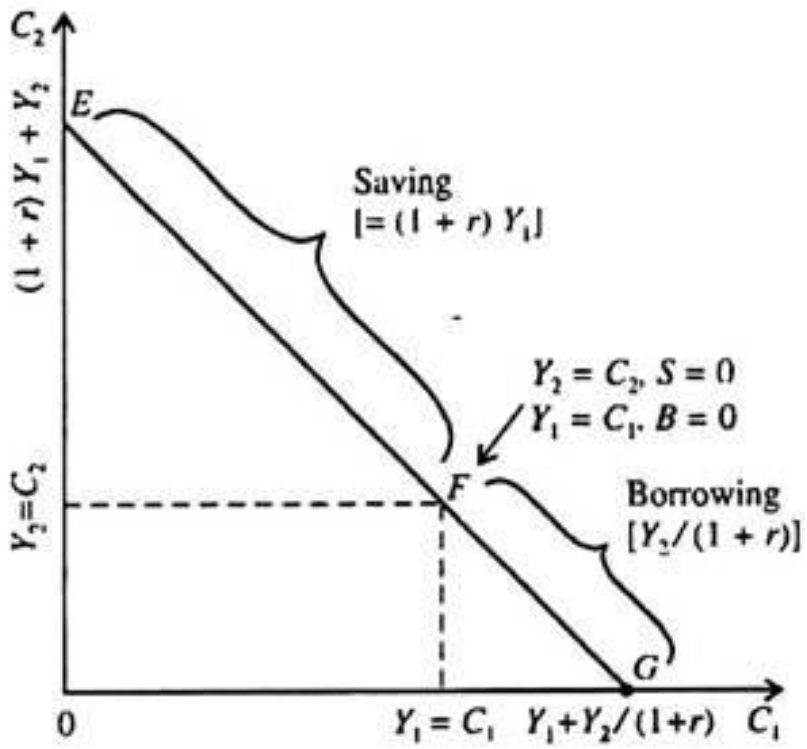

Figure 4: Intertemporal Budget Constraint[5]

In Hall's model, expected income changes influence consumption. This causes a smoothing effect as marginal utility to consume decreases and real interest rates counter the propensity to spend.

Hall redeveloped the macroeconomic framework on consumption functions by incorporating uncertainty into intertemporal models. This was a way of applying rational expectations instead of Friedman's adaptive expectations. This meant realised consumption can be expressed in terms of expected consumption and the surprise term. The element of surprise is completely unpredictable, hence random. This is called the Random Walk Hypothesis and can be expressed as:

$C_{t+1} = C_t + \epsilon$

[5] This figure is taken from: https://www.economicsdiscussion.net/consumption-function/intertemporal-choice-and-budget-constraint-with-diagram-consumption-function/16005

Where C_{t+1} is the consumption in the next period, C_t is current realised consumption and ϵ is the error term. The random-walk model predicts that the line relating Ct+1 to Ct should have an intercept of zero and a slope of 1 (Dornbusch et al., 2018).

The model can be further developed to incorporate borrowing constraints and time-inconsistent preferences, but it is beyond the scope of this study to further summarize the theoretical frameworks of the consumption functions.

2.2 Methodological Background

We continue our review with methodological studies relevant to our study.

2.2.1 Problem of Modelling under Nonstationarity

The central issue for econometric modelling of the consumption function is the nature of nonstationary in the data. Consumption and income data exhibit strong nonstationary, mostly unit roots in almost all databases. Econometric methods are evolving to operate under ubiquitous unit roots and relevant literature offers an important guidance on how to improve our modelling under nonstationary.

