Shocks, stocks and socks: consumption smoothing and the replacement of durables during an unemployment spell.

Martin Browning
Department of Economics,
McMaster University, Ontario.

and

Thomas F. Crossley
Department of Economics,
York University, Ontario.

May 1997

Abstract: We present results on consumption during an unemployment spell.

Acknowledgments: We are grateful to Jonathan Gruber and Julie Nelson for comments on a very early draft of this paper and to participants in the 1996 NBER summer workshop. We are also very grateful to Jerome Adda for helpful discussions concerning simulations. The data used in this study were made available by Human Resources Development Canada. The latter bears no responsibility for the analysis nor for the interpretation of the data given here. Some revisions of the paper were undertaken while the second author visited Australia National University. He thanks that institution for its hospitality.

Correspondence: Department of Economics, Faculty of Arts, York University, 4700 Keele St. Toronto, Ontario, Canada, . M3J 1P3. Email: crossley@yorku.ca.

1. Introduction.

How do agents smooth consumption (if, indeed, they do)? In particular, how do poor agents smooth consumption over income losses due to an unemployment spell? It seems unlikely that they do this by running down liquid assets since they typically have very little in the way of such assets. Equally, it seems implausible that they will run up significant debts even if they can find someone to lend to them. In this paper we suggest an alternative and examine its empirical plausibility using a survey of unemployed persons. The smoothing mechanism we suggest is that agents adjust the timing of replacement of clothing and small durables (such as plates, pillows, empty video cassettes etc.) to their income flow. The common features such durables and clothing share are: they all exhibit some durability; there are no significant transactions costs for purchases; there is some indivisibility; they are not typically collaterisable and there is an element of irreversibility in that there are very imperfect second hand markets for such goods.

Our suggestion is that agents in temporarily straitened circumstances put off replacing, say, a winter coat until they have 'some more money'. Although there is a welfare loss to replacing small durables or clothing at a non-optimal time it is typically of second order importance when compared to the loss from postponing the purchase of non-durables (such as food or heating). Thus we posit that agents who are *temporarily* down on their luck (formally: with current income below permanent income[1]) will choose to postpone replacing a worn but serviceable winter coat rather than go hungry.

Given discretion over the timing of replacement of clothing and small durables, agents can display considerable volatility in their total expenditures and yet still 'smooth' welfare flows from the purchase of non-durables and the flow of services from durables by concentrating expenditures on non-durables (and the replacement of small durables that are broken) during times of temporarily low income. For example, if expenditures on clothing and 'small durables' are normally about 15% of total expenditures (a figure suggested by budget surveys) then households can temporarily reduce total expenditures by about 15% without experiencing any fall in utility levels. Of course, this postponing cannot continue indefinitely but it is an option for the short and medium run.

We refer to the hypothesis that agents draw down stocks of durables during a temporary spell of income loss as the 'internal capital markets' hypothesis to distinguish it form the more usual '*external capital market*' hypothesis that is given in textbook treatments of the standard intertemporal allocation problem. It is important to emphasize two things. First, this is *not* an alternative to the standard intertemporal model but it does emphasize the inadequacy of examining only expenditures on non-durables when we analyze intertemporal allocation. The second point is that the internal markets hypothesis can be motivated by assuming that agents are liquidity

[1]We are here using 'permanent income' as a shorthand for the level of consumption that would be given by current prices and the current marginal utility of money.

constrained but this is not necessary. That is, it may be that some agents choose to smooth by varying the timing of small durables purchases even if they can borrow at non-prohibitive rates. We conjecture, however, that the presence of liquidity constraints makes postponing clothes and small durables more likely.

There is some evidence in favour of the hypothesis set out above. One of the obvious predictions of the 'internal capital markets' hypothesis is that we should see more volatility in expenditures on small durables and clothing over the business cycle than we do for non-durables. This is widely known to be the case; for example, Attanasio (1997, Tables 5 and 6) presents an analysis of the variability in income and expenditures on different categories of goods for the U.S. in the 1980's and early 1990's. He finds that the variance of log income is higher than the variance of log nondurable consumption but lower than the variance of log durable expenditure[2]. Even more importantly, in our context, he shows that durables are considerably more volatile (relative to income volatility) for low education households than for high education households. This is consistent with the view that low education/low wealth/high discount factor households are more likely to synchronise their durables expenditures to income fluctuations. Yet another prediction of the internal capitals markets hypothesis is that households that have a member who is experiencing a spell of unemployment will temporarily cut back on clothing and small durables. Browning and Meghir (1991) find that 'married' households in which the husband is unemployed have budget shares for clothing that are about 35% lower than for households in which the husband is employed. Still another prediction is that agents will adjust their expenditure patterns to small but predictable changes in income. Parker (1996) presents evidence from the U.S. that agents do exactly this. He considers the change in net income that arises each year for workers who reach their maximum Social Security tax withholding during the year. When the maximum is reached the tax stops and the agent receives a higher net income for the rest of the year. Parker finds strong and robust evidence that agents do indeed spend more when their income increases, even though this change is predictable. Moreover, the effect is quite large with an elasticity of about one half. More importantly, from our viewpoint, there is no effect on `food at home' expenditures, there is a modest but significant effect for 'entertainment and personal care' and a strong effect on clothing expenditures. The latter have an elasticity of about 2.5.

There are, of course, alternatives to the 'internal capital markets' hypothesis. The alternatives we consider in this paper are:

- the *standard life-cycle model* with no frictions: agents borrow or lend on a perfect capital market and set all expenditures so as to equalise the expected marginal utility of expenditure over time (we shall follow Browning and Lusardi (1996) and refer to this as the *'standard additive' model*);

- *'rule of thumb' behaviour*: some agents set consumption equal to current income (or some fraction of current income);

[2] This is for all durables excluding clothing.

- the *life-cycle model with capital market imperfections*: agents try to keep the marginal utility smooth but are constrained in the capital market, usually by higher or prohibitive interest rates for borrowing. This leads to lower expenditures on all goods, including non-durables.

To distinguish between these hypotheses from data on expenditures on non-durables and services has turned out to be a formidable task (see Browning and Lusardi (1996) and Deaton (1995) for surveys). The usual route is to look for 'excess sensitivity' of non-durable (or food) expenditures changes to anticipated income changes. Detecting such changes is, however, difficult since the changes in income that are typically exploited to generate 'anticipated' income changes are small and noisy. Ideally we would like a sample of households that experienced large and exogenous income changes to overcome these problems. Moreover, a finding of excess sensitivity, by itself, does not distinguish between the 'rule of thumb' and 'liquidity constrained version of the life-cycle' model. This requires supplementary information on, for example, asset levels (see Zeldes (1989)). Even worse, a finding of 'excess sensitivity' is consistent with the standard additive model if agents have a significant precautionary motive (see Carroll (1993)).

In this paper we consider simultaneously the determination of total expenditure (on all goods) during a period and the structure of demands. For the latter, we focus on the differences between expenditures on a non-durable good (food at home) and clothing. The basic idea is that if any of the three alternatives to our internal capital markets hypothesis holds then the structure of demands *conditional on total expenditure* should be uncorrelated with transitory fluctuations in income (whether these are anticipated or not). If, on the other hand, agents do synchronize clothing purchases with income then we should expect to see an effect from income changes on clothing even when we condition on total expenditures. In the theory section below (section 2) we discuss in greater detail the predictions from the four models. This leads on to tests of the four alternatives that can be implemented on the data we have.

Our tests rely heavily on the effects of Unemployment Insurance (UI) benefit levels on the structure of demand as well as the level of total expenditure ('consumption'). Most tests of alternative models of intertemporal allocation use only one good (`food' or `nondurable consumption'). Hamermesh (1982) and Parker (1996) discuss how changes in transitory income affect demands for individual goods. On the face of it they seem to present different effects. Hamermesh notes that if agents cut back on total expenditure then there will be a bigger proportional impact on luxuries; this is the standard uncompensated response. Parker (1996), on the other hand, suggests that agents who are temporarily constrained will cut back more on goods that exhibit high intertemporal substitution since the cost of postponing these is lower. In the theory section below we shall show formally that the Hamermesh and Parker effects are identical; that is, luxuries have a high intertemporal substitution elasticity. In fact, this is an exact form of Pigou's Law (see Deaton (1974)). This is very distinct from our explanation which emphasizes instead the discretion agents have in the timing of replacement of small durables and clothing.

