

The Effect of Current Income on Aggregate Consumption*

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Abstract: Using the statistical distributional approach of aggregation by Hildenbrand and Kneip (1999, 2002), this paper attempts to find out to what extent current labour income can explain the relative change in aggregate consumption expenditure. The coefficients of the changes in the income distribution are estimated as an average derivative of the cross-section Engel curve. We use the UK-FES [1974-1993] to estimate these coefficients separately for each year by a nonparametric estimation procedure. It is found that the change in current labour income plays a significant role for the commodity groups *services* and *total nondurable*, thereby contradicting the implications of the traditional life-cycle/permanent income hypothesis. For *services* the inclusion of dispersion in addition to the mean of the income distribution improves the goodness-of-fit of the model.

I INTRODUCTION

Consumer expenditure accounts for 50 per cent to 70 per cent of spending in most economies. Therefore, it is not surprising that the aggregate consumption function is the most studied aggregate relation. It first received significant attention around the 1940s after Keynes (1936) emphasised the role of the consumption function in his general theory. However, empirical studies with cross-section data as well as with long time-series data produced

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evidence that contradicts Keynes's assumptions. Therefore, new theories of consumption behaviour were put forward to explain these inconsistencies. They led to substantial improvement both in the theoretical and empirical work on aggregate consumption behaviour. Two important new theories appeared in the literature, the *life-cycle hypothesis* (LCH) by Modigliani and Brumberg (1954, 1979) and the *permanent income hypothesis* (PIH) by Friedman (1957).

These LCH/PIH models influenced micro as well as macro analysis of consumer behaviour for several decades. Both theories are based on intertemporal utility maximisation of consumers where consumption is either determined by lifetime resources (labour and non-labour income) or by expected normal income, treated as permanent income. The basic LCH/PIH models imply the insignificance of current labour income, as consumption does not respond one-for-one to transitory shocks on income, because assets are used to buffer consumption against such random shocks. Hence, the marginal propensity to consume (MPC) out of transitory income should be very low, because consumption is smoothed over one's lifetime.

Hall (1978) gave empirical support to the insignificance of current income in explaining aggregate consumption expenditure in his famous study. Using a representative agent model on aggregate time-series data, he showed that only consumption, lagged one-period, matters for the future consumption decision. These findings were contradicted by Flavin (1981), who found that consumption is responsive to lagged income. This result has been termed as *excess sensitivity* in the literature.¹ In order to explain the anomalies between empirical evidence and theoretical implications of the traditional LCH/PIH model several modifications and extensions appeared in the literature on aggregate consumption, e.g., precautionary savings, liquidity constraints, and buffer stock savings.² Yet all empirical analyses neglect the aggregation problem as they directly test the implications of hypotheses on individual behaviour on aggregate data. These attempts implicitly assume the existence of a representative agent which serves as the bridge from individual behaviour to aggregate behaviour. Therefore, it was unclear, whether *excess sensitivity* is a problem of individual behaviour or a problem in passing from the individual to the aggregate level.

The aggregation problem has led many authors to use household-level survey data to work from the bottom up. In micro-level studies the orthogonality condition predicted by the LCH/PIH is much harder to reject

¹ For *excess sensitivity* in aggregate data see also Campbell and Mankiw (1989, 1991).

² See Deaton (1992), Attanasio (1999), and Muellbauer and Lattimore (1999) for a detailed survey of this literature.

(e.g., Hall and Mishkin, 1982, Zeldes, 1989, Attanasio and Weber, 1993, and Attanasio and Browning, 1995). Yet all such micro-level studies are based on very specific assumptions on intertemporal behaviour, e.g., constant relative risk aversion (CRRA) or quadratic form of the intertemporal utility function. Some of the micro-level studies consider semi-aggregates, e.g., cohorts, but not the full aggregate like in macro-studies.

In our search for the influence of the change in current labour income on the change in aggregate (mean) consumption expenditure we adopt the statistical distributional approach of Hildenbrand (1998) and Hildenbrand and Kneip (1999, 2002) [henceforth described as HK]. This approach avoids an *ad hoc* specification of a functional form on the micro-level, particularly of the utility function, and derives an aggregate relation by aggregating the consumption relations of a population of heterogeneous households.³ Heterogeneity of households in their behavioural responses is incorporated by taking into account observable household attributes and income. This allows us to use micro-data, in which information is available at the household level, in the estimation process. To model the change in aggregate consumption HK start with the household-level consumption relation, which may be obtained from intertemporal utility maximisation without any assumption on the form of the utility function. They derive a relation for the change in aggregate consumption expenditure in which, in addition to the change in current labour income, other variables such as changes in prices, in wealth, in expected future interest rates, and in expectations concerning uncertain future labour income are also present. This decomposition *does not depend* on the form of the microrelation. Only the specification of a complete set of explanatory variables at the micro level is needed for this kind of distributional aggregation approach. The effect of the change in current labour income is captured through changes in two parameters of the distribution of current labour income: mean and standard deviation. Additionally, HK's approach allows us to explore the effect of relative price movements on the change in aggregate consumption expenditure for different commodity groups.

HK's approach has several major advantages. First, it does not require a specification of the form of the microrelation. Second, heterogeneity of the population plays a central role in the aggregation process. Third, it offers two advantages over the aggregate time-series analysis: the coefficients relating to the effect of the change in current income can be estimated from cross-section data *independently from each other and independently from the coefficients of*

³ Here we would like to mention that in a recent paper Blundell and Stoker (2000) treated different forms of heterogeneity across individuals in the population, considering an aggregate relationship in a parametric framework.

the other effects, thus avoiding problems of collinearity, and separately for each year, consequently *without assuming the time-invariance* of these coefficients.

Based on this distributional approach our goal in this paper is to quantify the effect of the change in the distribution of current labour income on the relative change in aggregate consumption expenditure. Since in the theoretical model it is not necessary to specify a functional form of individual behaviour, we also want to avoid *ad hoc* assumptions in the empirical model. Instead of a parametric estimation procedure (where a specification of the functional form is needed) we employ a nonparametric estimation procedure, which does not require such a specification. In the following two sections we briefly describe the model, which is used for estimation, and the estimation methodology. Section IV deals with the data description. In Section V we present the results. Finally, the conclusions are drawn in Section VI.

