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A structural dynamic microsimulation model of household savings and labour supply

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ABSTRACT

A structural model of the household is described that represents current best-practice in the analysis of savings and labour supply responses to the policy environment. Care has been taken in specifying the model so that it represents an appropriate basis for the analysis of incentive effects to policy change, and for exploring the empirical support for alternative structural assumptions. Matching the model to survey data for the UK reveals some interesting puzzles in relation to the timing of retirement.

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1. Introduction

Structural models of behaviour are the clock-work to which economic theorising is devoted, and upon which analyses of our changing environment depend. Current best practice in the economic analysis of intertemporal decision making is conducted within the life-cycle framework of Modigliani and Brumberg (1955) and Friedman (1957). Despite more than half a century of intense analysis, however, the life-cycle framework has had, and continues to have, a very limited bearing upon practical issues of policy design and reform. One of the reasons for this disappointing yield is the high computational burden that is generally involved when using the life-cycle model to identify decisions in contexts where future circumstances are uncertain. It is reasonable to suppose, therefore, that this aspect of economic analysis should have benefitted immensely from the rapid advance of computing technology, which has persisted for as long as the life-cycle framework has existed. In this paper I describe a model that represents the current state of the art in the economic analysis of savings and labour supply decisions, thereby revealing how much progress has been made, and – just as important – how far we still have to go before it can reasonably be said that this field of study has truly “come of age”.

Policy makers are faced with a multitude of difficult problems when considering the relative merits of policy alternatives. One of the most important of these is the evaluation of a policy counterfactual's incentive effects, which are often highly opaque and context dependent. Consider, for example, a reduction in the rate at which a means-tested retirement benefit is withdrawn in respect of private income. The most commonly expressed view is that this type of policy change reduces effective tax rates on saving, thereby encouraging an increase in private retirement provisions. But, as is well understood in the economic literature, there is no reason to suppose that this ‘intuitive’ view will hold in practice. This is because, for net savers who would have been eligible to receive the means-tested benefit in the absence of the policy change, the substitution and wealth effects of reducing the withdrawal rate act in opposite directions. Furthermore, for those who would only be made eligible to receive the means-tested retirement benefit following the policy change (as the benefit is extended up the income distribution), the income and substitution effects work in the same direction, to *reduce* incentives to save. And this stylised discussion ignores any interactions that might exist between the means-tested benefit and the wider tax and benefits system, which are often sufficiently complex in advanced economies to add substantially to the difficulty of inferring incentive effects.

In response to these complexities, microsimulation models are now one of the tools commonly applied in the analysis of the implications of policy reform. The feature that distinguishes microsimulation models from their macro based counterparts is that each agent from a population is individually represented. As such, microsimulation models are particularly useful for policy analyses where the effects depend upon individual specific circumstances (as in the preceding example), or where the distributional implications are a focus of interest.

Two types of microsimulation model can be distinguished. Static microsimulation models, as their name suggests, determine the

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impact of counterfactual conditions upon a population of agents at a point in time. In contrast, dynamic microsimulation models age each agent in response to stochastic variation and an accumulated history, eventually generating panel data over the entire life course. Most dynamic microsimulation models are consequently designed to consider the intertemporal and long term effects of counterfactual conditions, rather than the impact effects with which static models are concerned.

The vast majority of microsimulation models that are currently in use are based either upon simple assumptions regarding behavioural responses (the simplest being that there are none), or on regression equations that are selected for their empirical appeal more than their structural content. As the behavioural assumptions upon which these models are based are likely to be sensitive to changes in the policy environment, they are usually ill-suited to an evaluation of the incentive effects of policy reform. Addressing this short-coming is now a vibrant issue of academic research, and is the fundamental motivation for the modelling approach discussed in this paper.

The model that is described here is best referred to as a structural dynamic microsimulation model of the household. It departs from 'classical' dynamic microsimulation models (e.g. Curry (1996), Caldwell (1997)) because it is founded upon "deep parameters" that are defined to be structurally stable in context of environmental change. This is what motivates the emphasis placed on the 'structural' nature of the model, and makes it robust to the Lucas critique when exploring the implications of changes to the decision making environment.

The theoretical basis of the model is specified in response to two sets of empirical observations. First, are the empirical regularities that motivated formulation of the life-cycle framework in the 1950s as an alternative to the "fundamental psychological laws" of Keynes (1936). And second, are observations reported in the extensive literature that has sought to test specific assumptions within the life-cycle framework. Before discussing these, note that an explicit distinction is drawn here between the life-cycle 'framework' and a life-cycle 'model'. Following Browning and Lusardi (1996), I refer throughout to the life-cycle framework as the hypothesis that decisions are made to maximise expected lifetime utility, subject to the decision maker's circumstances, constraints, and expectations about the future. A life-cycle model obtains when additional assumptions are added to the framework that allow behaviour to be explored.