The data source we use is the Canadian Out of Employment Panel (COEP). The COEP is a one in ten sample of all Canadians who had a job separation in specified time windows in early 1993 and early 1995. The useful sample size is about 20,000 people. The survey itself collects detailed information on the old job; search behaviour; labour force participation since the job loss; family circumstances; personal and household income; assets; expenditures on a range of goods and total expenditure and a number of other variables. This is then merged with Unemployment Insurance (UI) administrative data (including eligibility for UI benefits and past labour supply information) and current and past tax information on the respondent and their spouse (if any). Thus these data give an unusually detailed picture of the circumstances of unemployed people and their household. For our purposes, the most important aspect of this is that we have information on expenditures and most of the sample experienced a spell of unemployment with an associated loss of income. Often the latter is large so that we are not so troubled by the signal extraction problem. Moreover we have some instruments for the size of the income fall (in particular changes to the Unemployment Insurance system) which also allow us to test for some of our exogeneity assumptions.

We estimate a (partial) demand system for food at home and clothing. This 'structural' approach is the natural complement to the 'reduced form' approach using the PSID of Gruber (1994). The reduced form approach most directly answers the immediate policy question: to what extent does expenditure during an unemployment spell depend on UI benefit levels. By contrast, we can provide insight into why expenditure levels depend on benefit levels and who is most affected. Besides being of interest in the wider literature on consumption and saving, this is also critical for the design of UI systems which must balance the incentive losses from higher UI benefits against the enhanced insurance given by higher UI benefits and the welfare gains that result for unemployed people and their families.

Our data are superior to the PSID in this context. First, all of our sample had a job separation so we have relatively large sample sizes. Second, we have exact details of benefit payments (from the administrative data). Third, we have expenditure measures on food at home, clothing and housing and also a total expenditure measure. Finally, the UI program design (and changes in it over our sample period) give exogenous sources of variation in transitory income. As against this, the survey design forced on us that the first interview could only take place six months after the job loss so that some of the information we use for the pre-job loss period is retrospective. This disadvantage is somewhat offset by the availability of tax and administrative data going back some years before the survey partially. In the end, the most serious missing data is on expenditure levels before the job loss to control for the marginal utility of money in the pre-separation period. All we have in this way is a survey measure of the change in total expenditure from before the job loss. In a companion paper (Browning and Crossley (1995)) we use this information to examine the effects of benefit levels and assets on the total expenditure change but this cannot be used to examine the specific (demand) effects we examine in this paper.

A job loss has three broad impacts on expenditures. First, if there are costs of going to work then we would expect to see total expenditure fall and also to see a fall in such specific work related items as transport and clothing. More generally, if preferences over goods are not separable from labour supply (see Browning and Meghir (1991)) then a change in labour force status will induce changes in total expenditure and also in the structure of demands conditional on that total. We control for this in our empirical work by considering only respondents who are unemployed so that they all have the same work status.

The second effect comes about because a job loss is usually an unpleasant shock and can be expected to lower desired lifetime consumption. This impacts on both durable and non-durable expenditures. Agents will typically wish to run down stocks of durables by letting them depreciate so that we should expect to see lower levels of purchases of durables (or more zeros) after a job loss. There will also be a corresponding fall in non-durable expenditures.

Finally, the temporary loss of income due to being out of work may lead to lower total expenditure. This is certainly the case if agents use 'rules of thumb' or if they are liquidity constrained, either of which will cause the marginal utility of expenditure to fluctuate in an anticipated way from period to period. Our alternative suggestion is that agents may display a sensitivity of current total expenditures to transitory and anticipated income flows and still keep the marginal utility of expenditure approximately constant (that is, they 'smooth' consumption). They do this by reducing expenditures on small durables and letting these depreciate beyond the optimal level (even allowing for the permanent shock).

2. Theory.

2.1 A Model of Durable Replacement and Nondurable Consumption.

In this section we derive the implications of the four hypotheses concerning intertemporal allocation. The purpose here is not to rigorously analyze a structural model of the internal capital markets hypothesis but rather to derive the qualitative implications of each of the alternatives which can then be tested for on a joint system of demands and total expenditure. There is not, in fact, any theoretical model of the joint determination of expenditures on non-durables and small durables in the literature. The closest we know of is the model of purchase of nondurables and the control of a durable with a resale price discount of Beaulieu (1993) (see also Eberly (1995)). This model has a nondurable good and a durable good which has to be replaced if the agent wishes to change the stock, with the current stock being sold at a discount. The agent has a financial asset which has a stochastic return but no other source of income; thus assets are always positive. The optimal solution displays the characteristic feature of control models with asymmetric control possibilities, namely that there are upper and lower threshold ratios of durables to assets. The agent does not adjust durables if the ratio is strictly between these thresholds. If, however, the durables-asset ratio hits the lower threshold then the agent buys some durables (and conversely).

Although the Beaulieu model is suggestive of some results it does not allow us to address directly the effects of, say, current earnings being below 'permanent' earnings (because there is no non-capital income) nor can it allow for the possibility of liquidity constraints (since the agent always maintains positive assets). Nonetheless, this paper and the results in other models with fixed costs and/or partial irreversibility (for example, Eberly (1995), Bertola and Caballero (1990) and Grossman and Laroque (1990)) do suggest some conjectures. To supplement these we present some results from numerical simulations of a fairly rich model that is tailored to the context considered here; some of the details follow Adda and Cooper (1996). We emphasize that this is only a 'worked example' to illustrate the effects that can arise; no attempt is made to 'calibrate' this example to realistic values for parameters or income processes. Equally no attempt will be made in this paper to estimate the exact structural model presented here. Fuller theoretical results will follow in a later, more 'structural' paper.

In our discrete time model we have an agent who faces an i.i.d. earnings stream (= y_t in period t) but no other uncertainty. The agent can lend as much as desired at a given interest rate (r) and borrow at the same rate subject to a borrowing constraint that net assets must not fall below $\underline{S}$ (with $\underline{S} \leq 0$). In each period the agent observes the current earnings draw and chooses the level of consumption of a nondurable (= c_t) and whether or not to replace the durable good. The agent can only ever own one unit of the durable and the durable decays in a deterministic fashion. Finally, the durable comes in two quality levels: low and high ($q = l,h$ respectively)[3]. The price for a new durable of quality q is p_q (with $p_h > p_l$). The high quality good provides both a higher level of utility when new and decays more slowly. In any period the agent can either keep the existing durable ($d_t = 0$), buy a new low quality durable ($d_t = 1$) or buy a new high quality good ($d_t = 2$). If the agent buys a new durable then the old one is thrown away. If we denote cash-on-hand (assets from the previous period plus earnings) by A, then the credit constraint gives that:

$$c + I(d=1)p_l + I(d=2)p_h \leq A - \underline{S} \tag{1}$$

(where $I(d=1)$ denotes that the agent buys the low quality good). That is, nondurable consumption and any purchase of the durable cannot exceed cash-on-hand plus available credit.

We assume that within period preferences are additive over the nondurable and the durable and that the utility from the latter depends on initial quality and the age of the good (= $a \geq 0$). Specifically, within period utility if a durable of quality q and age a is owned is given by:

$$\ln c \; + \; \eta_q \exp(-a * \rho_q) \quad \textit{with} \;\; \eta_h \geq \eta_l, \quad \rho_l \geq \rho_h \tag{2}$$

Thus a new ($a = 0$) high quality durable yields a utility level of η_h. Cash-on-hand evolves according to:

[3]The introduction of two qualities increases the state space dimension but is considered important here since we wish to investigate, among other things, whether agents who would 'normally' buy the high quality durable sometimes buy the low quality durable in low income states.

$$A_{t+1} = (1+r)(A_t - c_t - I(d_t=1)p_l - I(d_t=2)p_h) + y_{t+1} \tag{3}$$

The state variables are *(A,a,q)* and the control variables are *(c,d)*. For an infinite horizon program with a discount factor of β (*<1*) we have the following recursive form for the value function:

$$J(A,a,q) = \max \begin{bmatrix} max_c\{ln\ c + \eta_q exp(-a*\rho_q) + \beta EJ((1+r)(A-c)+y',a+1,q)\}, \\ max_c\{ln\ c + \eta_l + \beta EJ((1+r)(A-c-p_l)+y',1,l)\}, \\ max_c\{ln\ c + \eta_h + \beta EJ((1+r)(A-c-p_h)+y',1,h)\} \end{bmatrix}$$

(where E is the expectations operator for the earnings process y'). Conventional value iteration methods (with error bounds and Gauss-Seidel improvements, see Puterman (1993), for example) can be used to derive the value function and the decision rules c(A,a,q) and d(A,a,q). From these we simulate time paths for consumption and the purchases of the durable. Specifically, we give the agent some starting level of assets and a durable of a low age and quality and then follow them for 21,000 periods with the earnings process used in the determination of the decision rules. From these we calculate various statistics of interest from the last 20,000 outcomes.