II MODEL

Our econometric model, used for estimating the effect of current labour income on the relative change in aggregate (mean) consumption, is derived from the theoretical model of HK (1999, 2002). This approach combines characteristics of the macroeconomic as well as of the microeconomic literature. The goal is to model the *change* in aggregate consumption expenditure, not the level of aggregate consumption expenditure, which often is the goal in macroeconomics. HK start with the behaviour of micro-units, i.e., individual households, but without imposing any *ad hoc* structure on the microrelation. They explicitly model the aggregation process rather than taking the convenient assumption of a representative agent.

Aggregate consumption expenditure C_t in period t for a commodity group, e.g., *food*, is defined as

$$C_t := \frac{1}{\#H_t} \sum_{h \in H_t} c_t^h \quad (1)$$

where c_t^h denotes the consumption expenditure of household h in period t , and $\#H_t$ denotes the number of households in the population H_t . If individual consumption expenditure c_t^h is modelled by an intertemporal utility maximisation under the life cycle budget constraint with stochastic labour income c_t^h can be expressed as $c_t^h = c(y_t^h, v_t^h, \pi_t)$. In this expression y_t^h denotes current labour income of household h in period t , v_t^h denotes other household-dependent variables, e.g., wealth, expected value of future interest rates, expected present value of future uncertain labour income, or

preferences, and π_t denotes household-independent variables such as the vector of prices of all commodities. Yet the derivation of the aggregate relation does not require any structural formulation of the microeconomic relation $c(\cdot)$ on the household level. Any other modelling framework for individual behaviour, which explicitly spells out a complete set of explanatory variables, can be used.

In their distributional approach of aggregation, HK express (1) in terms of the joint distribution of the explanatory variables y_t^h and v_t^h . Then they model the evolution of this distribution over time in order to derive the change in aggregate consumption expenditure. The heterogeneity of the population in income, consumption expenditure, and household attributes is essential in this approach. It allows us to use cross-section data.

HK decompose the relative change in aggregate consumption expenditure into several effects. We consider only the effect of changes in the following observed variables: current income distribution and own prices. Therefore, in our case the relative change in real⁴ aggregate consumption can be written as

$$\begin{aligned} \frac{C_t - C_{t-1}}{C_{t-1}} &= \beta_{t-1} (m_t - m_{t-1}) + \gamma_{t-1} \left(\frac{\sigma_t - \sigma_{t-1}}{\sigma_{t-1}} \right) \\ &\quad + \rho \left(\frac{p_t - p_{t-1}}{p_{t-1}} \right) \\ &\quad + \text{remainder term} \end{aligned} \tag{2}$$

where m_t and σ_t denote the mean and the standard deviation of the log-income distribution, respectively, in period t , and p_t denotes the price of the commodity group considered. For convenience let

$$D_t := \frac{C_t - C_{t-1}}{C_{t-1}}.$$

The remainder term includes changes in cross prices, in wealth, in the expected value of future interest rates, in expected future labour income, and in preferences. It also includes omitted second order terms, as the aggregate relation is derived by a Taylor series expansion.

The first two terms in the aggregate relation (2) capture the effect of the changing distribution of current labour income which is characterised by mean m_t and standard deviation σ_t of the log-income distribution. Let α denote

⁴ Note that all variables considered, i.e., consumption expenditure, income, and commodity prices are deflated by the general price index.

an attribute profile consisting of household characteristics like age, number of persons in the household, etc. Then H_t^a denotes the subpopulation of all households with attribute profile a and $\bar{c}_t^a(x_t^h, p_t)$ the Engel curve of this subpopulation, where $x_t^h := \log y_t^h$ is the log-current income of household h and p_t the commodity price, which is common for all households, in period t . Using the definitions of β_t and γ_t given in HK one can define the corresponding coefficients for the subpopulation H_t^a as

$$\beta_t^a := \frac{\sum_{h \in H_t^a} \partial_x \bar{c}_t^a(x_t^h, p_t)}{\tilde{C}_t^a} \quad (3)$$

and

$$\gamma_t^a := \frac{\sum_{h \in H_t^a} (x_t^h - m_t^a) \partial_x \bar{c}_t^a(x_t^h, p_t)}{\tilde{C}_t^a} \quad (4)$$

where $\tilde{C}_t^a := \sum_{h \in H_t^a} c_t^h$ and m_t^a is the mean of x_t^h in the subpopulation H_t^a . Therefore, the values of β_t and γ_t for the whole population are obtained as

$$\beta_t = \frac{\sum_a \tilde{C}_t^a \beta_t^a}{\sum_a \tilde{C}_t^a} \quad (5)$$

and

$$\gamma_t = \frac{\sum_a \tilde{C}_t^a (\gamma_t^a + (m_t^a - m_t) \beta_t^a)}{\sum_a \tilde{C}_t^a}. \quad (6)$$

It can be seen from (3) and (4) that β_t and γ_t depend only on the average derivative of the cross-section Engel curve $\bar{c}_t^a(x_t^h, p_t)$ of the subpopulation H_t^a . If we recall the definition of *elasticity* it is clear from (2) that β_t and γ_t can be interpreted as aggregate elasticities with respect to mean current income⁵ and with respect to the dispersion σ_t of current income, respectively, under the *ceteris paribus* condition. This means that β_t can be regarded as an aggregate *income-elasticity of consumption expenditure*. In contrast, the coefficient γ_t , as an *income dispersion elasticity*, is a new concept.