Nelson and Plosser (1982) worked on classifying macroeconomic time series either as stationary around trend or non-stationary with no trend. Their findings depict that, for the US data they are using, time series exhibit non stationarity with no oscillation towards trend line but with aspects of stationarity and nonstationary under the different components of data, namely permanent and transitory distinction of the data. Hence, the study is important in segregation of permanent and transitory components as cyclical components are assumed transitory and dissipate over time while any long-run movements are assigned as a permanent component. Therefore, it is important to examine the conclusions of their study. First, the shocks affecting the permanent

component significantly influence the outcome. Second, the shocks that affect the permanent or transitory component transitory exhibit co-movement with transitory component or both components. Moreover, they argue that shocks to the components of growth result in considerable changes in outcome. The findings provide evidence that "time series do not contain deterministic time trends but contain stochastic trends characteristics" Nelson and Plosser (1982:14). They pointed out that some consumers are assumed to be forward looking such that model can be with PIH consumers and current Income (Keynesian) consumers. Hence, components that make up output are both stationary and non-stationary.

Campbell and Mankiw's (1989) study is another prominent work on methodological studies on consumption and income. Their work focused on rational expectations, consumption, and Euler's equation approach. They pointed to three empirical regularities. Firstly, anticipated difference in household income is correlated with anticipated difference in household expenditure. This contrasts with Hall's random walk model of PIH. Agents are modelled into two types: expectation spenders and rule of thumb current spenders. Thus, 1% expected rise in income results in less than 1 percent increase in consumption. Secondly, there is no relationship between real interest rates anticipated household expenditure. Thirdly, period with increased household expenditure is generally followed by a sharp rise in household income. These finding are similar in finding both permanent and transitory components in consumption behaviour. This offers support to modelling a weaker version of PIH as opposed to strong version because there appears to be clear need to incorporate both aspects of trend and cyclical components in modelling consumption and income data.

Eliasson's (1999) study focused on UK Consumption function and finds that DHSY equilibrium correction models depend heavily on restrictive assumption, weakening the method for application on most economic data. The study finds nonstationary in the UK data between 1958-1992 and DHSY model failing in modelling the data, instead suggesting using different methods such as Smooth Transitioning Regressions (STR) developed by Granger and Terasvirta (1995). The model consists of liner and a nonlinear component where nonlinear model is specified as a linear combination of variables multiplied with a nonlinear transition function (Eliasson 1999:8).

Relevant literature points to a need to develop alternative methods to better model data to separate permanent and transitory components to improve our understanding of macroeconomic trends.

2.2.2 Hodrick Prescott Filter and the Smoothing Parameter

Hodrick and Prescott challenges the hypothesis "that the growth component of aggregate economic time series varies smoothly over time" (Hodrick and Prescott, 1980:3). The failure of Keynesian Theory in 1970's propelled research on business cycles. Hodrick and Prescott's work offer great insight on equilibrium correction methods to filter out different trend and non-trends in a data set. The HP filter purges trend from data without presumption for observed series. This supports the weak rationality criterion better suited for PIH and works as a post proxy for rational expectations statement on indifference to transitory component in the consumption function (İsmihan, 2019:3).

Their findings show that growth is proportionally related to income, investment, consumption and capital, and productivity. Interestingly, productivity is found to be affected not by hours of employment but cyclical variations which are due to hours of

employment. Closer look at relationship of components of output, growth rate of labour productivity varied considerably and might be related to capital-labour ratio and change in composition of the labour force.

This finding leaves an unexplained, sizeable, and variable component within the model. To filter these components, filtering is applied via a smoothing parameter, lambda. Aggregate demand components can be decomposed into varying smoothness. Such that least varying are services, non-durables and government spending while most varying are investments. Monetary variables have very different response patterns. By trial and error, the smoothness parameter for the filter is found to be 100 for annual data. It is evident that filter alters serial correlation and thus serial correlations should be interpreted with caution under this application. On the other hand, co-movement results are not sensitive to the smoothing parameter. Thus, larger the smoothing parameter, larger the fluctuations, but relative fluctuation in series change little. The HP filter offers a useful decomposing tool especially under stationarity at second difference (that is for I (2) variables) and will be used in the empirical part of this study.