In our simulations we keep the interest rate, the earnings process and the durable characteristics constant. We shall only examine the effects of varying the discount factor and the borrowing constraint. Specifically, for the durable we take:

$$p_l = 3,\ \rho_l = 0.5,\ \eta_l = 3$$

$$p_h = 6,\ \rho_h = 0.4,\ \eta_h = 6$$

Earnings takes values *(0.55,1,1.45)* with probabilities *(0.1,0.8,0.1)*. Thus the most common earnings state is the mean and the low earnings state has earnings of 55% of mean earnings (the approximate UI replacement rate in Canada). The low (respectively, high) quality durable costs three (respectively, six) periods mean earnings. Finally, we take a value of 0.01 for the interest rate[4].

For the utility parameter values we take either β *=0.99* or *0.97*; these correspond to a patient and an impatient agent, respectively. For the credit constraints, we take $\underline{S}=0$ or *-6*; these correspond to the constrained and unconstrained cases, respectively. Thus in the unconstrained case the agent can borrow the cost of the high quality good. In Tables 2.1, 2.2 and 2.3 we present the frequencies

[4]There is a trade-off in choosing the interest rate. Low values (0.005, say) give a closer approximation to continuous time but convergence is slower. The rate chosen (1%) is obviously rather high if the decision period is a month but lower values gave similar qualitative results and were much slower.

of purchase of the different quality durables in each earnings state, means of expenditures in each earnings state and marginal propensities to consume each good respectively.

TABLE 2.1: Frequencies of Purchase of Durable							
		Frequency of Buying Low Quality			Frequency of Buying High Quality		
β	S	Low	Medium	High	Low	Medium	High
0.99	-6	0	0	0	0.061	0.093	0.107
0.99	0	0	0	0	0.096	0.102	0.116
0.97	-6	0	0.103	0.228	0	0	0
0.97	0	0.038	0.168	0.263	0	0.002	0.003
Note: ‘Low’, ‘Medium’ and ‘High’ refers to the earnings level.							

The first of these Tables gives information on the frequency of purchasing different qualities. As can be seen, the parameter values are such that the patient agent (the first two rows) never buys the low quality durable and the impatient agent (the final two rows) almost never buys the high quality durable. Moreover, the unconstrained agents actually purchase *less* often than their constrained counterparts; this is because, with the parameter values chosen, the unconstrained agents often carry forward debt and hence have lower total income (earnings and the return on capital) and hence lower long run consumption levels.

Looking across rows is equivalent to following the same person as they experience different earnings outcomes. As can be seen, in all cases the frequency of purchase is higher in higher earnings states, even though our earnings process does not have any time dependence. Thus even patient agents who are relatively unconstrained are more likely to purchase in the high earnings state (probability = 10.7%) than they are in the low earnings state (probability = 6.1%). For the impatient agent, the differences between frequencies in different earnings states are much more marked. Indeed, the unconstrained impatient agent never buys in a low earnings period but has a frequency of 22.8% in the high earnings state.

We turn now to expenditures on the two goods, see Table 2.2. Since these are potentially observable empirically, these can be used directly in the empirical predictions derived in the next sub-section. The first thing to note is that for all agents total expenditure in the mean earnings state is about equal to mean income (unity). It is slightly above for the constrained agents since they typically have to maintain positive balances to save for the durable and hence have positive capital income in the long run. The next thing to note is that the level of expenditure on the nondurable is very insensitive to the earnings state - it is only the constrained, impatient agent who shows any significant variation and that is rather small. This has important implications for tests for liquidity constraints on the PSID since these only use information on food which is generally taken to be nondurable. Thus if the allocation mechanism being analysed here is correct then we would dramatically underestimate the impact of earnings fluctuations on expenditures. The final feature of Table 2.2 that we draw attention to is that expenditures on durables are sensitive to the current earnings state; this is simply a restatement of the finding from the previous Table[5].

TABLE 2.2: Mean Expenditure on Durable and Non-Durable Good							
		Non Durable			Durable		
β	S	Low	Medium	High	Low	Medium	High
0.99	-6	0.441	0.442	0.441	0.363	0.558	0.639
0.99	0	0.444	0.444	0.444	0.577	0.611	0.694
0.97	-6	0.667	0.667	0.667	0.002	0.309	0.683
0.97	0	0.495	0.510	0.535	0.115	0.515	0.810
Note: ‘Low’, ‘Medium’ and ‘High’ refers to the earnings level.							

TABLE 2.3: Marginal Propensity to Consume			
β	S	Nondurable	Durable
0.99	-6	0.001	0.432
0.99	0	0	0.074
0.97	-6	0	0.682
0.97	0	0.034	0.890

Finally we present the marginal propensities to consume implicit in the numbers given above, see Table 2.3. This is defined as the change in expenditure as we move from the low earnings state to the medium earnings state divided by the change in earnings. As before we see that the marginal propensity for the nondurable is either zero or very small. The marginal propensity to consume the durable, however, is very large for impatient agents. Even for patient agents it can be large - paradoxically, this seems to be the case for the unconstrained agent. Further investigation is needed to discover why this is so, but once again we note that the patient agent with no constraint typically

[5]Given that patient agents only buy the high quality durable we have that expenditures on the durable are simply frequency times the price (in this case, 6).

carries forward debt so that they are less able to keep up durables purchases in low earnings states.

2.2 Modeling food and clothing expenditures.

We now present an empirical model that is designed to capture some of the features identified in the last subsection. Take the month to be the planning period and denote the expenditure on good i in the month by x_i. Let x be total expenditure in the month on all goods (including housing, durables, clothing, services and non-durables). The unrestricted joint system determining these variables is given by:

$$x_i = f^i(x,y,b) \quad \textbf{(6)}$$

and

$$x = g(y,\lambda,b) \quad \textbf{(7)}$$

where y is a vector of demographics such as the number of people in the household. The scalar b is a UI policy variable; in our discussion here we will take it to be the level of UI benefits. Finally, λ is the marginal utility of money; we shall return to how to deal with the fact that this is unobservable in the empirical section. The reduced forms are given by equation (7) and:

$$x_i = h^i(y,\lambda,b) \quad \textbf{(8)}$$

The four allocation models we consider each have different implications for the effects of changes in the benefit level, b, in the structural and reduced forms. Before turning to those implications, we consider the connection between the Hamermesh (1982) and Parker (1996) effects.

As mentioned in the introduction, in the nondurables context, the income effect $\partial x_i/\partial x$ has an interesting intertemporal analogue. Ignoring, for the moment, the UI benefit variable, let the (Marshallian or uncompensated) demand curve for good i be given by $q_i = \xi^i(p,x,y)$ where p is a vector of prices. The income elasticity for good i is defined as:

$$e_i = \frac{\partial q_i}{\partial x}\frac{x}{q_i} \quad \textbf{(9)}$$

To define the intertemporal substitution for a particular good, we need to discount prices using a nominal interest rate. Thus let R_t be the discount factor in period t:

$$R_t = \prod_{s=1}^{t-1} (1+i_s)^{-1} \quad \textbf{(10)}$$

(where i_s is the nominal interest rate between periods *s* and *s+1*) and define discounted prices as $\pi^t = R_t p^t$. Thus

$$\ln(\pi_t^i / \pi_{t-1}^i) \tag{11}$$

is the *real* interest rate for good *i* (between periods *t-1* and *t*). The *intertemporal* substitution elasticity for good i is then defined as:

$$\phi_i = \frac{\partial \ln(q_t^i / q_{t-1}^i)}{\partial \ln(\pi_t^i / \pi_{t-1}^i)} \tag{12}$$

If we have only one good ('consumption') then this is the conventional definition for the elasticity of intertemporal substitution (the numerator is the change in consumption growth and the denominator is the change in real rate of interest). An alternative definition that is easier to work with uses the Frisch demand functions:

$$q_i = g^i(\pi,\lambda) \tag{13}$$

where λ is the marginal utility of money and $g^i(.)$ is zero homogeneous in (π,λ). Then we simply have:

$$\phi_i = \frac{\partial \ln g^i}{\partial \ln \pi_i} = g_i^i(\pi,\lambda)\frac{\pi_i}{q_i} \tag{14}$$

where the *i* subscript denotes a partial derivative with respect to π_i. The *intertemporal* substitution elasticity is defined as:

$$\phi = \sum_n^{i=1} \omega_i \phi_i \tag{15}$$

where ω_i is the budget share for good i $(=p_i q_i/x)$.

The next proposition gives the link between the uncompensated income elasticities and the good specific elasticities of substitution if preferences within the period are additive across all goods.

Proposition 2.1. *If within period preferences are additive across goods then the vector of (uncompensated) income elasticities is proportional to the vector of intertemporal substitution elasticities:*

$$e_i = \frac{1}{\phi}\phi_i, \; for \;\; all \;\; i \qquad \textbf{(16)}$$

so that the factor of proportionality is the inverse of the intertemporal substitution elasticity.

