Considering the addition of Spatial, Dynamic dimensions and/or Alternative Unit of Analyses in EUROMOD

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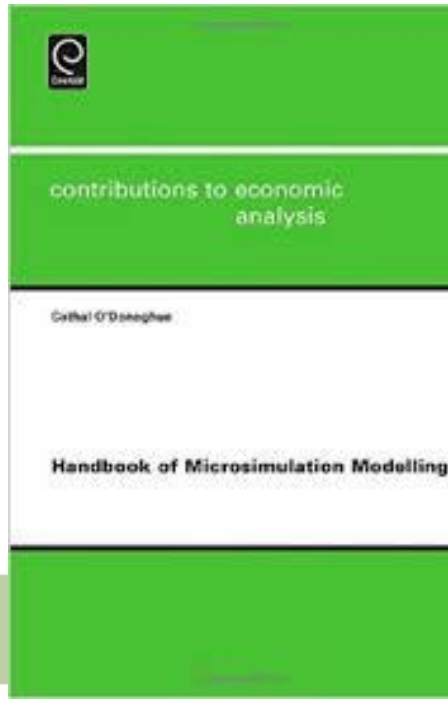
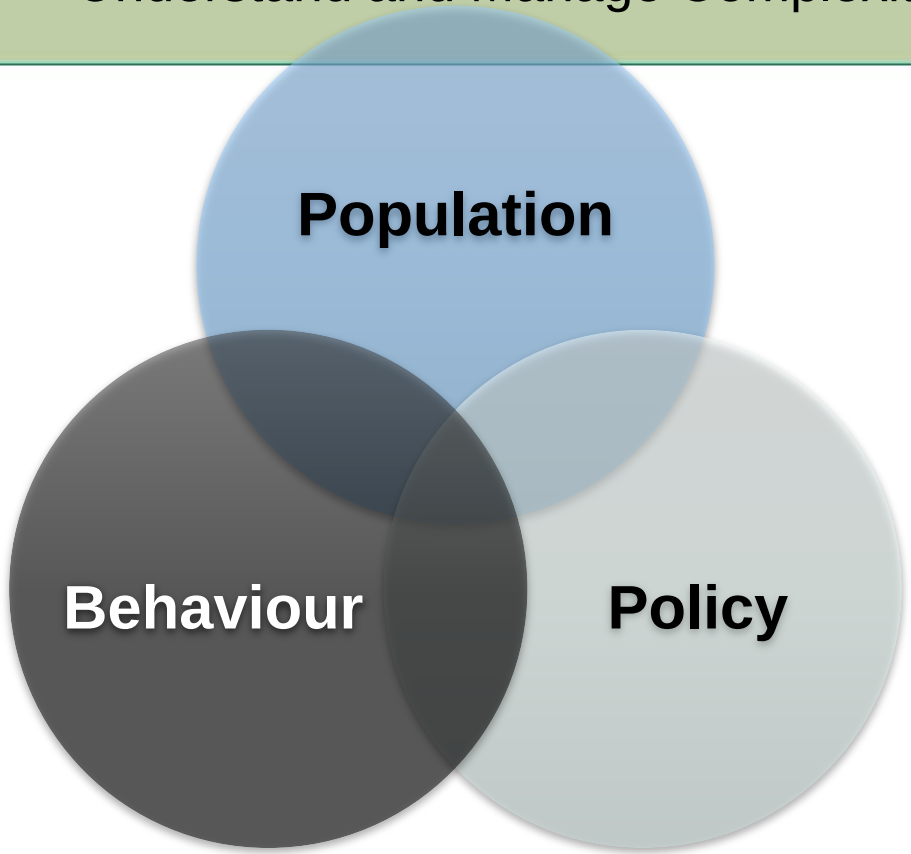
Understanding Complexity