2.2.3 The Dual Adjustment Approach

The need to separate distinctive components in the data proposes a specific need to simultaneously model these components. İsmihan (2019) aims to introduce the dual adjustment approach to develop such modelling. The dual adjustment approach and Common Hodrick Prescott (Co-HP) trend methods are used because, the concept of integration and cointegration are not appropriate for non-linear worlds. This is done by decomposing using the filtering via Granger et al. (2006)'s definition of the

dominant property. Dominant property aims to discriminate between trend and non-trend by identifying the dominant property (e.g., HP trend) in the dependent variable.

In his work, for the US between 1929-2017, the Dual Adjustment approach is applied by İsmihan (2019) with comparison to the traditional Engle-Granger cointegration method. Main findings of the study are as follows: First, personal consumption and disposable income are not cointegrated in the US. Second, consumption and income variables have a common HP trend. Third, the consumption is stationary around the common permanent (HP trend) component. Fourth, transitory components of C and Y are significantly related. Fifth, there is evidence of dual adjustment in aggregate consumption and disposable income.

2.3 Empirical Studies

Khan, Fei, Kamal, & Shaikh (2015) estimated the consumption function for eight countries (Canada, Japan, France, Germany, Italy, UK, and US) using the ARDL approach. They test relationship of income and wealth on private consumption separately for each country and separately for long and short term. Their findings show income as the most prominent parameter for determining private consumption for both short and long run. However, they find that, overall, income as more determining for short-term consumption while wealth more determining for the long-term. For the UK, they find that income is more determinant for both long and short term. Moreover, long-term income coefficient greater than short-run coefficient. Their relevant results for the UK are listed in the table below:

Table 1: Determinants of Consumption Function, UK 1985-2013 (KFKS)

Determinant	**Short-term**	**Long-term**
Income	0.56**	0.87***
Wealth	0.127*	0.17*

Source: Khan, FEI, Kamal, and Shaikh [KFKS] (2015)

It is worthy to note that Khan at al. (2015) uses the ARDL approach for the UK data between 1985-2013 due to the presence of I (1) variables. Similar results are found for income coefficients in other studies. For the European Union between 2000-2013, Ianole & Elena (2015) estimated MPC to be approximately 0.7. Hall & Mishkin (1982), estimated USA MPC coefficient as 0.8 for years 1969-1975. Manitsaris (2006) estimated MPC coefficient to be 0.7-0.85 for the Euro Area between 1980-2015. The existing literature is vast and comprehensive; therefore, Table 2 provides a condensed overview of literature by considering selected number of studies and their findings on consumption function[6]

Table 2: Some Empirical Studies on the Consumption Function.

Authors	**Sample**	**Hypothesis**	**Method**	**Findings**
Altunç & Aydın (2014)	D-8 Countries (1980-2010)	PIH	EG-CI	PIH is confirmed.
Henry, Maellbauer and Murphy (1990)	UK, (1957-1976)	DHSY	ARDL	DHSY is confirmed.
İsmihan (2019)	USA, 1929-2017	SAH., PIH and DAH	Dual Adjustment Approach	DAH exists, WPIH confirmed.
Jawadi & Sousa (2015)	USA, UK and Euro Area (1947 2008)	PIH	QRLM	PIH is confirmed.
Manitsaris (2006)	Euro Area (1980-2005)	PIH	Time Series Analysis	PIH is rejected.
Bilik & Kök (2020)	Europe 2000-2017	PIH	GLM	PIH is confirmed
Poterba (1988)	USA (1959-1987)	Random Walk	OLS	is rejected.
Ianole & Elena (2015)	EU (2000-2013)	AIH	Panel data analysis	confirmed.

[6] This section draws heavily from Bilik & Kök (2020).

Chapter 3

MODEL AND METHODOLOGY

3.1 Dual Adjustment Approach and the Dual Consumption Function

The empirical steps of the basic dual adjustment approach can be motivated by comparing it to the standard Engle-Granger (EG) cointegration approach, which is the benchmark case (İsmihan 2019:6).

For dual adjustment, a given variable (e.g. Y) can be decomposed into permanent (P) and temporary (T) components of itself, at any given time t:

$Y = Y_P + Y_T$ in which temporary variable is irrelevant in the long-run.