Proof. *See appendix A.*

Thus in a world where preferences are additive within the period, luxuries (e_i>1) are also high intertemporal substitution goods. Put another way, when agents are forced to cut total expenditure they cut back more on goods that can be 'postponed' (that is, goods with a high intertemporal substitution). Thus the Hamermesh and Parker effects are simply reflections of each other in an additive world. Of course, preferences are not additive within the period but often complementarities or substitution will enhance this effect. For example, consider 'food at home' and 'food in restaurants'. The former is a necessity and the latter is a luxury and the two goods are also obvious substitutes. When total expenditure is cut the disproportionate effect on expenditures on these two goods is amplified by this substitutability.

Returning to the implications of the four alternative models, we take derivatives of the individual demands with respect to *b*, holding λ constant:

$$\frac{\partial x_i}{\partial b}(y,b,\lambda) = \frac{\partial f^i}{\partial b}(x,y,b) + \frac{\partial f^i}{\partial x}(x,y,b)\frac{\partial x}{\partial b}(y,b,\lambda) \qquad \textbf{(17)}$$

We interpret derivatives holding λ constant as reduced form responses and those holding total expenditure, x, constant as structural form responses.

The four allocation models we consider each have different implications for the effects of changes in the benefit level, b, in the structural and reduced forms. Consider first the standard additive model. Here there are only lifetime effects of changes in the benefit level. First, there is a wealth effect which is positive for those who expect to receive net gains from the system - presumably those who experience many unemployment spells - and negative for those who expect to contribute more in the future than they receive in benefits. There is also an insurance effect since prudent agents will reduce current consumption if the insurance aspect of the UI system is reduced by a fall in benefit levels. If, however, we hold the marginal utility of money constant then neither of these effects appears in the consumption responses. Thus we have:

$$\frac{\partial f^i}{\partial b}(x,y,b) = \frac{\partial x}{\partial b}(y,b,\lambda) = 0 \qquad \textbf{(18)}$$

That is, in a standard model with no liquidity constraints there should not be any discernible effect of benefit levels on either total expenditure or the structure of demands. From equation (17) this also implies that the reduced form response to a benefit change should be zero.

We take the 'rule of thumb' model to imply that changes in current income lead to changes in total expenditure but not to the structure of demand conditional on this total. That is:

$$\frac{\partial f^i}{\partial b}(x,y,b) = 0, \qquad \frac{\partial x}{\partial b}(y,b,\lambda) = \Delta > 0 \qquad \textbf{(19)}$$

From this and equation (17) (and recalling that x_i is an expenditure) we have that the reduced form prediction:

$$\frac{\partial f^i}{\partial b}(y,b,\lambda) = \Delta\omega_i\epsilon_i \qquad \textbf{(20)}$$

where ϵ_i and ω_i are, respectively, the expenditure elasticities and budget share of good *i*. Since we have estimates of these variables from other demand studies, we can give predictions of the responses. For example taking values of 0.4 and 1.5, respectively, for food at home and clothing expenditure elasticities and budget shares of 0.15 and 0.08, respectively, we see that the reduced form effects are likely to be relatively small even if the marginal propensity to consume is unity ($\Delta = 1$). For these values, a one dollar increase in UI benefits leads to a one dollar increase in total expenditures and increases of $0.06 and $0.12 on expenditures on food at home and clothing, respectively.

Returning to the standard model, if we introduce liquidity constraints then there is a role for benefit effects. Agents who are liquidity constrained have a unit marginal propensity to consume out of current 'cash-on-hand' (see, for example, Deaton (1991)). Thus an one dollar increase in benefit levels will lead to a one dollar increase in total expenditure and a corresponding increase in all reduced form expenditures, with the exact amount being governed by expenditure elasticities and budget shares:

$$\frac{\partial f^{i}}{\partial b}(y,b,\lambda) = \omega_i \epsilon_i \tag{21}$$

This is the same as the 'rule of thumb' model with a marginal propensity to consume of unity. Indeed, the only way to distinguish these predictions from a rule of thumb model in which agents set total expenditure equal to income is by splitting the sample according to some proxy for being constrained (see Zeldes (1989)). In particular, agents who carry liquid assets forward from one period to the next are not, by definition, liquidity constrained and hence will obey (18) rather than (21).

Finally we come to the predictions for the internal capital markets hypothesis for expenditures on food at home, clothing and total expenditure. If an agent is not liquidity constrained then the standard model predictions hold. If, however, an agent is constrained in the sense that they are smoothing by holding off replacing durables then an increase of one dollar in benefits will lead to an increase of one dollar on expenditures on clothing and other durables whilst expenditures on non-durables will be unchanged. Thus we now have different *reduced form* predictions for different goods:

$$\frac{\partial x}{\partial b}(y,b,\lambda) = 1,\ \frac{\partial x_{food}}{\partial b}(y,b,\lambda) = 0,\ \frac{\partial x_{cloth}}{\partial b}(y,b,\lambda) = \Delta_c > 0 \tag{22}$$

Thus the benefit level will appear in the (reduced form) demand for clothing but not for food at home. This is in obvious contrast to the liquidity constrained and rule of thumb cases. From (17) we have the following structural form predictions:

$$\frac{\partial x_{food}}{\partial b}(x,y,b) = -\epsilon_{food}\omega_{food},\ \frac{\partial x_{cloth}}{\partial b}(x,y,b) = \Delta_c - \epsilon_{cloth}\omega_{cloth}, \tag{23}$$

The structural form prediction for the benefit effect for non-durables is negative since we are holding total expenditure constant (but the agent, of course, does not do this). Thus if expenditures on durables increases, expenditures on non-durables must decrease. Although we cannot sign the structural form effect for clothing we see that if clothing is the only good that is being used for smoothing (so that $\Delta_c = 1$) then the effect is positive. We conjecture that this effect will generally be positive even if there are other durables.

The four sets of predictions for the reduced and structural forms are given in Table 2.4 and 2.5 respectively. We turn now to the econometric issues that arise in modeling these on our data.

Table 2.4: Predictions for Reduced Form Coefficients on Benefit Variables.

Model	total expenditure	food	clothing
"rule of thumb"	$\Delta > 0$	$\Delta\epsilon_f\omega_f$	$\Delta\epsilon_c\omega_c$
standard LC model	0	0	0
Liquidity constraints			
a)low assets	1	$\epsilon_f\omega_f$	$\epsilon_c\omega_c$
b)high assets	0	0	0
Internal capital markets			
a)low assets	1	0	$\Delta_c > 0$
b)high assets	0	0	0

ϵ_i - *elasticity of good i with respect to total expenditure*

ω_i - *budget share of good i*

Table 2.5: Predictions for Structural Coefficients on Benefit Variables.

Model	total expenditure	food	clothing
"rule of thumb"	$\Delta > 0$	0	0
Standard Additive	0	0	0
Liquidity constraints			
a)low assets	1	0	0
b)high assets	0	0	0
Internal capital markets			
a) low assets	1	$-\epsilon_f \omega_f$	$\Delta_c - \epsilon_c \omega_c$
b) high assets	0	0	0

3. Econometric issues

3.1 Functional Form.

One immediate issue we must face is that because our expenditure measures are for short periods (one week for food at home and one month for clothing) we have a fair number of zeros. We believe that for these two goods this a pure ‘infrequency’ problem; and that none of the zeros represent corner solutions in the long run[6]. If we had a formal theory model for the purchases of clothing we could formulate a formal statistical model that captured this ‘infrequency’. Lacking such a model, the best we can do is to follow the lead of Keen (1986) and Pudney (1985) and model the infrequency relatively informally (see Pudney (1989) for an excellent discussion of infrequency models). To do this we first chose a functional form which restricts the ‘long run’ expenditures to be positive. This requirement is not met by several of the usual choices for functional form (for example, the Working-Leser form). Instead we use a log-log form for the long run Engel curve:

$$x_i = x e^{\zeta^i(x,y,b)} e^{u_i} \qquad \textbf{(24)}$$

where x_i is the demand for good i and u_i is a random error term. Such a system will clearly not satisfy adding-up but since we are only modeling a small subset of goods this is not considered a serious problem. We define:

$$\zeta^i = \gamma_i + \alpha_i \ln(x) + \beta_i y + \theta_i b \qquad \textbf{(25)}$$

Substituting and taking logs we have we have a log-linear form for the food and clothing demand equations[7]:

$$\ln(x_i) = \gamma_i + (1+\alpha_i)\ln(x) + \beta_i y + \theta_i b + u_i \qquad \textbf{(26)}$$

Our parameterisation of the total expenditure equation is:

$$\ln(x) = \beta y + \theta b + \delta(\lambda) + u \qquad \textbf{(27)}$$

---

[6]For example, 99% of households in the Canadian Family Expenditure Survey (a survey of *annual* expenditures) report positive purchases of clothing.

[7]If we divide both sides by total expenditure and then take logs, we see that we have the conventional Working-Leser form but with the log of the budget share on the left hand side rather than the budget share.

where, as before, λ is the (unobservable) marginal utility of money[8]. We consider the unobservability of this quantity next.