In a recent review, Attanasio and Weber (2010) cite the following stylised empirical facts as providing the underlying motivation for the life-cycle framework: the marginal propensity to consume out of disposable income is lower in the short-run than the long run; there is an inverse relationship between saving rates and population sub-group average income after controlling for income level; and there is a positive correlation between saving rates and income changes. These stylised observations, which continue to hold in contemporary survey data, can all be coherently explained within the life-cycle framework (e.g. Attanasio and Weber (2010)).

One of the central issues addressed by the literature that has tested alternative assumptions within the life-cycle framework is whether consumption growth is orthogonal to predictable changes in income, as is implied by a highly stylised life-cycle model. This implication has been rejected over a wide range of dimensions considered in the literature: age specific measures of consumption and income are both hump shaped, with consumption appearing to track income across the life-course over a wide range of alternative population subgroups (e.g. Carroll and Summers (1991)); consumption growth appears to respond significantly to instrumented income growth (e.g. Campbell and Mankiw (1989, 1991), and Flavin (1981)); and consumption is significantly influenced by predictable changes in both behaviour (e.g. retirement, Hamermesh (1984), Banks et al. (1998), and Berneim et al. (2001)) and the policy environment. These deviations between the data and the stylised life-cycle model first considered for analysis are referred to in the literature as 'excess sensitivity'.

Furthermore, observed aggregate consumption growth is more smooth than aggregate income growth, despite the positive serial correlation that is exhibited by income growth (e.g. Campbell and Deaton (1989)). This is a discrepancy with the implications of common life-cycle model specifications that is referred to in the literature as 'excess smoothness'. The literature has also documented cases where individuals appear to exhibit a preference for commitment mechanisms that are absent from most life-cycle models (e.g. Thaler and Benartzi (2004)), where decisions show a significant bias in favour of the choice involving the least effort (where such a distinction exists; e.g. Choi et al. (2002), Madrian and Shea (2001), and Beshears et al. (2008) on the influence of default options for 401 (k) pension plans in the US), and where investment decisions depart radically from model implications (e.g. Gross and Souleles (2002) on coincident holding of assets and debt, and Mehra and Prescott (1985) on the equity premium puzzle).

Excess sensitivity violations of life-cycle models have been resolved in the contemporary literature by relaxing a number of specific assumptions made in the models that predominated in the early empirical literature. The hump shaped profile of consumption is now commonly understood to be the product of population demographics; changing household needs due to marriage and child rearing during the working lifetime, and uncertainty regarding the time of death late in life (see, e.g., Tobin (1967), Attanasio and Weber (1995), and Browning and Ejrnæs (2002)). Precautionary saving in response to income uncertainty has been identified as an important factor underlying the timing of the peak in household consumption, which occurs later in life than the peak in income (e.g. Carroll (1992), Browning and Ejrnæs (2002), and Gourinchas and Parker (2002)). Heckman (1974) recognised that we should not expect consumption to be independent of retirement decisions if consumption and leisure are not additively separable in utility, and Smith (2006) identifies the role of negative shocks to life-cycle income associated with involuntary retirement. Furthermore, a number of authors have reported evidence that liquidity constraints are important in understanding the responsiveness of consumption growth to income growth described by survey data more generally (e.g. Zeldes (1989), and Agarwal et al. (2007)). The model discussed in this paper is designed to reflect all of these considerations.

The desire for commitment mechanisms that has been identified in some contexts is commonly attributed in the literature to time-inconsistency of preferences, with the majority of attention paid to quasi-hyperbolic discounting in the aggregation of intertemporal utility (e.g. Laibson et al. (2007) and van de Ven (2010) for empirical investigations). Less substantive progress has, however, been made in relation to the other deviations between common life-cycle models and the statistical record that are set out above, with the most promising candidates for model amendments being the introduction of information asymmetries, decision costs, and habit formation, which are all closely related concepts. A common explanation for excess smoothness, for example, is that intertemporal consumption is influenced by prevailing habits (e.g. Fuhrer (2000), Sommer (2001)).[1] Alternatively, Ludvigson and Michaelides (2001) emphasise the potential of imperfect information about the state of the macro-economy to explain excess smoothness within the life-cycle framework. Where biases are identified in favour of decision alternatives that impose the minimum effort on the decision maker, then decision costs represent an intuitive explanation; most of the related literature in this regard has focussed on stock accumulation at the firm level and the demand for factors of production (see Khan and Thomas (2008), for a review). Similarly, the role of decision costs and habit formation in explaining apparently errant investment decisions has been explored at length (see e.g. O'Donoghue and Rabin (1999) on decision

[1] There is, however, weak evidence of habits in panel microdata; see Dynan (2000).

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