Similarly, for our PIH model, at a given time, each variable (FCE and GDP) can be decomposed into permanent and transitory components as:

$$FCE = FCE_P + FCE_T \quad (1)$$

$$GDP = GDP_P + GDP_T \quad (2)$$

where FCE is Final Consumption Expenditure and GDP is Gross Domestic Product, which is used as a proxy for disposable income,

Initially, we define the relationship between the two variables in traditional Keynesian function as:

$$FCE_t = \beta_0 + \beta_1 GDP_t + u_t \quad (3)$$

where u is the error term and β_1 is the marginal propensity to consume (MPC) from income. We expect and test to find nonstationary in variables and hence use EG to estimate this relationship.

Now we consider a strong version of Friedman's PIH (WPIH), in which transitory components are unrelated, and use it to represent the co-trending of the consumption and income variables as follows:

$$FCE_P = \beta_0 + \beta_1 GDP_P \quad (4)$$

This version claims that permanent consumption is a function of permanent income and by using the identity of the above decomposition (for FCE), we can rewrite (4.) as:

$$FCE - FCE_T = \beta_0 + \beta_1 GDP_P \quad (5)$$

Rearranging:

$$FCE = \beta_0 + \beta_1 GDP_P + FCE_T \quad (6)$$

As we treat temporary component as a random deviation from "mean", we expect FCE_T to be stationary, therefore we use the following equation to test our model as:

$$FCE = \beta_0 + \beta_1 GDP_P + u_T \quad (7)$$

If u_t is stationary, then FCE and GDP are said to be sharing common HP trend and hence a weak version of PIH (WPIH) seems to be valid.

As explained before, HP is the preferred method for the decomposition of variables. Therefore, the crucial step in applying the HP method is the choice of the smoothing parameter (İsmihan 2019:7). In line with the standard Engle-Granger cointegration approach (benchmark case), Co-HP Trend analysis involves two steps:

Step 1.

In the first step, OLS is applied to the following:

$FCE_t = \beta_0 + \beta_1 GDP^P_t + u_t$

where FCE is Final Consumption Expenditure and GDP^P is the permanent component of the Gross Domestic Product and u the stochastic error term.

Step 2.

Test equation is set-up as:

$\Delta u_t = p^* u_{t-1} + e_t$

Having an absolute value of p* significantly different than zero implies Common HP trend.

Step 3.

To distinguish between long run and transitory (short run) effects, another test equation is set-up as:

$FCE^T_t = \beta_2 GDP^T_t + u_t$

where GDP^T (FCE^T) is the transitory or cyclical component of GDP (FCE). β_2 is the marginal propensity to consume (MPC) from transitory income

If $\beta_1=\beta_2$, there is singular adjustment, otherwise it is dual adjustment. More formally, we can talk about several hypotheses, like singular adjustment and dual adjustment hypotheses, regarding the consumption behavior. By considering the above version of PIH, consumption is primarily determined by permanent income over the long run (İsmihan 2019:6). It is re-stated below as Equation (I),

$FCE_t = \beta_0 + \beta_1 GDP^P_t + FCE^T_t$ (Equation I)

where all variables are as defined before.

Since the transitory consumption (FCE^T) is stationary, from Equation (I) we infer that the weak form of PIH requires $FCE_t - (\beta_0 + \beta_1 GDP^P_t)$ should also be stationary. This implies the existence of Co-HP Trend between FCE and GDP in the dual adjustment approach (İsmihan 2019:6).

For weak form of PIH, we can consider the possibility that the transitory components of consumption and income could also be related as follows:

$FCE^T = \beta_2 GDP^T$ (Equation II)

Therefore, it is more intuitive to consider a more general framework, *dual consumption function*, in which dual components (permanent and transitory) are allowed to have separate dual co-movements (as jointly modelled in Equations I & II) and hence the possibility of dual adjustment (İsmihan 2019:6).

Thus, three hypotheses emerge from the Dual Consumption Function:

Strong version of PIH (SPIH) [$0<\beta_1<1$, $\beta_2 = 0$].