3.2 Unobservability of λ

Even if we take *u* to be uncorrelated with *y* and *b*, the econometric problem that arises in (27) is that λ is potentially correlated with both *y* and *b* so that we cannot simply absorb it into the error term. For example, the benefit level, *b*, is dependent on 'normal' income which is clearly correlated with lifetime wealth and hence with the marginal utility of money. The usual way to deal with the latency of λ is to formulate an Euler equation. Although we present some results on this below we prefer an alternative approach in which we model the marginal utility of money with levels of observable correlates *z*:

$$\delta(\lambda_t) = \phi z_t + \epsilon_t \quad \textbf{(28)}$$

where, critically, the vector of `permanent income' variables *z* may overlap with the demographics *y* but it does not contain the transitory benefit level *b*. We assume that z_t contains the lost job wage w_{t-k}. Thus our identifying assumption for the parameter θ in equation (27) is that ϵ is uncorrelated with the benefit level *b*. That is, once we condition on observables such as education, past income and labour supply and demographics, then the benefit level is uncorrelated with the residual ϵ. This is much weaker than assuming that *b* and λ are uncorrelated. Our data set contain a much richer set of controls for λ than are usually available so this assumption is at least plausible. We also have, however, good instruments for benefits which we can use to test the assumption that ϵ is uncorrelated with b; details are postponed until the empirical section.

Given all this, we have:

$$\ln x_t = \beta y_t + \theta b_t + \phi z_t + (u_t + \epsilon_t) \quad \textbf{(29)}$$

where now *z* is taken to be the set of 'permanent' controls that are not included in *y*. We shall not be much concerned with the estimates of these coefficients so that the lack of identification does not bother us. For example, age may be one of the right hand side variables in (28) (perhaps because older people have lower lifetime wealth because of productivity growth) and also be one of the right hand side variables in (27) (the allocation of consumption (conditional on λ) at any point in time). Thus we cannot interpret the coefficient on age in any simple way. The coefficient on *b*, however, can be interpreted given our identifying assumption above; it is the `benefit' effect that is the primary focus of this paper.

[8]The function $\delta(.)$ is strictly decreasing; among other things it determines the intertemporal substitution elasticity.

To see how we implement an Euler equation approach, let the current period be *t* and let *t-k* be the period before the job separation (so that *k = about 6* in our data). The conventional way to deal with the fact that λ is not observed is to note that using (27), k-lagged λt ($= \lambda_{t-k}$) can be written as a function of lagged total expenditure, demographics and lagged earnings (denoted w_{t-k}):

$$\delta(\lambda_{t-k}) = \ln(x_{t-k}) - \beta y_{t-k} - \bar{\theta} w_{t-k} - u_{t-k} \qquad \textbf{(30)}$$

and then to use the `approximate' Euler equation:

$$\delta(\lambda_t) = \delta(\lambda_{t-k}) + {}_t, \quad E_{t-k}({}_t) = 0 \qquad \textbf{(31)}$$

where $E_{t-k}(.)$ is the expectations operator conditional on information at time *t-k* and ${}_t$ includes all news between *(t-k)* and *t* (including the job loss shock)[9] . This gives:

$$\Delta \ln x_t = \beta \Delta y_t + \theta(b_t - w_{t-k}) + (\theta - \bar{\theta}) w_{t-k} + (\Delta u_{t-k} + {}_t) \qquad \textbf{(32)}$$

where Δ is the k-order lag operator. Thus the change in total expenditure depends on the change in demographics (including the change in labour force status), the UI replacement difference, the wages on the old job and a composite error term.

3.3. Measurement Error and Identification of the Demand System

We turn now to the estimation method for our system. Write the system as:

$$A \ln X = BY + u, \quad u \sim N(0,\Sigma) \qquad \textbf{(33)}$$

where lnX is the vector of log total expenditure, log food at home and log clothing; Y is the vector of variables on the right hand side of equation (29); u is the vector of composite error terms and :

$$A = \begin{bmatrix} 1 & 0 & 0 \\ -(1+ {}_f) & 1 & 0 \\ -(1+ {}_c) & 0 & 1 \end{bmatrix}$$

The usual manipulations give:

---

[9] Note, however, that we have a selected sample (of those how actually experienced a job separation) so that for our sample $E_{t-k}(\nu_t) \neq 0$. Thus we cannot use the usual orthogonality conditions.

$$\ln X = \Pi Y + \mu \quad \textbf{(34)}$$

Where

$$\Pi = A^{-1}B, \;\; \mu = A^{-1}u \quad \textbf{(35)}$$

The availability of good instruments for total expenditure serves two purposes. First, note that although the system given in (33) is (block) recursive, the system is not identified since the covariance cannot be taken to be diagonal. These structural errors will be correlated both because household shocks will impact all demands and because any change in an individual demand must also impact on total expenditure.

Second, it is certainly true that our expenditure data are measured with error. We allow the observed expenditure X to diverge from the true measure by a multiplicative error:

$$x = \tilde{x}\ \exp(\ ) \quad \textbf{(36)}$$

So long as our instruments for total expenditure are uncorrelated with this error term, then parameters of demand system remain identified[10]

3.5 Recovery of the Structural Parameters.

We first estimate the reduced form parameter matrix and then recover the elements of the structural parameter matrices A and B by the minimum ^{2} step:

$$A,B = \underset{A,B}{argmin}(F(A,B) - \hat{\Pi})\hat{C}^{-1}(F(A,B) - \hat{\Pi})' \quad \textbf{(37)}$$

where F(.) is the mapping from structural parameters to reduced form parameters and *C* is the estimated covariance matrix for .

This two step procedure offers several advantages over conventional techniques. First, we actually use non-linear techniques to account for the infrequency of clothing purchases (see below) so there is a computational advantage since the dimension of the optimization problem in the second step is only the number of parameters. Second, minimum ^{2} allows us to incorporate information

[10]We recognize that this may not be the best way to deal with measurement error. In particular, it should be possible to use the second cross moments to obtain more precise estimates. However, identification off of covariance matrix restrictions is complicated by the infrequency problem we deal with below and we choose not to use these methods.

from other sources (for example, household budget surveys; see below) in a simple way. Finally, only the second step needs to be estimated for each of the models we test for; the reduced form is estimated only once.

3.6 The Infrequency of Clothing Expenditures

We now deal with the fact that because our expenditure measure for clothing is for one month we would have a fair number of zeros even if agents were all following the standard model. In this case we have a pure 'infrequency' problem and none of the zeros represent corner solutions in the long run. If we had a formal theory model for the purchase of clothing we could formulate a formal statistical model that captured this 'infrequency'. Lacking such a model, the best we can do is to follow the lead of Keen (1986) and Pudney (1988) and model the infrequency relatively informally (see Pudney (1989) for an excellent discussion of infrequency models).

In this context we interpret x_c* as the average or 'normal' demand for clothing[11]. Llet p be the probability that an agent buys some clothing in the survey period. Both p and x_c* may be functions of *(x,y,b)* since agents may adjust both their frequency of purchase and their normal purchases according to their current circumstances. Observed purchases of clothing, x_c, are given by:

$$X_c = \frac{X_c^* e^{v}}{p} \text{ with probability } p \quad \textbf{(38)}$$

$$= 0 \text{ with probability } (1-p) \quad \textbf{(39)}$$

$$\text{where } E(e^{v}) = 1 \quad \textbf{(40)}$$

Thus:

$$E(x_c|Y) = p\,[E(\frac{x_c^* e^{v}}{p})] + (1-p)\,0 = x_c^* \quad \textbf{(41)}$$

so that the non-linear regression of the observed purchases x_c for the whole sample (including those who have zero purchases) gives the mean function for the unobservable x_c*. Although this formulation is very convenient for incorporation into the SURE system we use, it is inefficient and

[11] Pudney (1989) uses the term ‘the unobservable true rate of consumption’ for good i. He also presents and interpretation of it as the long run average if all the variables that determine it are held fixed. We prefer the more succinct term `normal demand’.

imprecise (relative to x there is a lot of noise in x_c*). There are more 'structural' alternatives. These allow us to determine whether, for example, *b* enters both the 'probability of purchase' function p and the function x_c*. To investigate this we shall also estimate the parameters of the Generalised P-Tobit form due to Blundell and Meghir (1987) and compare the responses with our regression estimates.

4. The Data.

4.1 The Canadian Unemployment Insurance System

The Canadian Unemployment Insurance (UI) program provides earnings related benefits of limited duration [12] to unemployed workers who qualify by having worked at least the minimum required number of weeks is the previous year. In recent years, the minimum number of weeks worked required to qualify has depended on local unemployment rates and ranged from 10 to 20 weeks. The duration of benefits has depended on both local unemployment rates and the number of weeks worked in the year prior to the unemployment spell and could be up to one year. Benefits have been a fixed fraction (the *statutory replacement rate*) of earnings in the 20 weeks prior to the unemployment spell up to the *maximum insurable earnings.* For example, in 1992 the statutory rate was 60% and the maximum insurable earnings was $710/week, so that the maximum weekly benefits were $426. The system is financed by payroll taxes.