Let us emphasise again two important advantages of this cross-sectional approach, mentioned in the introduction. First, the coefficients β_t and γ_t are estimated for each time-period t , i.e., every year in our analysis, *separately*, which means that they can be time-varying. This is in contrast to the time-series approach, where the coefficients are implicitly assumed to be time-

⁵ Under the assumptions of log-normality of the distribution of current income and the *ceteris paribus* condition $\sigma_t = \sigma_{t-1}$ it can be easily shown that $m_t - m_{t-1} = \frac{Y_t - Y_{t-1}}{Y_{t-1}}$, where Y_t is the mean of the current income distribution (see HK, 2002, for details).

invariant. The second advantage is the possibility of estimating the effect of the changing income distribution *independently* of the other effects. From the definitions of β_t and γ_t in (3) and (4) it follows that these coefficients are estimated separately from cross-section data in each period. Therefore, the problem of collinearity with each other and other excluded variables is avoided in the estimation procedure. As far as we know, the possibility of analysing the effect of current income without the need of modelling the remainder term is new in the literature. This is due to the fact that these coefficients involve the derivative of the cross-section Engel curve with respect to current labour income. In their decision process regarding consumption expenditure households incorporate their current level of income, expected level of future income, wealth, etc. One expects that anticipated future labour income is strongly correlated with current income across the subpopulation. Therefore, the coefficients β_t and γ_t also include the part of expectations about future income which is dependent on current labour income. Consequently, under certain circumstances the remainder term is negligible. This can be illustrated by a simple example. Assume that the expectations concerning the present value of future uncertain labour income are modelled by a stochastic process such that they are a random multiple of current labour income y_t^h . Provided the stochastic term does not depend on y_t^h , the remainder term in (2), which captures only people's view or attitude towards forming expectations about the future, will be negligible in the "normal" situation without any drastic changes in the socio-economic and political environment.⁶ In contrast to the coefficients β_t and γ_t , relating to the effect of current labour income, the coefficient ρ has to be estimated as a time-series coefficient (for details see Section III).

The other effects, occurring in the aggregate relation, except the effect of price changes, are either unobserved in the FES-data set (i.e., wealth⁷) or unobservable in principle. Therefore, one would have to find suitable proxies to include them in the empirical analysis. Since we want to avoid using proxies, we just concentrate on the observable effects. Consequently, one cannot expect our empirical model to give the best possible performance or prediction. The higher the influence of income and prices on the change in aggregate consumption expenditure as compared to other excluded variables, the better is the performance of our model in explaining the observed change.

⁶ For mathematical details and further explanations see HK (2002).

⁷ In the FES-data only a part of the asset variable, i.e., property income, is given.

III ESTIMATION METHODOLOGY

To estimate the average derivative of the Engel curve, i.e., $E[\hat{\partial}_x \bar{c}_t^a(x_t^h, p_t)]$, we employ the direct average derivative estimator (DADE) (see Stoker, 1991). We use the Nadarraya-Watson type kernel regression estimator with kernel $K(\cdot) = \frac{1}{b} K\left(\frac{\cdot}{b}\right)$, $b = \text{bandwidth}$. Hence,

$$\hat{c}_t^a(x_t) = \frac{\sum_{h \in H_t^a} c_t^h K\left(\frac{x_t - x_t^h}{b}\right)}{\sum_{h \in H_t^a} K\left(\frac{x_t - x_t^h}{b}\right)}$$

We take the regression derivative as

$$\hat{\partial}_x \bar{c} = \frac{\partial \hat{c}}{\partial x}.$$

Then the DADE estimator can be obtained as a sample average of the estimated values of the regression derivatives:

$$\hat{\delta} = E[\hat{\partial}_x \bar{c}_t^a(x_t^h)] = \frac{1}{\#H_t^a} \sum_{h \in H_t^a} \hat{\partial}_x \bar{c}_t^a(x_t^h) \quad (7)$$

For the estimation we use the quartic kernel which is of the following form:

$$K(u) = \frac{15}{16} (1 - u^2)^2 \quad \text{for } |u| \leq 1$$

To estimate β_t and γ_t we explored quite a high range of bandwidth values, i.e., from $.25 * \text{stand.dev.}(\log(\text{income}))$ to $2 * \text{stand.dev.}(\log(\text{income}))$. Yet here we present the results only for that value of b , where the estimates $\hat{\beta}_t$ and $\hat{\gamma}_t$ are most stable.

In the theoretical literature it is claimed that current labour income does not have a significant effect on the change in aggregate consumption expenditure. It is argued that, because of the intertemporal decision problem, what really matters is the expected normal income or present discounted value of life cycle income, in which current labour income constitutes a negligible component. Therefore, our goal is to observe how far current labour income can capture the actual change in aggregate consumption expenditure without assuming a simple representative agent. The aim is to find out whether current labour income affects and if it affects how much it can explain.

In order to proceed according to our goal we consider the following two empirical models:

$$(I) \quad \hat{D}_t = \hat{\beta}_{t-1} (m_t - m_{t-1})$$

$$(II) \quad \hat{D}_t = \hat{\beta}_{t-1} (m_t - m_{t-1}) + \hat{\gamma}_{t-1} \left(\frac{\sigma_t - \sigma_{t-1}}{\sigma_{t-1}} \right)$$

Recall that m_t is the mean and σ_t is the dispersion of log-current income in period t . Therefore, the first two models include the effects of changes only in the income distribution.

Different from the time-series least-square estimates of the parameters, $\hat{\beta}_t$ and $\hat{\gamma}_t$ are estimated independently, and not jointly by minimising an average squared distance between data points and corresponding predictions. Instead these coefficients are estimated from cross-section data each year, using (3) and (4), and then substituted into equations (I) and (II). Consequently, the statistical properties of the remainder term do not create any problem in the estimation of model (I) and (II). To demonstrate how far current labour income explains the observed change in aggregate consumption we use two residual criteria:

- the average absolute error (AAE):

$$AAE = \frac{1}{T} \sum_t |D_t - \hat{D}_t| \quad (8)$$

where T is the number of time periods.

- the relative residual sum of squares (RRSS):

$$RRSS = \frac{\sum_t (D_t - \hat{D}_t)^2}{\sum_t (D_t)^2} \quad (9)$$

By comparing these residual statistics for the first and the second model one is able to judge about the importance of the influence of the *dispersion* of income on the change in aggregate consumption expenditure. The values of $\hat{\gamma}_t$ itself are of no help in drawing conclusions about the significance of this dispersion term, since they are estimated independently from $\hat{\beta}_t$ without fitting model (II) by minimising the sum of squared errors. There is no statistical, data-analytical reason to assume that these residual statistics might be small because the empirical models (I) and (II) are not estimated by regressing the L.H.S. variable, i.e., D_t , on the R.H.S. variables, i.e., $(m_t - m_{t-1})$ and/or $\frac{\sigma_t - \sigma_{t-1}}{\sigma_{t-1}}$, by OLS

We also look into the effect of the change in another observed variable, i.e., the relative change in own prices, on the change in aggregate consumption expenditure for the commodity group considered. The consideration of relative

price movements will be particularly important if one considers different commodity groups because of the large variation in price elasticities across commodity groups.

