Assessing affordability using random effects models of income and consumption growth

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Outline

• Introduction
• Income change model
• Consumption change model
• Simulation
• Affordability assessment
• Example based on artificial data
• Conclusions
Affordability assessment

  - “Affordability assessments are a key component of responsible lending, but can be difficult.”

- Office of Fair Trading (2011) “Irresponsible lending – OFT guidance for creditors”, p.36:

  'Assessing affordability', in the context of this guidance, is a 'borrower-focussed test' which involves a creditor assessing a borrower's ability to undertake a specific credit commitment, or specific additional credit commitment, in a sustainable manner, without the borrower incurring (further) financial difficulties and/or experiencing adverse consequences.
Affordability assessment

• The Lending Code (2011), Section 4: Credit assessment:
  
  – “50. Before lending any money, granting or increasing an overdraft or other borrowing, subscribers should assess whether the customer will be able to repay it in a sustainable manner.”

• Codes and guidelines on responsible lending and affordability assessment
  
  – very general
  
  – no recommendation of any specific approach or model
Affordability assessment

• Affordability/overindebtedness models
  – offered by credit bureaus (e.g. Experian, Callcredit)
  – used by large banks to calculate mortgage loan amounts

• The implemented approaches are usually static

• Need for including time, e.g. FSA (2010) Mortgage Market Review: Responsible Lending, consultation paper (p. 21 & 29):
  – “We do propose to require that the lender considers the variability of income over time in their assessment”
  – “When assessing affordability, lenders should consider the applicant’s ability to repay over the life of the loan”
Dynamic affordability assessment

• The aim of this research is to propose a theoretical framework for dynamic affordability assessment
  – income and consumption vary in time and their changes are modelled with random effects models
  – the estimated models are applied in a simulation
  – each possible instalment amount is assigned with a probability of default over the life of the loan

• In practice, this could help assess affordability and determine the maximum affordable instalment
Proposed definitions

- **affordability** – a function $A(x)$ that assigns to each possible instalment amount $x \in X$ a probability of the applicant defaulting over the loan repayment period.

- **affordability assessment** – estimation of this function.

- **maximum affordable instalment (MAI)** – the highest possible instalment amount $x \in X$ for which affordability is less or equal to the cut-off, e.g.:

$$MAI = \max\{x \in X: A(x) \leq 0.05\}$$
Panel data models

• **panel data** – time-series cross-sections

• **individual effects** – components that are specific to individuals and constant over time

• **fixed effects (FE) models**
  – individual effects are estimated like the other parameters
  – cannot be used to predict outside the training sample

• **random effects (RE) models**
  – individual effects are part of the error term
Income models in economic literature

- Auten and Carroll (1999)
- Etienne (2006)
- Guiso, Jappelli and Terlizzese (1992)
- Jappelli and Pistaferri (2006)
- Lillard and Willis (1978)
- Lusardi (1992)
- Miles (1997)
- Skinner (1988)
Income models in economic literature

- net labour income
- log transformation of income
- individual or household level
- income or income change
- if income change:
  - individual’s characteristics or their changes
- if individual effects:
  - FE or RE models
Income determinants

- age
- cohort
- sex
- education level
- occupation
- industry/sector
- region
- macroeconomic conditions
Macroeconomic conditions

• In panel data models, macroeconomic conditions can be taken into account by using:
  – macroeconomic variables (e.g. GDP)
  – random time effects
    • require data covering long time periods
  – fixed time effects (time dummies)
    • can capture the combined effect of macroeconomic variables that are not used as regressors in the model
    • describe the macroeconomic environment as a whole
Income change model

\[ \Delta \ln Y_{it+1} = \sum_{s=1}^{T-1} \gamma_s D_{t+1}^{(s)} + \alpha_0 + \alpha_1 \text{age}_{it} + \alpha_2 \text{cohort}_i + \alpha_3 \text{sex}_i + \alpha_4 \text{education}_i + \alpha_5 \text{occupation}_i + \alpha_6 \text{sector}_i + \alpha_7 \text{region}_i + \mu_i + \epsilon_{it+1} \]

- RE model
  - random individual effects \( \mu_i \)
  - fixed time effects: time dummies \( D_{t+1}^{(s)} \)
- All characteristics but age are coded as sets of dummies
Consumption models in economic literature