Beginning in 1993 there have been a two important legislative changes to the Canadian Unemployment system[13], bills C113 (1993) and C17 (1994). These changes were introduced and enacted as Canada came out of the 1991 recession. Broadly, the two acts were intended to finance a cut in payroll taxes (as a job creation strategy) while keeping the program's budget under control. Bill C-113 made two changes to Canada's regular unemployment insurance system. First the statutory replacement rate was cut from 60 to 57 percent of insurable earnings. Second, individuals who, according to Human Resources Development Canada (HRDC)[14], either voluntarily quit their jobs or were dismissed with cause were disentitled. Prior to Bill C113, quitters' were penalized by a 12 week waiting period and had their statutory replacement rate cut from 60 to 50%.

Four further changes to system were introduced with Bill C17 in 1994. This bill raised the minimum entrance requirement (ie., in high unemployment regions) from 10 to 12 weeks (effective July, 1994). It contained a further cut in the statutory replacement rate (from 57% to 55%, also effective July, 1994). Finally there was a revision in the mapping from weeks of work and

[12] Canadians are also eligible for social assistance benefits, which are of unlimited duration. These benefits depend on family type and other measures of need rather than past earnings or contributions. There is a means test (on assets) and a high implicit tax on earnings.

[13] The previous legislative changes were in 1989.

[14] The federal department responsible for unemployment insurance.

unemployment rates into weeks of benefit entitlement (effective April 1994). Finally, a new “dependency rate” was introduced. Individuals with dependent children and insurable earnings less than $390 became eligible for a statutory replacement rate of 60%. This change was intended to shield poor families from the two cuts in the general statutory rate. It also represented somewhat of a change in the philosophy of unemployment insurance in Canada. Previously, benefits had been tied strictly to contributions and not to need.

4.2 The Canadian Out of Employment Panels.

To evaluate the impacts of Bill C113, HRDC commissioned a panel survey of individuals that separated from jobs in windows before and after the Bill came into force on April 3rd, 1993. To avoid issues of strategic filing, the windows were separated from the effective date of the bill by about one month. Each window was about 6 weeks long. This survey has come to be called the 1993 Canadian Out of Employment Panel (COEP). Respondents from the first sampling window constitute “cohort 1" and those from the second window constitute “cohort 2". Because the cohorts span the policy change, the data has a “quasi-experimental” structure.

In Canada, employers are required to submit a Record of Employment (ROE) whenever a job separation occurs. Approximately 6 million such forms are issued each year. The sampling frame for the COEP is the population of individuals receiving a Record of Employment (ROE) form in one of the two window periods, and having a Social Insurance number ending in "5". We often refer to the job whose end led to an individuals inclusion in our sampling frame as “the ROE job”. The ROE form contains a reason for separation. All reasons were sampled except for participation in a Work Sharing program, apprenticeship, and retirement at age 65. Approximately 6,000 separations were sampled in each window.

Each respondent was interviewed by phone three times, at about 26, 39 and 60 weeks after the job separation. The average interview length was 25 minutes for the first interview. Subsequent interviews were shorter. The long lag to the first interview is imposed by the time it takes all the administrative records that form the sampling frame to become available. This lag means that only a selected sample of respondents are observed in unemployment. We return to this issue in the next section.

It is possible to merge the survey information with UI administrative information from HRDC and with tax data for the respondent and his or her spouse (if married). Thus these data give an unprecedentedly detailed glimpse into the circumstances of households that contain someone who has lost a job. For example, the administrative data gives the exact benefit and entitlement period for every respondent; these are usually very badly measured in surveys (or imputed from state level averages). Conversely the tax data allow researchers to control for the labour supply and income of the spouse which is typically missing from administrative data. Finally, the survey provides information concerning expenditures, search measures, demographics, and other issues that is never observed in administrative or tax data. Moreover, there are often two or three independent measures of the same quantity in the three sources (an example is past earnings) which allows for the correction of measurement error.

In 1995 HRDC commissioned a second survey of individuals separating for jobs. The 1995 COEP sampled approximately 4000 ROE's in each of two windows, timed to roughly correspond to the 1993 sampling windows. We refer to these samples as cohorts 3 and 4. There were no policy changes between cohorts 3 and 4, so they provide a seasonal control for cohorts 1 and 2. And cohorts 2 and 4 provide a before and after framework for the evaluation of Bill C17.

In the 1995 COEP, respondents were only interviewed twice, at approximately 36 and 60 weeks. Sampling of separation reasons was more restricted than in 1993 with further minor categories excluded: only short work, other, voluntary quit, dismissal and illness were sampled. The survey questionnaire was revised somewhat in light of the experience with the 1993 COEP, but great care was taken to ensure backwards comparability.

4.3 The Sample.

While the 1993 and 1995 COEP together comprise some 20,384 respondents (12,490 in cohorts 1 and 2 (1993) and 7,894 in cohorts 3 and 4 (1995)), we work with a sample which is restricted in several important ways.

First, we restrict the sample to separation reasons "short work" (about 50% of separations), "voluntary departures" or "quits" (almost 20%) , "dismissals" (some 5%) and the approximately 20 percent labeled "other". These last represent the second largest single category of separations. Discussions with HRDC staff suggest that this group is similar to the "short work" group; our investigations support this and we commonly pool them. This leaves us with 11,228 observations from cohorts 1 and 2 and 7,573 observations from cohorts 3 and 4.

Second, we focus on respondents between the ages of 20 and 60. This reduces the 1993 sample to 10,528 and the 1995 sample to 7195. In addition we select respondents from three family types: singles, couples and couples with children and/or others. Single parents and young individuals living with parents or unrelated adults are the primary groups excluded. Though these latter groups are not unimportant, we found in preliminary analysis that it was difficult to adequately capture the heterogeneity of responses in a pooled sample. Furthermore, the quality of responses to questions about household income and expenditure were very poor among respondents living with parents or unrelated adults. The family types we do consider comprise 6,750 respondents in 1993 and 5,676 in 1995

Finally, we focus on those individuals who are unemployed[15] at the time of the first interview: this is the group who are likely to have current earnings below "permanent" earnings, and for whom UI benefits (if any) provide a good measure of current 'earnings'. Of course, because the first

[15]That is, we exclude both the employed and those that report withdrawal from the labour market.

interview occurs at least six months after the separation date, this leaves 3,132 respondents in 1993 and 1,557 respondents in 1995. This selection introduces a possibility that our results will be biased by sample selection. We discuss this possibility at length in Browning and Crossley, (1997). Here we note that the bias in our results depends on the correlation of selection with the variation in benefits we employ, conditional on our permanent income and other controls. Given the richness of our controls, we believe that this plausibly unimportant. We present in tests which support this position in Browning and Crossley (1997).

In addition to these sample selections, our estimating sample is further reduced because we are forced to discard observations for which the expenditure information is missing or inconsistent and observations which do have a complete set of information. This leaves us with a final sample of 2,594 respondents (1,567 in cohorts 1 and 2 and 1,027 in cohorts 3 and 4). The incidence of incomplete records is quite high, but this reflects the fact that we are merging data from four sources (the survey responses, two HRDC administrative files and the tax data base). We consider it the acceptable cost of the very rich set of information we are able to use.

4.4 Variation in Benefits

A crucial issue in any study such as this is the source(s) of variation in the benefits. The fact that UI benefits in Canada are earnings related means that some of the variation in benefits across individuals is due to difference in past earnings. As discussed in section 3.2, this source of variation is likely correlated with differences in λ (the marginal utility of money), and in fact we will control for past income in a rich way to ensure as best we can that we are not using this source of variation in the benefits in our estimation of benefit effects.

Because the UI system is federal in Canada, we cannot use the cross-state variation in benefits which is the common basis of U.S. studies of UI. Instead our source of variation is primarily changes in the UI system through time. The COEP data allows us to capture variations in benefits induced by bills C113 and C17, as well as administrative changes in the same period. This source of variation in UI benefits is explored in detail in Browning and Crossley (1997).

The variation we use is captured in a set of instruments which are listed in the appendix Table A2. The available variation in the statutory rate is small relative to cross state differences in the US. Against this, our rich controls and exact measurement of benefits means there is less noise from which to extract the signal. Furthermore the source of the variation we are using is transparent: a series of legislative cuts to the UI system designed to reduce program expenditures against the backdrop of a very slowly improving labor market[16]. Elsewhere (Browning and Crossley, 1995) we point out that the cross-state variation in replacement rates is not obviously exogenous; state replacement rates might be correlated with the permanent income shock of job separation if, for example, states adjust their replacement rates to smooth program expenditures (or balance their budgets).