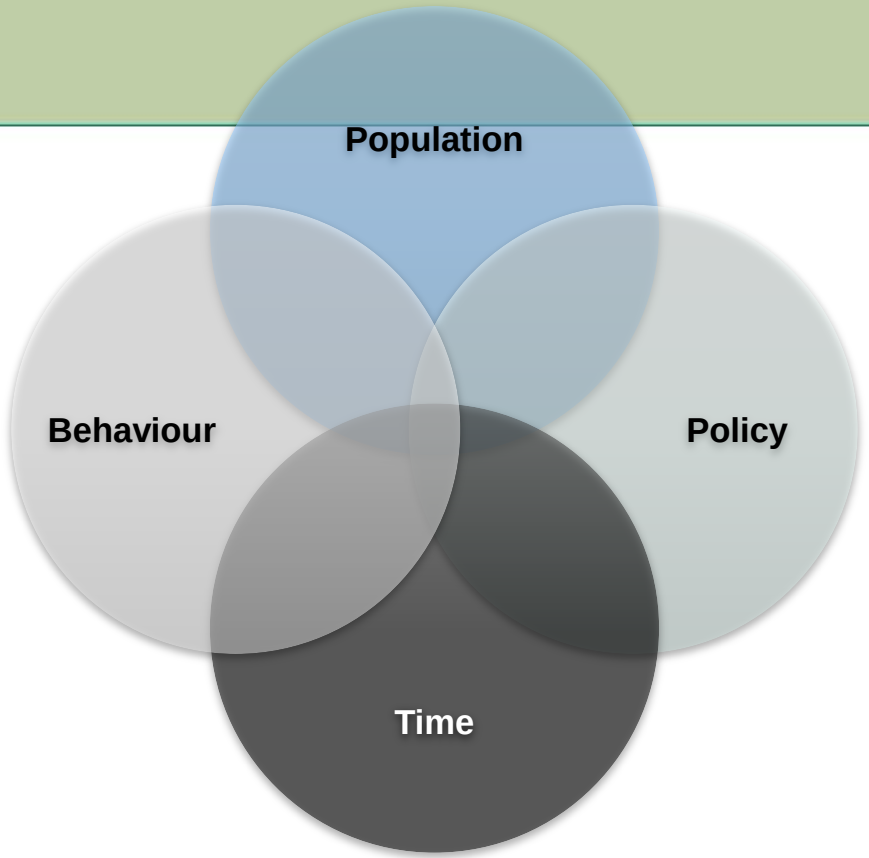


Sources of Complexity

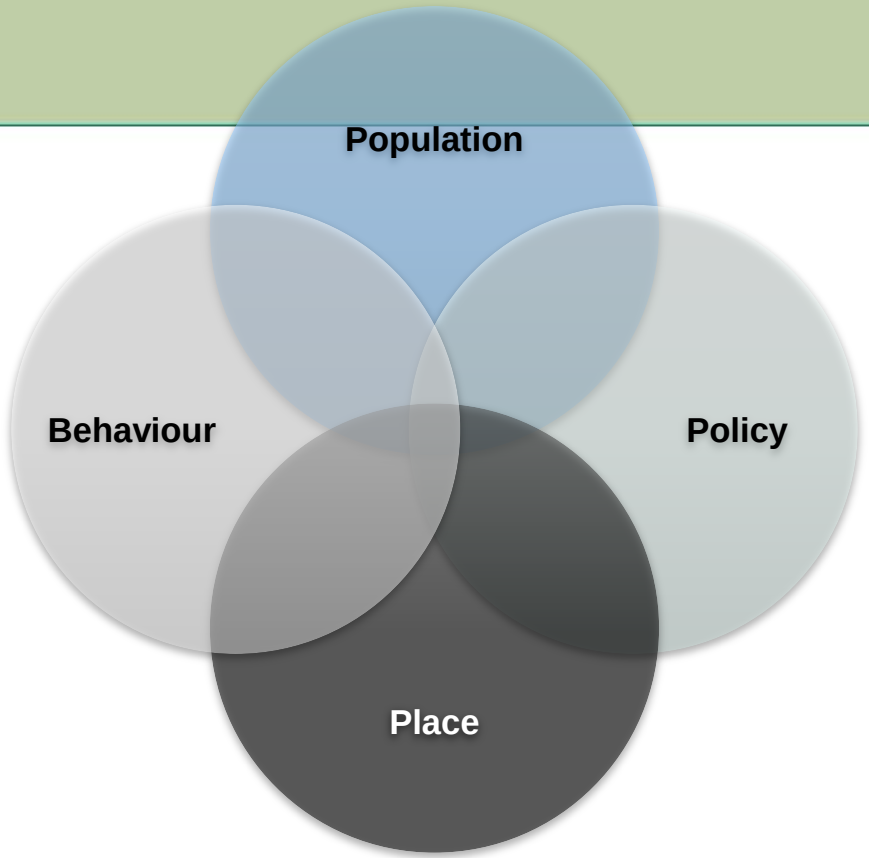
Core Purpose of Microsimulation Models
Understand and Manage Complexity