To study the effect of the time-series variable “change in relative prices”, we use OLS to regress the remainder term on the relative price movements. Therefore, we use the following regression equation:

$$D_t - \left[\hat{\beta}_{t-1} (m_t - m_{t-1}) + \hat{\gamma}_{t-1} \left(\frac{\sigma_t - \sigma_{t-1}}{\sigma_{t-1}} \right) \right] = \rho \left(\frac{p_t - p_{t-1}}{p_{t-1}} \right) + \varepsilon_t \quad (10)$$

From (10) it is clear that ρ represents the effect of the own price change on aggregate consumption expenditure after accounting for the changes in the income distribution. The estimated value of ρ is used to make predictions based on the following empirical model (III):

$$(III) \quad \hat{D}_t = \hat{\beta}_{t-1} (m_t - m_{t-1}) + \hat{\gamma}_{t-1} \left(\frac{\sigma_t - \sigma_{t-1}}{\sigma_{t-1}} \right) + \hat{\rho} \left(\frac{p_t - p_{t-1}}{p_{t-1}} \right)$$

After substituting the values of the estimates $\hat{\beta}_t$ and $\hat{\gamma}_t$, obtained separately for each time period, into (III) the same residual criteria are used to calculate the magnitude of the effect of relative prices.

The average absolute value of the original change, i.e., $|D_t|$, will serve as a benchmark for comparing subsequent values of AAE. We also calculate the relative gain in AAE to measure the influence of the change in current labour income. These tests are of particular interest for our inference on current labour income, since our model does not incorporate any parameter related to current labour income which is fitted to the time-series model. Hence, the smaller the values of AAE and RRSS the better is the performance of our model to support that current labour income is an influential factor on the change in aggregate consumption expenditure. The results will be presented in Section V.

IV DATA DESCRIPTION

For the estimation we use the UK-Family Expenditure Survey (FES). This cross-sectional data set offers information on income, consumption expenditure, and also on household characteristics, such as household size and composition, age, and employment status of the head of household. The FES covers about 7,000 households from all over Great Britain and Northern Ireland each year. It started in January 1957, but due to changes in the definition of the basket of goods and services we only use data from 1974 to

1993 to ensure a consistent definition of the consumption good categories. We also excluded the year 1978 because problems within the database made the construction of our income variable impossible.

We use disposable labour income (which means excluding deductions like tax and excluding investment income). We present results for the following three (groups of) consumption goods: *food*, *services*, and *total nondurable consumption* (excluding durable goods and housing costs).⁸ *Total* is the most important commodity in macro analysis. *Food* constitutes a major proportion of total expenditure and is considered to be very inelastic with respect to prices and current income. In contrast, households have much scope to vary the consumption expenditure for *services*. Therefore, *food* and *services* are expected to behave completely differently due to their different nature.

Closely connected with the FES is the Retail Price Index (RPI) which is given for most of the commodity aggregates. The reference period is January 1987. In order to deflate all our variables by the general price index in our empirical model, we use the price index of the respective months in which the household has been surveyed.

Table 1: *Household Characteristics Considered for Forming Subgroups*

<i>Categories Based on Households' Characteristics</i>				
<i>Employment Status</i>	<i>Head Age</i>	<i>Number of Persons</i>	<i>Household Composition</i>	<i>Number of Persons Working</i>
Employee	≤65	1	adult	1
		2	only adults	1
				2
			only adults	≥1
Self-employed	any		≥ two adults	1
		≥3	with children	≥2
		≤2	only adults	≥1
		≥3	≥ two adults	≥1
Unemployed/ Unoccupied	≤65	≤2	only adults	≥0
		≥3	≥ two adults	≥0
	>65	any	any	≥0
Retired	≥60	1	adult	0
		2	two adults	≥0

⁸ For a detailed description of the data structure see Kemsley *et al.* (1980); for the items included in the commodity groups see the Appendix.

We check for outliers to avoid problems with “extreme” observations. For that reason we followed three different rules to decide on what can be regarded as outliers of different kinds:

- Exclude the 0.1 per cent households with highest and lowest income, respectively.
- Exclude those households whose consumption expenditure on any of the two groups of goods (i.e., except *total nondurable*) is larger than the household's income.
- Fix the consumption expenditure of households whose expenditure on *total nondurable* exceeds three-times the mean consumption expenditure on *total nondurable* and three-times the household's income as three-times the mean consumption expenditure on *total nondurable*.

In order to estimate the Engel curve (see Section II) we consider different subgroups based on relevant household characteristics given in the FES data. The attribute profiles of the subgroups are given in Table 1.⁹

Because of the exclusion of outliers and the grouping procedure we get a smaller sample compared to the original sample for each year. The number of observations of the modified sample and some other descriptive statistics on income and consumption expenditure can be found in Table A.1 in the Appendix.

V RESULTS

Table 2 presents the estimated values for the coefficients β_t and γ_t , $t = 1974, \dots, 1993$, except 1978, for all three commodity groups. $\hat{\beta}_t$ for *total nondurable* lies in between the $\hat{\beta}_t$ -values for *food*, which has the lowest income-elasticity, and that for *services*, which has the highest income-elasticity.

For all commodity groups we can see that $\hat{\gamma}_t$ -values are very low compared to the $\hat{\beta}_t$ -values. For *services* the $\hat{\gamma}_t$ -values are largest in comparison to the $\hat{\gamma}_t$ -values for the other two commodity groups. If one interprets the results in terms of the mean of $\hat{\beta}_t$ and $\hat{\gamma}_t$, $mean(\hat{\beta}_t)$ and $mean(\hat{\gamma}_t)$, respectively, another fact also becomes clear. A higher value for $mean(\hat{\beta}_t)$ also means a higher value for $mean(\hat{\gamma}_t)$. This means that the higher is the income-elasticity for a commodity group, the higher is the income dispersion elasticity.