[16] The unemployment rate in Canada drifted down from 11.3% in 1992 to 9.5% in 1995.

We also note that not all our instruments move in the same direction through time. While most of the changes in this period made the program less generous, there were two with the opposite effect. One was the introduction of the "dependency rate" between cohorts 2 and 3 which allowed for higher benefits for low income individuals with dependents. The other was the significant real growth in the maximum insurable earnings over the period. Finally, we note that the relevance and adequacy of an (over-identifying) set of instruments is subject to empirical investigation; we take this up in section 5.4.

4.5. Reliability of the Expenditure Responses.

To access the reliability of the expenditure in the COEP surveys we have compared with the expenditure information in the Canadian Family Expenditure survey (FAMEX). The latter is a retrospective survey of annual expenditures that is known to be of high quality. In order to draw a sample of comparable to the COEP samples, we select households in the FAMEX in which the 'head' of the household is of prime age and had some market work in the year, but less than 52 weeks[17]. We find that budget shares and slopes of Engel curves in the COEP are very similar to those in the FAMEX. The complete results of this exercise are presented in Browning and Crossley (1997).

5. Results

We turn now to the results of our empirical investigation of the four models of consumption behavior introduced in section 1. We begin with the reduced form estimates.

5.1 Reduced Form Estimates

Table 5.1 summarizes our estimates of reduced form (conceptually, conditional on λ - see section 2.2) equations for food, clothing and total expenditures. The first row reports the impact of UI benefits for respondents who had liquid assets at the separation date - that is, the coefficient on UI benefits crossed with a dummy variable indicating positive assets. The only significant impact is on clothing expenditures. The second row reports the coefficient on UI benefits crossed with a dummy a variable indicating zero liquid assets at separation - that is, the impact of UI benefits for those who are more likely to be liquidity constrained. These three coefficients are strikingly different than those in the row above - there are significant effects for all three expenditures. Thus the distinction between the constrained and unconstrained is empirically significant. The full list off covariates in these equations is reported in Appendix Table A1.

The next two rows present statistics pertaining to the empirical fit and adequacy of our specifications for these equations. The low R^2 for clothing simply reflects the fact that we are fitting the common conditional mean of observed and normal expenditures to the former, which is much

[17]This is intended to mimic the COEP sample, which is of course, based on the respondent having been unemployed at some time in the survey period.

noisier than the latter (see section 3.6). The next row presents RESET tests for omitted variables - essentially a test of the empirical adequacy of our nonstandard functional form. The marginal rejection for food reflects some decline in the expenditure elasticity of food for total expenditures above $3000 per month (less than 10% of our sample).

The final two rows report on the robustness of our estimates. We calculate DFBETA influence statistics for each observation for each of the two variables of interest, in each of the three equations. These represent, for each observation, the change (in standard deviations) in the coefficient on a particular variable that would result from the removal of that observation (see Chaterjee and Hadi, 1988) . We report the largest DFBETA (in absolute value) for each coefficient reported in the first two rows of the table; these statistics indicate that no coefficient estimate seems unduly influenced by any one observation.

TABLE 5.1: Reduced Form Coefficients on UI Benefits

	Total Expenditure	Food at Home	Clothing
UI benefits x High Assets	0.0091 (0.49)	0.028 (1.43)	0.12 (2.00)
UI benefits x Low Assets	0.071 (3.90)	0.059 (3.10)	0.18 (3.19)
R^2	0.45	0.51	0.21
RESET (p-value) (F-test for omitted variables/functional form)	0.98 (0.40)	2.56 (0.054)	1.80 (0.14)
max[abs(dfbeta)] UI benefits x High Assets	0.21	0.17	0.12
max[abs(dfbeta)] UI benefits x Low Assets	0.16	0.18	0.10

Notes:
t-values in parentheses
2594 Observations
note that clothing is scaled differently
complete results available from the authors

5.2 Estimates of Structural Parameters

From the reduced form estimates, we recover the structural form coefficients by a minimum ^{2} step. The coefficients on the two benefit variables are presented in the first two rows of Table 5.2. Because the system is recursive, the total expenditure coefficients are of course, identical to those reported in 5.1 (the reduced form coefficients). For food and clothing, these are the conditional on *x* (total expenditure) derivatives - the impact of benefits on the *structure* of demand - holding total expenditure constant.

According to these estimates, there is no significant effect of benefits on food expenditure, once we condition on total expenditure. The same is not true of clothing expenditures. Conditional on total expenditures, marginal benefit dollars appear to increase clothing expenditures. Of the alternative models of consumption behavior discussed in section 2, only the “internal capital markets” hypothesis is consistent with this observation.

The third line reports the estimated total expenditure elasticities for food and clothing. These are precisely estimated and the food expenditure elasticity is smaller than the clothing elasticity. The latter seems low compared to other estimates in the literature. Because we have several instruments for total expenditure, the system is overidentified and the minimized distance provides an (asymptotically ^{2}) test of the overidentifying restrictions. As can be seen from the 3rd note to Table 5.2, the overidentifying restrictions are not rejected.

TABLE 5.2: Structural Form Coefficients on UI Benefits

	Total Expenditure	Food at Home	Clothing
UI benefits x High Assets	0.0091 (0.49)	0.022 (1.15)	0.100 (1.78)
UI benefits x Low Assets	0.071 (3.90)	0.019 (0.96)	0.11 (2.00)
Total Expenditure		0.56 (10.1)	0.77 (4.68)

Notes:
1. t-values in parentheses.
2. 2594 Observations.
3. Over-identification of expenditure instruments: $^2_{(8)}$ =6.04 ; p =0.64 .
4. complete results available from the authors.

5.3 Tests of Alternative models

Now we turn to direct tests of the models of consumption behavior discussed in sections 1 and 2. Using further minimum ^{2} steps we impose the restrictions implied by each (derived in section 2.2) on the structural form coefficient estimates. Tests of these restrictions are reported in Table 5.3.

The "rule of thumb" model implies that benefits should have no effect on the structure of demand (should not appear in the structural equations for food and clothing), regardless of liquidity. We also take it to imply that the impact on total expenditure should be the same for those with and without assets. This set of five restrictions is overwhelmingly rejected by the data.

The standard additive model has the strong implication that benefits should not matter. To test this we exclude both benefit variables from all three expenditure equations. This set of six restrictions is also strongly rejected by the data.

Allowing for liquidity constraints changes the predictions of the standard model. Benefits may affect total expenditure for the constrained. However, clothing and food are affected only through the impact on total expenditure and their respective expenditure elasticities - there is no impact on the structure of demand. Thus we exclude both the benefit variables from the food and clothing structural equations and the "high assets" benefits variable from the total expenditure equation. The data does not reject this set of 5 restrictions.

Finally, the "internal capital markets" hypothesis allows that benefits might affect both total expenditure and the structure of demand (conditional on total expenditure). Under the additional hypothesis that the unconstrained will prefer external to internal capital markets, these effects should only be evident for the constrained. Thus we test the internal capital markets hypothesis by excluding the "high assets" benefit variable from all three structural equations. The data does not reject these three restrictions.

TABLE 5.3: Tests of Alternative Models

Model	^{2} Statistic	Degrees of Freedom	Probability
Rule of Thumb	25.4	5	0.00012
Standard Additive	25.4	6	0.00029
Liquidity Constraints	7.69	5	0.174
Internal Capital Markets	4.82	3	0.186

Notes:
1. The restrictions corresponding to each model are discussed in the text.

To summarize, benefits appear to have an effect on the structure of demand, conditional on total expenditure. This is consistent with the idea that agents in temporarily straitened circumstances smooth consumption by adjusting the timing of durables purchases. Our priors were that this behavior should be much more prominent among those without liquid assets at the job loss. The data does not support this conjecture. Presumably, sufficient transactions costs could induce agents to chose to manipulate the timing of durables purchases rather than dis-save. Benefits appear to have a significant effect on total expenditures only for the liquidity constrained. Based on the restrictions derived in section 2.2, our data cannot formally discriminate between the "internal capital markets" and "liquidity constraints" model.

5.4. Exogeneity of Benefit Variables

As described in section 3.2, the identifying assumption behind the results presented above is that the variation in the marginal utility of money not captured by our controls (see Appendix Table A1) is orthogonal to the benefit variables. In section 4.4 we pointed out that some of the variation in benefits results from legislative and administrative changes to the Canadian UI system captured by the quasi-experimental structure of the data. In this section we use a set of instruments based on these changes to test the exogeniety of the benefit variables. The program changes are discussed in section 4.4 and the full set of instruments listed in Appendix Table A2.