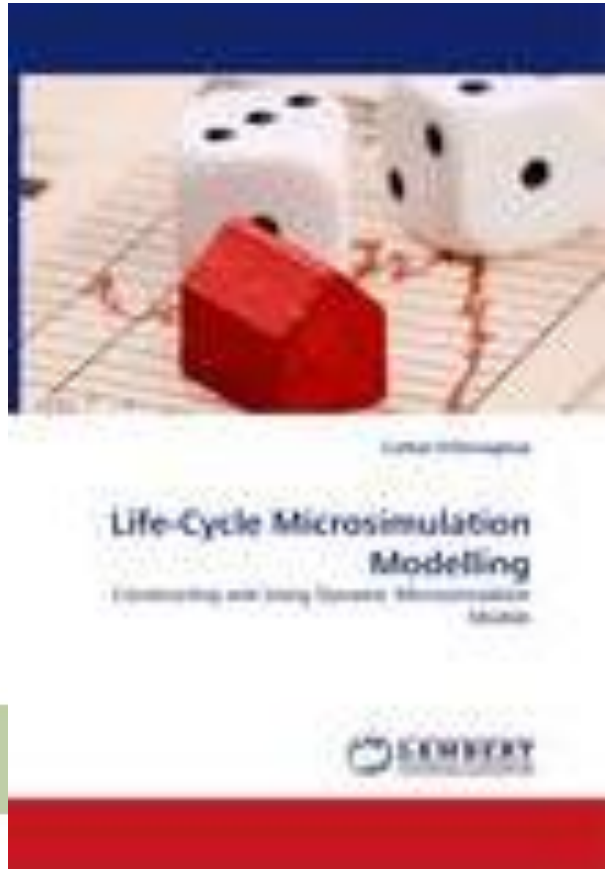
Sources of Complexity – Dynamic Models



Sources of Complexity – Spatial Models



Dynamics



Issue

- Temporal Dimension important because
  - Policy Changes over time
  - Different market conditions
  - Underlying population changes – Ageing
  - Dynamics and Mobility
  - Policies that depend upon life-cycle attributes
  - Period of Analysis – Lifetime distribution quite different to current or annual