> In addition to the stationarity of [$FCE_t - (\beta_0 + \beta_1 GDP^P_t)$] if the null hypothesis of $\beta_2 = 0$ is not rejected, then it can be concluded that SPIH is valid. … As mentioned before, SPIH is the version favored by Friedman (1957) (İsmihan 2019:6).

Dual Adjustment Hypothesis (DAH) [$0< \beta_1 \neq \beta_2<1$].

> Nevertheless, in case WPIH is valid, if the transitory components are significantly related (i.e., the null hypothesis of $\beta_2 = 0$ is rejected) then we can conclude that dual components (permanent and transitory) have separate dual co-movements. However, this is confirmed after eliminating the possibility of common (singular) adjustment (İsmihan 2019:6).

Singular Adjustment Hypothesis (SAH) [$0< \beta_1 = \beta_2<1$].

> In this case, transitory and permanent components are related with a same slope parameter ($\beta_2=\beta_1$ …). In other words, while marginal propensity to consume out of permanent income and transitory income are different in DAH, they are identical in SAH. Thus, this claim or SAH ($\beta_2=\beta_1$) could be tested by using a simple *t*-test … SAH could be called as the Dynamic Keynesian Consumption Function (İsmihan 2019:6).

3.2 Hodrick Prescott Filter

We pick HP filter for following three reasons:

1. It is a widely accepted method in the literature; hence it is credible.

2. It is unbiased in a way it wields the same results.

3. We utilize Dual Consumption function which incorporates PIH.

PIH and HP is highly compatible, the findings of Lucas (leading figure in rational expectations) and Prescott (one of the filter developers) are used together both in theory and methodology (Prescott and Lucas, 1971). This enables us to incorporate rational expectations theorem simultaneously into our model and method.

For the smoothing parameter Lambda, we pick 100 as the original suggestion of Hodrick-Prescott ,6.25 as the suggestion of Ravn and Uhlig (2002), and 5 and 10 as Mills (2003) suggests (İsmihan 2019:6).

This is important because smoothing parameter is defined manually, and it is better to utilize several alternatives to have a robust result.

Chapter 4

EMPIRICAL RESULTS

4.1 Data

This study uses Word Bank's World Development Indicators data for aggregate expenditure of households and non-profit institutions serving households (FCE) and Gross Domestic Product (GDP), both in constant local currency units, for the UK over the period 1970-2020. As noted earlier, in our analysis, we use GDP as a proxy for disposable income.

Figure 5 shows time plots of FCE and GDP. As expected, graphical examinations suggest strong correlation between our variables.