The first two rows of Table 5.4 report tests of the explanatory power of our instruments in auxiliary regressions of our benefit variables on our instruments and permanent income controls. In the case of both benefit variables the instruments have good explanatory power. Next we test the over-identifying restrictions implied by our multiple instruments. As reported in the third row of Table 5.4, our instruments sets satisfy this test.

Finally we turn to the actual exogeniety test. We augment the total expenditure equation with the residuals from the auxiliary regressions of benefit variables on instruments and controls, and then test for the exclusion of these residuals. The exogeniety test passes easily.

6 Conclusions.

In this paper we have examined how poor agents smooth consumption over income losses due to an unemployment spell. We proposed that they adjust the timing of the replacement of small durables to the timing of income. Because old but serviceable durables continue to provide a flow of services, such a strategy minimizes the utility cost of a cut in expenditures.

The plausibility of such a strategy is confirmed by simulations. Furthermore, we find support for it in data from a survey of unemployed Canadians. In particular, marginal dollars of unemployment insurance benefits tend to increase clothing expenditures *even conditioning on total expenditures*. The same is not true of expenditures on a nondurable good, food at home.

These results have several interesting implications. From the point of view of Unemployment Insurance evaluation, they suggest that the sensitivity of total or food expenditures to benefit levels (as measured by Gruber (1994), or Browning and Crossley, (1995)) may not provide a direct picture of the welfare costs of income losses during an unemployment spell. Similarly, from the point of view of testing consumption behavior, a caution regarding the (exclusive) use of expenditures nondurable goods in such research is implied. Finally, the results suggest a partial explanation for the volatility of durables expenditures.

TABLE 5.4: Exogeniety of Benefit Variables

	Test statistic	DF	p-value
F-test of Instrument Relevance: UI benefits x High Assets	4.96	(18,2536)	0.00
F-test Instrument Relevance: UI benefits x High Assets	11.63	(18,2536)	0.00
Overidentification of Instruments in Total Expenditure Equation (^{2})	22.2	16	0.13
Exogeniety test in Total Expenditure Equation by Residual Stuffing (F-test)	0.13	(2,2550)	0.88

7. References.

Adda, Jerome and Russell Cooper (1996), "Balladurette and Juppette: a discrete approach", Boston University.

Attanasio, Orazio (1997), “Consumption”, working paper, University College London.

Beaulieu, Joseph ``Optimal durable and nondurable consumption with transactions costs", Working Paper 93-12, Federal Reserve Board, Washington.

Bertola, Giuseppe and Ricardo Cabaallero (1990), "Kinked adjustment costs and aggregate dynamics" in O. J. Blanchard and S. Fischer (eds), *NBER Macroeconomic Annual 1990.*

Blundell, Richard and Costas Meghir (1987), ``Bivariate alternatives to the Tobit model", *Journal of Econometrics*, 34, 179-200.

Browning, Martin and Thomas Crossley (1995), "Unemployment insurance benefit levels and consumption changes", Working Paper 96-04, Department of Economics, McMaster University.

Browning, Martin and Thomas Crossley (1997), "Evaluating the Impact of Unemployment Insurance on Households: Data and Methodological Issues." Mimeo.

Browning, M. and A. Lusardi (1996), "Household saving: micro theories and micro facts", *Journal of Economic Literature*, 34(4), 1797-1855.

Browning, Martin and Costas Meghir (1991), ``The effects of male and female labour supply on commodity demands" , *Econometrica*, 49(4), 925-51.

Carroll, C. (1993), "Buffer stock saving and the life cycle/permanent income hypothesis", mimeo, Federal Reserve Board.

Chaterjee and Hadi (1988). Sensitivity Analysis in Linear Regression. New York. Wiley.

Deaton, A. S. (1974), "A reconsideration of the empirical implications of additive preferences", *Economic Journal*, 84, 338-48.

Deaton, A. S. (1991), "Saving and liquidity constraints", *Econometrica*, 59(5), 1221-48.

Deaton, A. S. (1995), *Understanding consumption*, Oxford: Oxford UP.

Eberly, Janice (1995), "Optimal consumption under uncertainty with durability and transactions costs", mimeo, Wharton School, University of Pennsylvania.

Grossman, Sandford and Guy Laroque (1990), "Asset pricing and optimal portfolio choice in the presence of illiquid durable consumption goods", *Econometrica*, 58, 25-52.

Gruber, Jonathon (1994). “The Consumption Smoothing Benefits of Unemployment Insurance”. NBER working paper #4750.

Hamermesh, Daniel (1982), "Social insurance and consumption: an empirical inquiry", *American Economic Review*, 72(1), 101-113.

Keen, M. (1986), "Zero expenditures and the estimation of Engel curves", \ *Journal of Applied Econometrics*, 1, 277-86.

Parker, Jonathan (1996), ``The reaction of household consumption to predictable changes in payroll tax rates", mimeo, University of Michigan Business School.

Pudney, Stephen (1988), "Estimating Engel curves: a generalisation of the P-Tobit model", *Finnish Economic Papers*, 1.

Pudney, Stephen (1989), *Modelling Individual Choice*, Basil Blackwell, Oxford.

Puterman, Martin (1994), *Markov decision processes*, New York:\ John Wiley.

Zeldes, S. (1989), "Consumption and liquidity constraints: and empirical investigation", *Journal of Political Economy*, 97(2), 305-46.

Appendices.

Appendix A: Proof of Proposition 2.1.1 If preferences are additive across time and within the period then:

$$q_i = g^i(\lambda\pi_i)$$

so that:

$$\phi_i = g_i^i(\lambda\pi_i)\frac{\lambda p_i}{q_i}$$

Since the marginal utility of money is a function of (π,x) we can write the income elasticity as:

$$e_i = g_i^i(\lambda,\pi_i)\lambda_x\frac{xp_i}{q_i}$$

where λ_x is the partial of the marginal utility of money with respect to x. From these two relationships we have:

$$e_i = \frac{x\lambda_x}{\lambda}\phi_i$$

Applying the Engel aggregation condition:

$$\sum_{n}^{i=1}\omega_i e_i = 1$$

and the definition given in (4) gives that the factor of proportionality is ϕ. □

Appendix B: Descriptions of Variables.

Table A1: Description of Controls	
Household Type	dummy for single female dummy for male with spouse employed at separation dummy for female with spouse employed at separation dummy for male with spouse not employed at separation dummy for female with spouse not employed at separation (omitted category: single male)
Demographics	age age squared dummy for highschool graduate dummy for tertiary education log of household size dummy for children
Region	dummies for Atlantic, Quebec, Prairies, B.C. (omitted category: Ontario) Local unemployment rate at job separation
Seasonality	month dummies (to control for seasonality) weeks elapsed between separation and interview
Household Resources	dummy for home ownership dummy for liquid assets at separation date dummy for some employment between separation and interview
Characteristics of ROE job	fraction of household income provided by ROE job, prior to separation dummy for separation expected dummy for seasonal job dummy for job tenure > 1yr dummy for managerial occupation dummy for bluecollar occupation insurable weeks
Regular UI use	dummy for UI use in previous 2 years
Instruments for Total Expenditure	lagged household incomes (sum of respondent and spouse's incomes from tax files) polynomial in earnings in job that ended

Table A2: Description of Instruments for Benefit Variables	
Note: UI benefits, in $1000s per month were interacted with a dummy for no liquid assets at separation and a dummy for some liquid assets at separation to create two benefit variables, for the liquidity constrained and unconstrained respectively. Each of the following instruments was also interacted with these two dummies.	
Instrument	Discussion
Program features:	
dummy for sufficient qualifying weeks to be eligible at separation date	a nonlinear function of the local unemployment rate and weeks worked in the ROE job, both of which are among our controls
weeks of entitlement at separation date	a nonlinear function of the local unemployment rate and weeks worked in the ROE job, both of which are among our controls
Legislative Changes to Replacement Rate:	
statutory rate	Cut from 60% to 57% between cohort 1 and 2 and to 55% between cohorts 3 and 4
dummy for children x cohort 3,4	In cohorts 3 and 4 individuals with dependents and low incomes were entitled to a replacement rate of 60%
Legislative Changes to Probability of Receipt	
eligibility dummy x cohort 2	Voluntary quits and dismissals with cause were disentitled between cohorts 1 and 2, and this disentitlement was enforced more strictly over time. These variables pick up changes, across legislative and administrative regimes, in the probability that an individual with a given number of weeks worked and local unemployment rate will receive benefits. Note that none of instruments is a function of separation reason, which could be endogenous.
eligibility dummy x cohort 3,4	
entitlement weeks x cohort 2	
entitlement weeks x cohort 3,4	
Administrative Changes.	
dummy for earnings in ROE job above insurable maximum	We control for past earnings in a flexible way The maximum insurable earnings rose by 10% in real terms over the period covered by the data. This completely offset the fall in the statutory rate for those with earnings above the insurable maximum