Table 3 presents the $\hat{\rho}$ -values with t-ratios and Durbin-Watson statistics obtained from equation (10). Recall that $\hat{\rho}$ is the coefficient of relative move-

⁹ This grouping procedure is based on our intuition about connections between income, consumption expenditure, and household characteristics and also on the purely statistical requirement of a sufficient number of observations in each subgroup.

ments in own prices. Except for *services* the t-ratios indicate a significant effect of the change in relative prices, with the highest value for the commodity *total* [with $\hat{\rho} = 1.127$].¹⁰

Table 2: *Estimated coefficients $\hat{\beta}$ and $\hat{\gamma}$ from DADE procedure*

Year	Commodity Groups					
	Food		Services		Total	
	$\hat{\beta}$	$\hat{\gamma}$	$\hat{\beta}$	$\hat{\gamma}$	$\hat{\beta}$	$\hat{\gamma}$
1974	0.290	0.070	0.953	0.333	0.572	0.218
1975	0.264	0.056	0.866	0.346	0.538	0.204
1976	0.263	0.079	0.871	0.417	0.558	0.218
1977	0.238	0.060	0.900	0.420	0.555	0.202
1979	0.254	0.067	0.960	0.435	0.557	0.219
1980	0.263	0.096	0.762	0.382	0.531	0.203
1981	0.226	0.044	0.863	0.338	0.563	0.203
1982	0.290	0.085	0.883	0.406	0.606	0.250
1983	0.189	0.036	0.900	0.422	0.541	0.204
1984	0.295	0.078	1.029	0.431	0.618	0.243
1985	0.265	0.033	0.887	0.342	0.579	0.230
1986	0.258	0.071	0.874	0.464	0.586	0.260
1987	0.225	0.059	0.858	0.438	0.558	0.212
1988	0.246	0.071	1.005	0.633	0.571	0.281
1989	0.230	0.041	0.907	0.399	0.545	0.235
1990	0.244	0.086	1.017	0.573	0.533	0.252
1991	0.232	0.055	0.842	0.388	0.537	0.193
1992	0.238	0.066	0.900	0.475	0.534	0.226
1993	0.249	0.085	0.920	0.456	0.563	0.248
Mean	0.250	0.065	0.905	0.426	0.560	0.226

Keeping in mind our aim of quantifying the influence of changes in the log-income distribution on the aggregate consumption growth we present the residual statistics, e.g., AAE and RRSS in Table 4.¹¹ Our empirical models (I) to (III) are given again in the footnote of Table 4. The third, fourth, and fifth columns give the values of AAE, of relative gain in AAE, and of RRSS, respectively. The results for the empirical model (III) are obtained after substituting the estimated values of β_t and γ_t in (10) and estimating (10) by

¹⁰ We also checked for cross-price effects in the case of *services* and *food*. For *services* we could not find any significant effect of prices of other goods. In the case of *food* we found that the inclusion of prices for *services* and *clothing*, which we did not analyse in this paper, improved the fit.

¹¹ Recall that we cannot judge about the importance of the effect of the change in the income distribution by looking only at the values of $\hat{\beta}_t$ and $\hat{\gamma}_t$ because these are not derived by OLS.

OLS. In support of our observations from Table 4 we also provide the plots for the actual change in mean consumption and for the estimated change obtained from our empirical models (Figures 1 to 3).

Table 3: *Results for $\hat{\rho}$ Estimated by OLS Using Equation (10) (t-ratios in parentheses)*

	<i>Food</i>	<i>Commodity Groups Services</i>	<i>Total</i>
$\hat{\rho}$	0.574 (2.329)	0.609 (1.543)	1.127 (2.564)
Durbin-Watson	0.932 ^a	2.285	1.767

^aindicating presence of AR(1),

For *total nondurable* the effect of current labour income is significant, though the inclusion of the dispersion of income does not help to explain the change in consumption expenditure further. Only a slight improvement in terms of AAE can be observed. Besides, from the graphs in Figure 1 no clear judgement about the two models is possible because of the close movements of the time paths for these models. Yet the inclusion of the effect of own price movements improves the model performance. AAE as well as RRSS are reduced a lot. For the model including prices it can be seen that in the last years this model can trace the movements of the actual time path better than the two other models.

The effect of current labour income on the consumption expenditure on *services* is very significant. In contrast to the case of *total nondurable* the inclusion of the dispersion of income improves the performance of our model in terms of explaining the observed change in aggregate consumption expenditure. This is supported (but not explained) by the highest $\hat{\gamma}_t$ -values for *services* in Table 2. The insignificance of the relative price movements can be seen by the increase in the value of AAE and also by the insignificance of $\hat{\rho}$, see Table 3. The demand for *services* is known to be very price-elastic. Therefore, an increase or decrease in own prices will be compensated by a decrease or increase, respectively, in the quantity demanded, thereby leaving consumption expenditure on *services* more or less constant. The better performance of model (II), i.e., including dispersion but excluding prices, for *services* can also be seen from Figure 2, especially for the years 1975 to 1984. The significant effect of the dispersion of income on consumption expenditure on *services* is very plausible, since an increase in dispersion, keeping mean income constant, leads to higher inequality. Consequently, for a commodity group with high income-elasticity like *services*, for which there is much scope to vary consumption, the increase in consumption expenditure of households with

higher income dominates the decrease in consumption expenditure of households with lower income. This results in an increase in mean consumption expenditure.