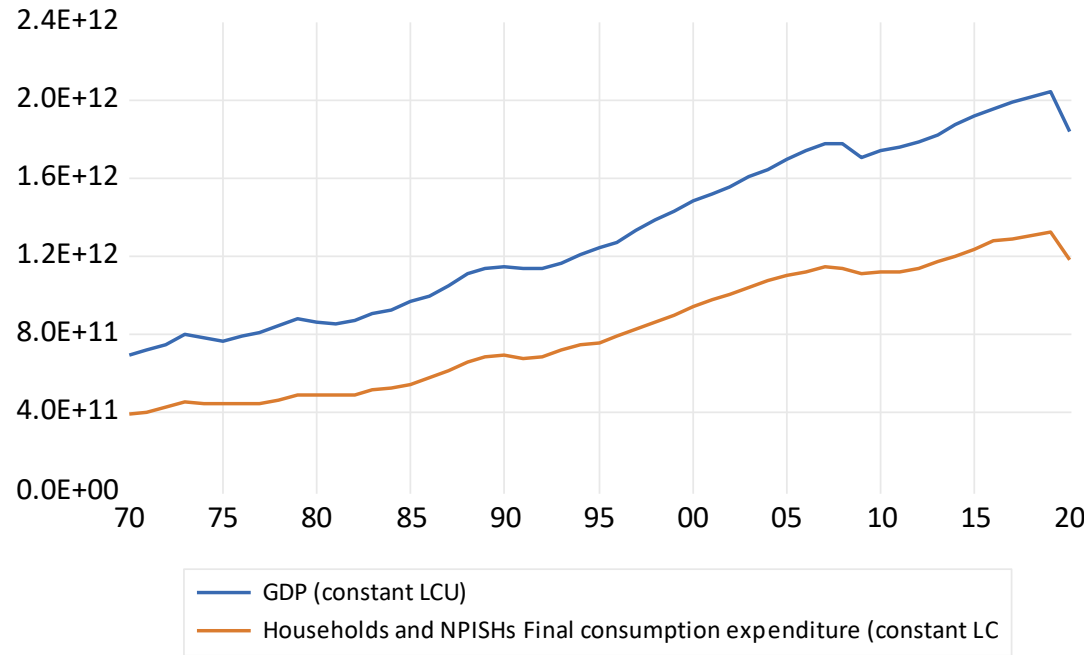

Figure 5: Household Consumption and GDP levels in the UK over 1970-2020

4.2 Unit Root Tests

We conduct unit root tests as a pre-test to better understand the possibility of spuriousness of the pair of the variables under consideration. Unit roots are tested at different levels to check for the nature of non-stationarity in our data. This allows to better detect spuriousness and the level it occurs. This in turn allows us to better decide which method is more suitable for further empirical analysis. Table 3 shows the results for Augmented Dickey Fuller (ADF) tests conducted at level, first difference and second difference levels of both variables.

Table 3: Augmented Dickey Fuller Tests[7]

Test Variable and Details	P-Value	Result
FCE, level, Constant	0,5550	We cannot reject null hypothesis
FCE, level, Constant & Trend	0,8441	We cannot reject null hypothesis
FCE, first difference, Constant	0,4564	We cannot reject null hypothesis
FCE, second difference, Constant	0,0016	We can reject null hypothesis
GDP, level, Constant	0,8069	We cannot reject null hypothesis
GDP, level, Constant & Trend	0,7039	We cannot reject null hypothesis
GDP, first difference, Constant	0,0952	We can reject null hypothesis at 10% significance level but not at 5%
GDP, second difference, Constant	0,0000	We can reject null hypothesis

We observe that both FCE and GDP are nonstationary and they became stationary at the second difference at 5%. This implies that regular OLS regressions via standard Engle-Granger (EG) cointegration may be unsuitable. Since the non-stationarity is eliminated only at the second difference level, this lays a suitable case for Hodrick

[7] Note: Null hypothesis is that the *level* / *first difference* / *second difference* of variable has a unit root

Prescott (HP) filter's application and hence for co-HP trending via Dual Adjustment approach. Moreover, alternative and popular ARDL Bounds approach is not suitable for empirical examination of our data.

4.3 Cointegration and Dual Adjustment Analyses

We proceed to check for co-movements between the two variables with the standard EG for the sake of comparison. Standard OLS results yield the following equation:

FCE = -1.20E+11 + 0.71 GDP R^2= 0.999

OLS results imply the variables are strongly correlated. However, standard EG analysis is not suitable due to the nature of our variables.

From Table 4, we can observe that OLS and co-trending estimates are close. Moreover, transitory and permanent components are close as well. We find the coefficient estimates of transitory component to be 0.6961, 0.6338, 0.6276 and 0.6468 while permanent components are 0.7125, 0.7128, 0.7128 and 0.7129, for HP smoothing parameters 100, 6.25, 5 and 10 respectively. This implies permanent and transitory components are not dissimilar to their relation to aggregate consumption and is contrary to Ismihan's (2019) results for the USA where permanent components coefficient values ranged over 0.91 while transitory components remained between 0.8617, 0.6127, 0.5937 and 0.6554 for HP smoothing parameters 100, 6.25, 5 and 10 respectively. Our findings are also in contrast with Khan et al. (2015) where coefficients for long-term and short-term income coefficient were 0.87 and 0.56 respectively. One similarity with other dual adjustment and other cointegration studies on UK components of income are higher than short term components, whether inadequate or great.