Issue

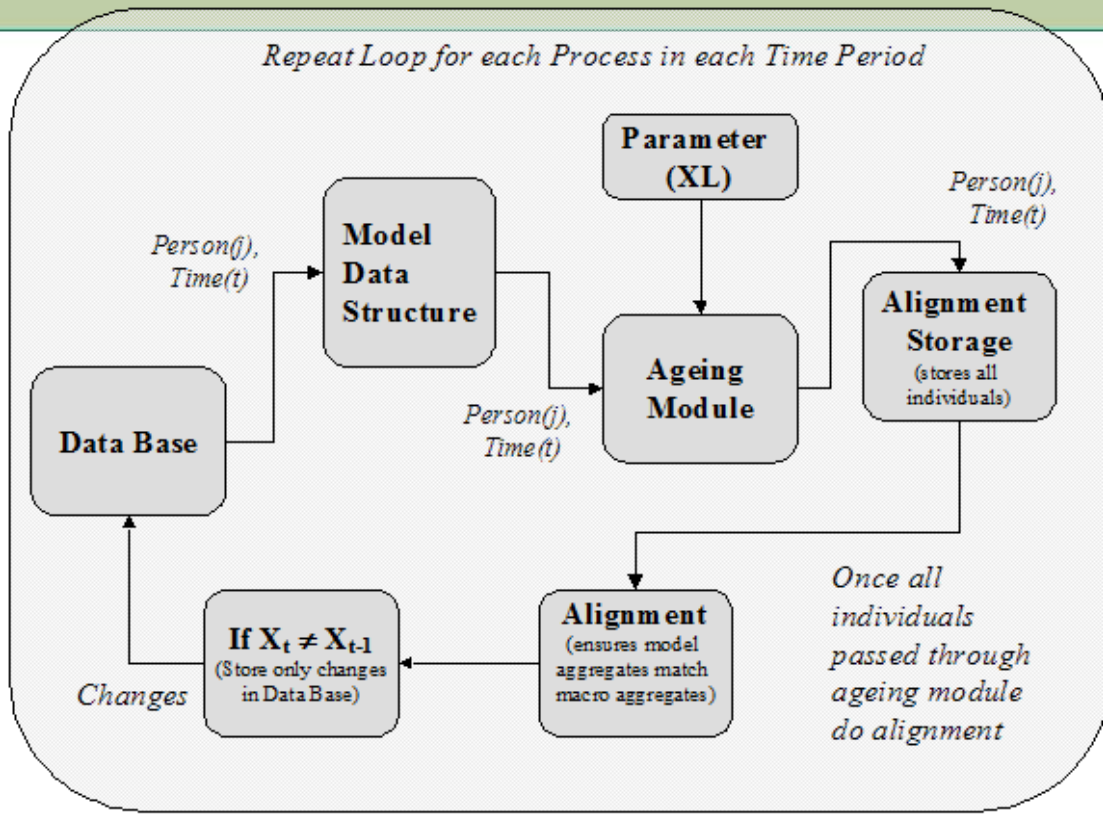
- Many EU wide cross-cutting problems
  - Ageing
  - Social Exclusion and Poverty
  - Public Finance Cost of Ageing
  - Implications for Mobility of Work of Social Insurance Pension Systems
  - Behavioural Change
- EU role in monitoring Eurozone public finances
  - Pensions and Social Insurance are very important components