For *food* it appears that the model based only on cross-section estimates of the income effects cannot explain the actual change well. But after introducing the effect of the changes in relative prices the goodness-of-fit of our model improves slightly. This can be clearly seen from Figure 3. The insignificance of the dispersion of income for a commodity group with low income-elasticity is quite plausible, because there is not much scope to vary the consumption pattern for *food*, as compared to other commodity groups like *services*, due to variation in income. Recall that we consider the *change* in the consumption expenditure for *food* for *one* lag. Therefore, households are not expected to change their demand for *food* immediately to a large extent due to changes in the distribution of current income. Hence, changes in consumption expenditure can be attributed mainly to the change in prices. As the demand for *food* is very price-inelastic, changes in *food* prices are directly reflected in changes in the consumption expenditure on *food*. From Figure 3 it is also clear that the level and the direction of the actual changes in consumption expenditure on *food* cannot be captured by the corresponding values of the changes estimated by the first two models. This peculiar relationship between the change in consumption expenditure on *food* and the change in income may occur due to some other unobserved influential determining variables which tend to overcompensate the positive change in income in a reverse way.¹² There may be several reasons that can be put forward. One reason may be the change in the composition of the population, e.g., it is observed that the average number of persons per household decreases over the years.¹³ This change in the composition leads to different consumption patterns in the population. Also it may occur that over time households change their preference pattern. Therefore, in the case of *food* people substitute the consumption of home-made food by the consumption of take-away or restaurant food.¹⁴ This also explains the observed decrease in mean *food* consumption expenditure (see Table A.1). The change in the preference

¹² The Durbin-Watson value for *food* indicates the presence of autocorrelation in the error term in equation (10). Yet, all statistical tests rejected the presence of misspecified dynamics or omitted variables correlated with included regressors. Therefore, in order to interpret the t-value of the coefficient $\hat{\rho}$ correctly we used an estimation procedure which checks for autocorrelation. This gave even a higher value for $\hat{\rho}$ which is 0.641 with a t-ratio of 3.412.

¹³ It is observed from the data that whereas the share of 1-person-households in the total number of households increases very much and the share of 2-person-households slightly, the shares of all other types of households decrease over the years.

¹⁴ Note that the commodity group *food* in our analysis does not include *catering* (canteen, restaurant, etc.).

pattern may also lead to higher expenditure on leisure or travel.

Table 4: *Goodness-of-fit Tests for our Empirical Models*

<i>Commodity</i>	<i>Model</i>	<i>AAE*100</i>	<i>Relative Gain in AAE</i>	<i>RRSS</i>
Total	Benchmark	2.416		
	(I)	1.896	0.215	0.548
	(II)	1.859	0.231	0.604
	(III)	1.654	0.315	0.436
Services	Benchmark	5.067		
	(I)	3.531	0.303	0.528
	(II)	2.842	0.439	0.489
	(III)	3.184	0.372	0.428
Food	Benchmark	2.058		
	(I)	2.123	-0.032	1.172
	(II)	2.130	-0.035	1.209
	(III)	1.847	0.103	0.916

Benchmark model: $|D_t|$

$$\text{Model (I)} \quad \hat{D}_t = \hat{\beta}_{t-1} (m_t - m_{t-1})$$

$$\text{Model (II)} \quad \hat{D}_t = \hat{\beta}_{t-1} (m_t - m_{t-1}) + \hat{\gamma}_{t-1} \left(\frac{\sigma_t - \sigma_{t-1}}{\sigma_{t-1}} \right)$$

$$\text{Model (III)} \quad \hat{D}_t = \hat{\beta}_{t-1} (m_t - m_{t-1}) + \hat{\gamma}_{t-1} \left(\frac{\sigma_t - \sigma_{t-1}}{\sigma_{t-1}} \right) + \hat{\rho} \left(\frac{p_t - p_{t-1}}{p_{t-1}} \right)$$

Hence, we can say that the change in current labour income can explain a high proportion of the change in aggregate consumption for the commodity with highest income-elasticity, *services*, and the commodity of major policy concern, *total nondurable*. For *services* the results also show a better fit of the model including the dispersion of income. The change over time in the preference pattern, as explained above in the case of *food*, leads to a substitution across commodity groups within households' total consumption expenditure. The decrease in expenditure on *food* is compensated by an increase in expenditure on several other commodity groups with higher income elasticities, like take-away food, leisure, and services.¹⁵ Therefore, *total* is not affected very much by the unobservable change in the preference

¹⁵ The change in the preference pattern may also lead to an increase in the expenditure on durable goods which are not considered in this paper.

Figure 1: *Actual and Estimated Changes in the Consumption Expenditure for Total Nondurable*

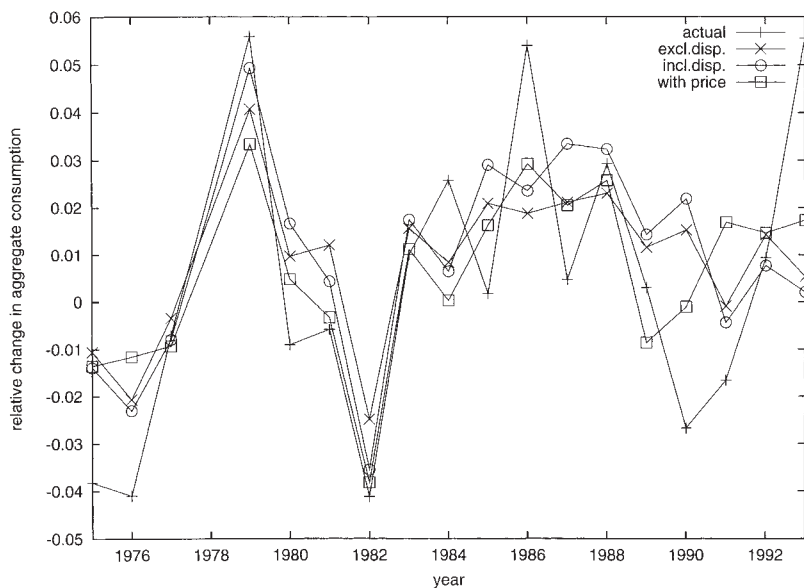


Figure 2: *Actual and Estimated Changes in the Consumption Expenditure for Services*