On the other hand, Engle-Granger cointegration (EG-CI) test's p-value and co-HP trending tests' p-values are quite similar. However, while EG CI test is significant at %10, co-trending tests are significant at 5% (for lambda 5, 6.25 and 10) except for lambda 100 which is significant at 10%. This implies that evidence for long run co-movement is slightly stronger under the dual adjustment approach. Therefore, there is considerable evidence for WPIH.

Additionally, we can reject the hypothesis of strong PIH as $\beta_2 \neq 0$. However, we cannot reject the null hypothesis of singular adjustment, all four singular adjustment tests for lambdas 100, 6.25, 5 and 10 are insignificant. Thus, evidence suggests there is singular adjustment and dual adjustment does not exist for the UK between 1970 and 2020. These findings support the Dynamic Keynesian Consumption Function for the UK between 1970-2020. However, evidence does not reject the WPIH.

Table 4: Empirical Results: EG and Dual Adjustment Approach

	EG CI	Co-HP Trend Analysis			
		λ HP	λ ru	λ ol	λ ou
β_0 (s.e)*	-1.20E+11 (4.88E+09)	-1.21E+11 (9.41E+09)	-1.22E+11 (7.13E+09)	-1.22E+11 (6.67E+09)	-1.22E+11 (7.51E+09)
β_1 (s.e)	0.711474 (0.003522)	0.712472 (0.010634)	0.712833 (0.005741)	0.712800 (0.007257)	0.712861 (0.005069)
EG/Co-HP**	-3.198873	-3.199892	-3.942218	-4.105401	-3.587007
β_2 (Adj. s.e)***	-	0.696057 (0.030381)	0.63376 (0.057964)	0.627605 (0.057964)	0.646819 (0.052663)
Singular Adj. Test	-	-1.273131	-1.516527	-1.588702	-1.448038
Lambda	-	100	6.25	5	10

*s.e. = standard errors
** Optimal lag length is determined by SIC (max lag 10)
***Newey-West standard errors (s.e.)

Taking a closer look at household expenditure composition within GDP over time, we can broadly observe a declining trend (with some temporary oscillations) in the percentage of GDP composed of household expenditure (See Figure 6). This lends some support to a Keynesian result for the UK. MPC is constant as income levels increase and APC falls as a result. This is in line with Absolute Income Theory.