Ageing and Reweighting

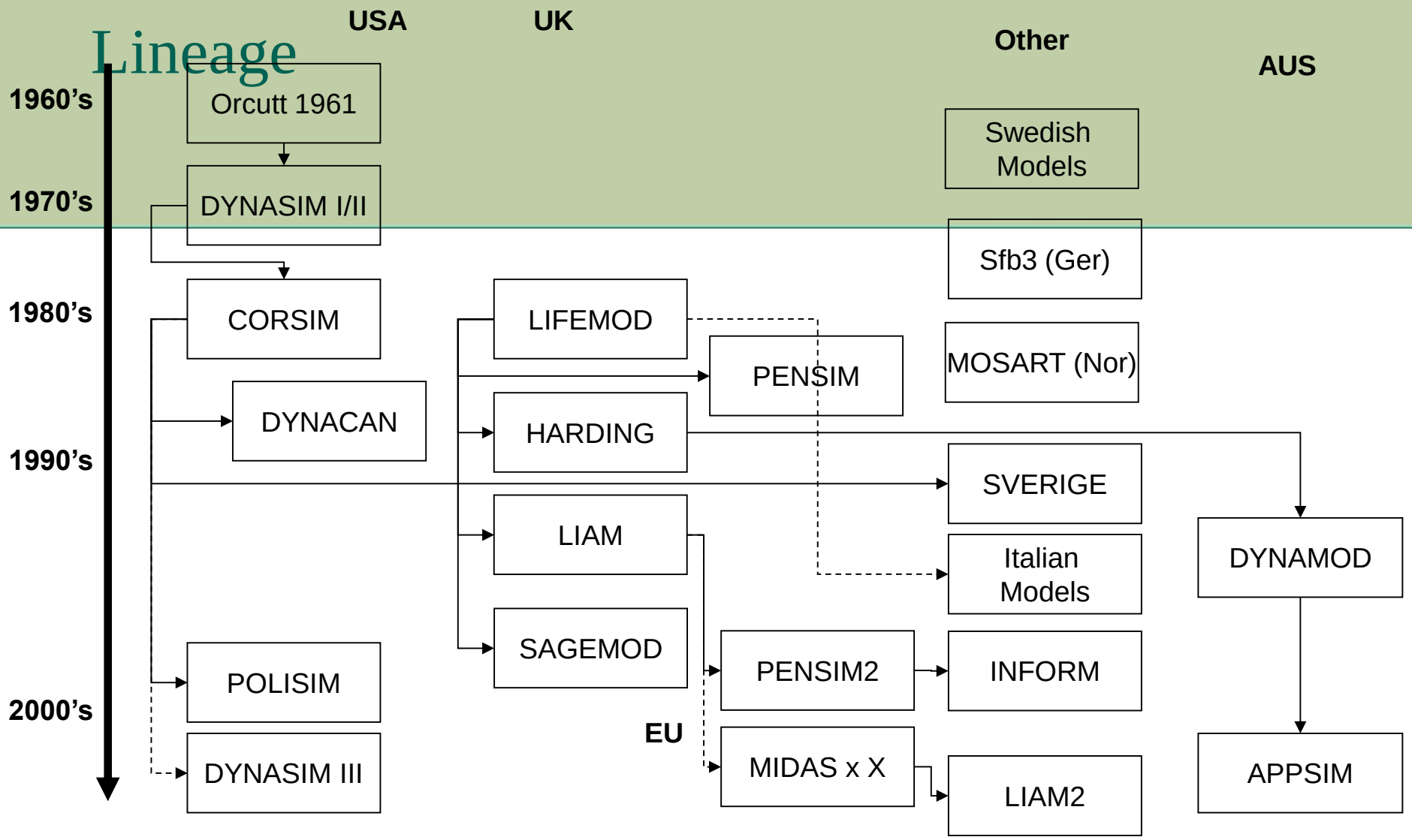
- Dynamic – Ageing (Longitudinal)
  - System of Equations (j) that simulate labour market and demographic characteristics, incorporating individual transitions $Y_{ijt} = (BX_{ijt} + u_{ij} + v_{ijt})$
- Dynamic – Ageing (Cross-sections)
  - System of Equations (j) that simulate labour market and demographic characteristics, for cross-sections $Y_{ijt} = (BX_{ijt} + e_{ijt})$
- Static – Ageing
  - Reweighting the Data to correspond to control totals

Dynamic Microsimulation

- Takes a system of equations – age individuals over time
- Sometimes constrain to external totals