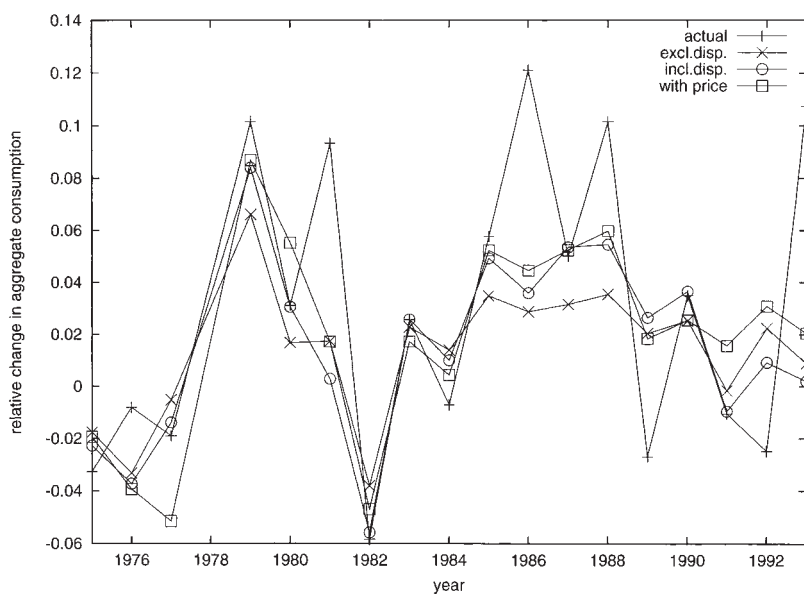
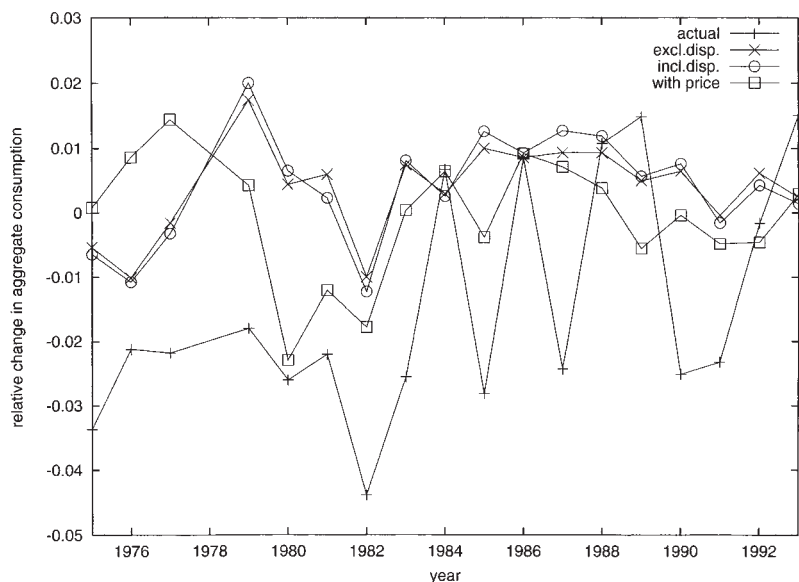


Figure 3: *Actual and Estimated Changes in the Consumption Expenditure for Food*



pattern and remains more or less constant. For *services* most of the variation is explained by the change in income because the change in expenditure on *services* due to the change in the preference pattern is not so influential as *services* is only one of several commodity groups with high income elasticities among which the decrease in expenditure on *food* is spread over.

VI CONCLUSIONS

In this paper we used a distributional approach of aggregation based on heterogeneous households' decisions developed by Hildenbrand and Kneip (1999, 2002) to find out what explains the change in aggregate consumption expenditure. Our empirical model derived from their theoretical approach accounts for the effect of changes only in observed variables on the change in aggregate consumption expenditure. Our goal is to explore the magnitude of the effect of these variables in the aggregate relation for different commodity groups. We estimated the effects of current labour income from FES cross-section data using a nonparametric procedure. The effect of the time series variable "change in the relative prices" was estimated by OLS. We computed residual statistics based on the estimated values to judge about the

importance of each included observed variable for the change in aggregate consumption. Three empirical models were used, the first one including only the mean of the log-income distribution, the second one including the mean and the dispersion of the log-income distribution, and the third one including also the change in own prices. Current labour income significantly explains the actual changes in the aggregate consumption expenditure on *services* and *total nondurable*. The dispersion of income, i.e., the heterogeneity of the income distribution significantly affects the change in aggregate consumption for *services*, the commodity group with the highest income-elasticity. Though current income does not exert a significant effect on the change in consumption expenditure for *food*, the change in relative prices can explain a significant portion of the change in aggregate consumption expenditure on this commodity. Hence, this analysis gives an insight into the relevant explanatory variables which determine the changes in aggregate consumption expenditure. Yet this exploratory study can be extended further towards incorporating other unobserved or unobservable variables by taking proxies.

REFERENCES

- ATTANASIO, ORAZIO P., 1999. "Consumption", in J.B. Taylor and M. Woodford (eds.), *Handbook of Macroeconomics*, Vol. 1, Amsterdam, New York: North Holland, pp. 741- 812.
- ATTANASIO, ORAZIO P. and MARTIN J. BROWNING, 1995. "Consumption over the Life Cycle and over the Business Cycle", *American Economic Review*, Vol. 85, No. 5, pp. 1118-1137.
- ATTANASIO, ORAZIO P. and GUGLIELMO WEBER, 1993. "Consumption Growth, the Interest Rate and Aggregation", *Review of Economic Studies*, Vol. 60, pp. 631-649.
- BLUNDELL, RICHARD W. and THOMAS M. STOKER, 2000. "Models of Aggregate Economic Relationships that Account for Heterogeneity", mimeo, Institute for Fiscal Studies, London, to appear in *Handbook of Econometrics*, Vol. 6.
- CAMPBELL, JOHN Y. and N. GREGORY MANKIW, 1989. "Permanent Income, Current Income, and Consumption", in O.J. Blanchard and S. Fisher (eds.), *NBER Macroeconomics Annual*, Cambridge, MA: MIT Press, pp. 185-216.
- CAMPBELL, JOHN Y. and N. GREGORY MANKIW, 1991. "The Response of Consumption to Income: A Cross-Country Investigation", *European Economic Review*, Vol. 35, No. 4, pp. 723-767.
- DEATON, ANGUS S., 1992. *Understanding Consumption*, 1st Edition, Oxford: Oxford University Press.
- DSS, 1995. *Household Below Average Income 1979-1992/93: A Statistical Analysis*, London: Her Majesty's Stationery Office.
- FLAVIN, MARJORIE, 1981. "The Adjustment of Consumption to Changing Expectations about Future Income", *Economic Journal*, Vol. 89, pp. 974-1009.