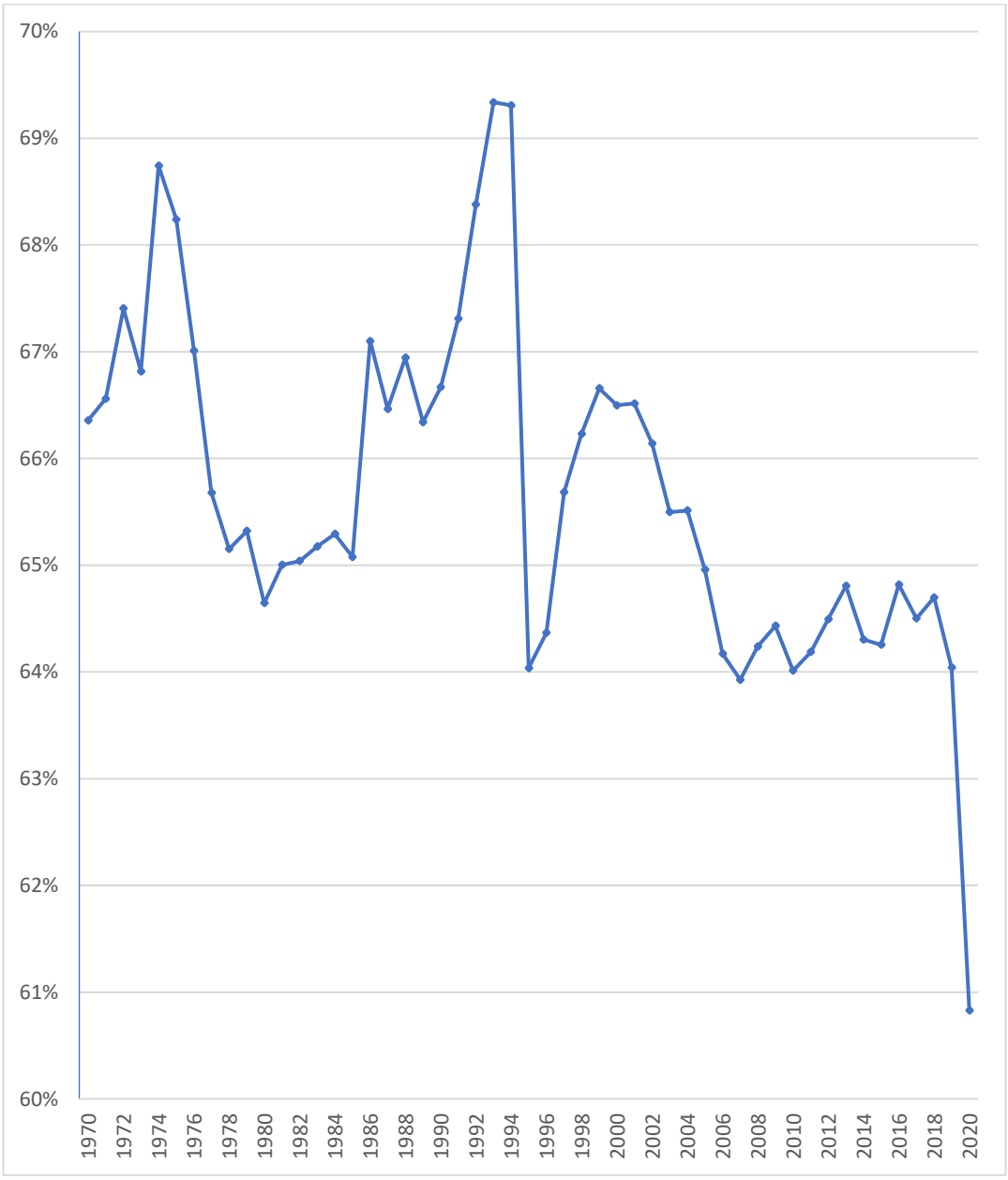

Figure 6: Households and NPISHs Final Consumption Expenditure (% of GDP)

Chapter 5

CONCLUSIONS

We examined the co-movements between household consumption expenditure and household income over the period 1970-2020 in United Kingdom. The focus was to improve our understanding of permanent and transitory components of household disposable income and how it affects household consumption behaviour. Our results have contributions both to our understanding of consumption dynamics in the UK and on the consumption function controversy.

Our findings suggest the UK data better fits the Dynamic Keynesian Consumption Function. There is singular adjustment between household expenditure and household income. There is not enough evidence to suggest a dual adjustment between permanent and transitory components of income and aggregate consumption. These findings are not in line with İsmihan's results on US data, in which some evidence of dual adjustment was found (İsmihan, 2019).

Our findings lend support for monetary and fiscal interventions in macroeconomic policy making.

It is important to note limitations of our data. First, we took GDP as a proxy for disposable income because Word Development Indicators lacked a separate category for household disposable income. Second, data only extended until 1970, which

limited our number of observations. Third, the data was in an annual frequency which constrains our ability to track cyclical movements in income and consumption. Empirical analyses with the long-term, high frequency and non-proxy data are likely to greatly improve the precision of our results.

It is also important to note the limitations of our theoretical modelling. Mainly due to the nature of our theoretical framework, we excluded important variables such as inequality, inflation rate and real interest rates in our modelling. As the theory suggests, it is important to count for the effects of such variables into account. For example, inequality might provide a useful to decompose income groups and to track the extend types of household behaviour. This is especially important in the UK where income inequality is amongst the highest in Europe. Similarly for interest rates, where ultra-low rates might be contributing to endeavours of households to be able to find access to money for their expenses.

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