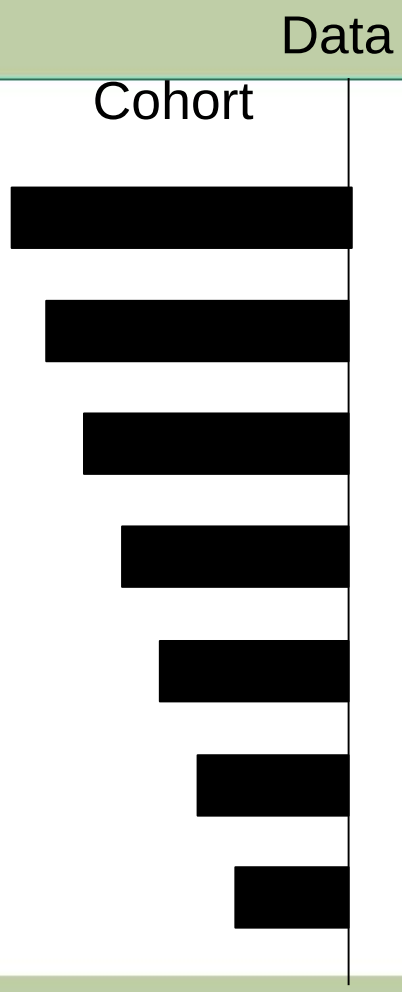


Lineage


USA
UK
Other
AUS
1960's
1970's
1980's
1990's
2000's
Orcutt 1961
DYNASIM I/II
CORSIM
DYNACAN
POLISIM
DYNASIM III
LIFEMOD
PENSIM
HARDING
LIAM
SAGEMOD
EU
PENSIM2
MIDAS x X
Swedish Models
Sfb3 (Ger)
MOSART (Nor)
SVERIGE
Italian Models
INFORM
LIAM2
DYNAMOD
APPSIM

Spectrum of Analyses

- **Simulating entitlement of time-dependent benefits in a single year**
- Nowcasting
- Simulation of single cohort over a full-lifecycle
- Simulating full cross-section over time
- Simulating Inter-generational and Intra-Generational impacts
- Simulating behavioural responses to these instruments



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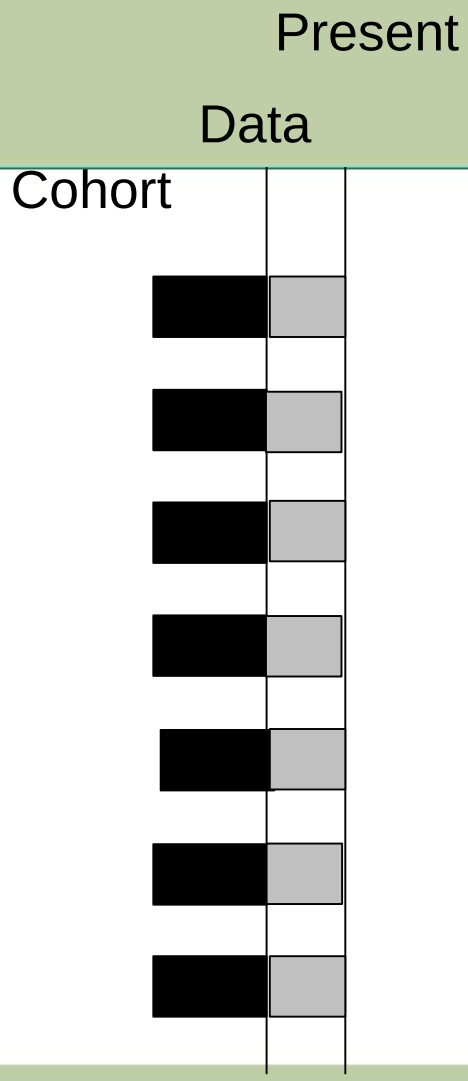