- FRIEDMAN, MILTON, 1957. *A Theory of the Consumption Function*, Princeton, MJ: Princeton University Press.
- HALL, ROBERT E., 1978. "The Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence", *Journal of Political Economy*, Vol. 86, pp. 971-987.
- HALL, ROBERT E. and FREDERIC S. MISHKIN, 1982. "The Sensitivity of Consumption to Transitory Income: Estimates from Panel Data on Households", *Econometrica*, Vol. 50, pp. 461-481.
- HER MAJESTY'S STATIONERY OFFICE, *Family Expenditure Survey*, Her Majesty's Stationery Office. Annual Report. Material from the Family Expenditure Survey is Crown Copyright; has been made available by the Office for National Statistics through the Data Archive; and has been used by permission. Neither the ONS nor the Data Archive bear any responsibility for the analysis or interpretation of the data reported here.
- HILDENBRAND, WERNER, 1998. "How Relevant are Specifications of Behavioral Relations on the Micro-level for Modelling the Time Path of Population Aggregates?", *European Economic Review*, Vols. 3-5, No. 42, pp. 437-458.
- HILDENBRAND, WERNER and ALOIS KNEIP, 1999. "Demand Aggregation under Structural Stability" *Journal of Mathematical Economics*, Vol. 31, pp. 81-109.
- HILDENBRAND, WERNER and ALOIS KNEIP, 2002. "Aggregation under Structural Stability: the Change in Consumption of a Heterogeneous Population", *Bonn Graduate School of Economics Discussion Paper No. 4/2002*, University of Bonn.
- KEMSLEY, W. F. F., R. U. REDPATH and M. HOLMES, 1980. *Family Expenditure Survey Handbook*, London: Her Majesty's Stationery Office.
- KEYNES, JOHN M., 1936. *The General Theory of Employment, Interest and Money*, New York: Harcourt Brace.
- MODIGLIANI, FRANCO and RICHARD BRUMBERG, 1954. "Utility Analysis and the Consumption Function: an Interpretation of Cross-section Data", in K.K. Kurihara (ed.), *Post-Keynesian Economics*, New Brunswick, NJ: Rutgers University Press, pp. 128-197.
- MODIGLIANI, FRANCO and RICHARD BRUMBERG, 1979. "Utility Analysis and the Consumption Function: an Attempt at Integration", in A. Abel (ed.), *The Collected Papers of Franco Modigliani*, Vol. 2, Cambridge, Mass.: MIT Press, pp. 128-197.
- MUELLBAUER, JOHN N. J. and RALPH LATTIMORE, 1999. "The Consumption Function: A Theoretical and Empirical Overview", in M. Hashem Pesaran and M.R. Wickens (eds.), *Handbook of Applied Econometrics*, Vol. I: *Macroeconomics*, Oxford, Cambridge: Blackwell Publishers, pp. 221-311.
- STOKER, THOMAS M., 1991. "Equivalence of Direct, Indirect and Slope Estimators of Average Derivatives", in W.A. Barnett, J.L. Powel, G. Tauchen (eds.), *Nonparametric and Semiparametric Methods in Econometrics and Statistics*, Cambridge: Cambridge University Press, pp. 99-124.
- ZELDES, STEPHEN P., 1989. "Consumption and Liquidity Constraints: an Empirical Investigation", *Journal of Political Economy*, Vol. 97, pp. 305-346.

APPENDIX

Table A1: *Descriptive Statistics: Mean and Standard Deviation (in parentheses) for Log-income and Consumption Expenditure*

Year	Sample Size	Log Income	Descriptive Statistics		
			Food	Services	Total Nondurable
1975	5581	4.93 (0.630)	34.50 (18.437)	12.11 (14.263)	108.31 (38.072)
1975	6163	4.91 (0.620)	33.34 (17.991)	11.72 (13.726)	104.17 (63.163)
1976	6159	4.87 (0.613)	32.63 (17.315)	11.62 (13.488)	99.90 (61.048)
1977	6254	4.87 (0.600)	31.92 (16.941)	11.40 (15.016)	99.18 (60.265)
1979	5856	4.94 (0.626)	31.34 (17.473)	12.56 (15.309)	104.73 (66.706)
1980	5996	4.96 (0.646)	30.53 (17.036)	12.95 (14.307)	103.78 (66.414)
1981	6579	4.98 (0.621)	29.86 (16.332)	14.16 (17.436)	103.18 (65.078)
1982	6487	4.93 (0.589)	28.55 (15.997)	13.33 (16.581)	98.93 (62.914)
1983	6005	4.96 (0.593)	27.82 (15.223)	13.67 (16.142)	99.92 (62.789)
1984	6121	4.98 (0.588)	28.00 (15.626)	13.57 (16.666)	102.50 (66.969)
1985	6101	5.01 (0.608)	27.22 (15.320)	14.36 (16.585)	102.67 (68.110)
1986	6180	5.04 (0.620)	27.45 (16.405)	16.10 (20.492)	108.21 (75.420)
1987	6365	5.08 (0.650)	26.78 (16.009)	16.90 (21.179)	108.72 (75.201)
1988	6314	5.12 (0.678)	27.07 (16.000)	18.62 (29.657)	111.90 (81.362)
1989	6405	5.14 (0.685)	27.47 (16.567)	18.12 (23.070)	112.23 (79.577)
1990	5959	5.17 (0.704)	26.78 (16.006)	18.75 (25.030)	109.23 (77.895)
1991	6015	5.17 (0.694)	26.16 (16.157)	18.55 (24.538)	107.41 (75.267)
1992	6230	5.19 (0.670)	26.11 (15.621)	18.09 (23.446)	108.42 (72.895)
1993	5753	5.20 (0.661)	26.51 (15.571)	20.04 (26.967)	114.43 (80.619)

Contents of the commodity groups:

Total nondurable: food, catering, alcohol, tobacco, fuel & light, household consumables, petcare, household services, clothing, personal goods and services, fares, leisure goods (excluding audio goods), leisure services

Services: household services, personal services, leisure services