- Hall and Mishkin (1982)
- Jappelli and Pistaferri (2000)
- Lusardi (1992)
- Runkle (1991)
- Zeldes (1989)
Consumption models in economic literature

- nondurable consumption
- log transformation of consumption
- individual or household level
- consumption change
- if individual effects:
  - FE or RE models
Consumption change determinants

- age
- change in the number of children/in the number of children in different age groups
- change in the number of adults/in the family size
- macroeconomic conditions

Income is normally not included: according to the Permanent Income Hypothesis, current consumption does not depend on current income!
Euler equation of consumption

• A condition for the consumer’s optimisation problem

• If their consumption choices are optimal, then their current marginal utility is equal to the present value of the expected future marginal utility corrected for the time preference rate:

\[ U'(C_{it}, \theta_{it}) = E_t \left[ \frac{U'(C_{it+1}, \theta_{it})(1 + r_i)}{(1 + d_i)} \right] \]

• Marginal utilities ratio (for \( t + 1 \) and \( t \)) can be log-linearized (Zeldes, 1989; Runkle, 1991; Lusardi, 1992) to produce e.g.:

\[ \Delta \ln C_{it+1} = \beta_0 + \beta_1 age_{it} + \beta_2 \Delta X_{it+1} + \nu_i + \lambda_{t+1} + \zeta_{it+1} \]
Consumption change model

\[
\Delta \ln C_{it+1} = \sum_{s=1}^{T-1} \delta_s D_{t+1}^{(s)} + \beta_0 + \beta_1 \text{age}_{it} + \beta_2 \Delta \text{children}_{it+1}^{(0-3)} + \beta_3 \Delta \text{children}_{it+1}^{(4-15)} \\
+ \beta_4 \Delta \text{children}_{it+1}^{(16-19)} + \nu_i + \zeta_{it+1}
\]

- **RE model**
  - random individual effects \( \nu_i \)
  - fixed time effects: time dummies \( D_{t+1}^{(s)} \)
- Changes in the number of children in three age groups
Using income and consumption models

• Once the models are developed, there are estimates of:
  – model parameters
  – variances of the individual effects
  – variances of the idiosyncratic components

• The applicant’s income and consumption
  – are known at the time of application
  – can be predicted for future months by using the models
    • simulation for the applicant
Simulation

- A simulation is run to take into account
  - random components (individual effects and idiosyncratic components)
    - randomly drawn from normal distributions with zero means and the estimated variances
  - unknown future macroeconomic conditions (time effects)
    - it is assumed that each future month is similar to one of the months in the training sample
    - for each future month one of the time dummies is randomly selected
Affordability check

• Simulation products
  – pairs of the predicted income and consumption time series

• For each pair the applicant’s ability to repay is checked
  – based on the predicted income and consumption, existing debts and a new instalment amount
  – over the loan repayment period
  – with a default/no default result
    • default – failing to pay in any three consecutive months
Affordability assessment

- Estimate of the probability of default over the life of the loan
  - proportion of the pairs where there are predicted defaults
- Assessing affordability
  - repeating affordability checks for all pairs of time series and all possible instalment amounts
  - assigning each of these amounts with an estimate of the probability of default over the life of the loan
Example based on artificial data

- Assumptions: the estimated models (a 5-year training sample)
- A hypothetical applicant (45, no children etc.)
  - is applying for a loan with a 2-year repayment period
  - income: £2300
  - consumption: £1500
  - credit card limit: £1000
  - no other loans
- Simulation
  - 10000 iterations
Example: affordability
Example: maximum affordable instalment

![Graph showing probability of default vs. instalment amount (£), with a cut-off point at 735 £ and MAI = £735.](image)
Conclusions

• In this research a theoretical framework for dynamic affordability assessment is proposed that allows for the identification of the maximum affordable instalment

– ability to repay is assessed over the life of the loan
– possible future changes in income and consumption are taken into account
– a loan is affordable if the applicant is able to repay it while also meeting consumption costs and repayments of all other debts month after month until the loan is paid in full

...which is in line with recommendations of the OFT and FSA
Conclusions

• Needed to build the models in practice
  – monthly panel data on income and consumption for
    a few thousand consumers and covering a few years
    (ideally: the whole economic cycle)
  • sources: surveys or current account transactions

• Further analysis
  – liquidity constraints or precautionary saving
  – permanent and transitory income shocks
References


References


Thank you!