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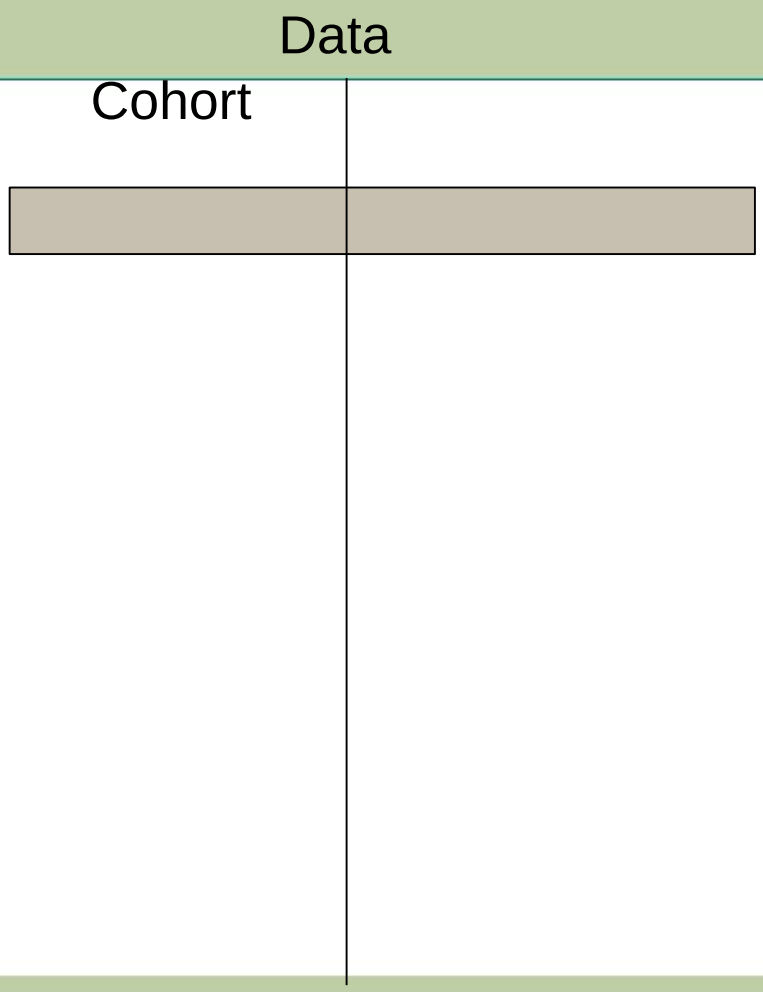

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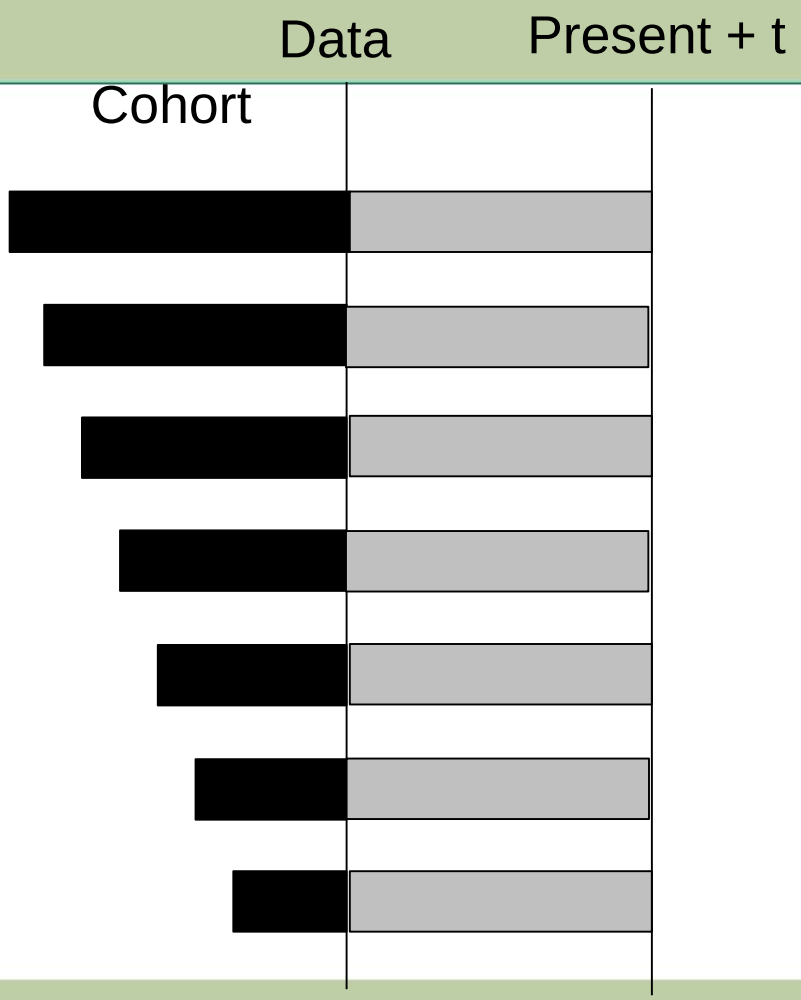

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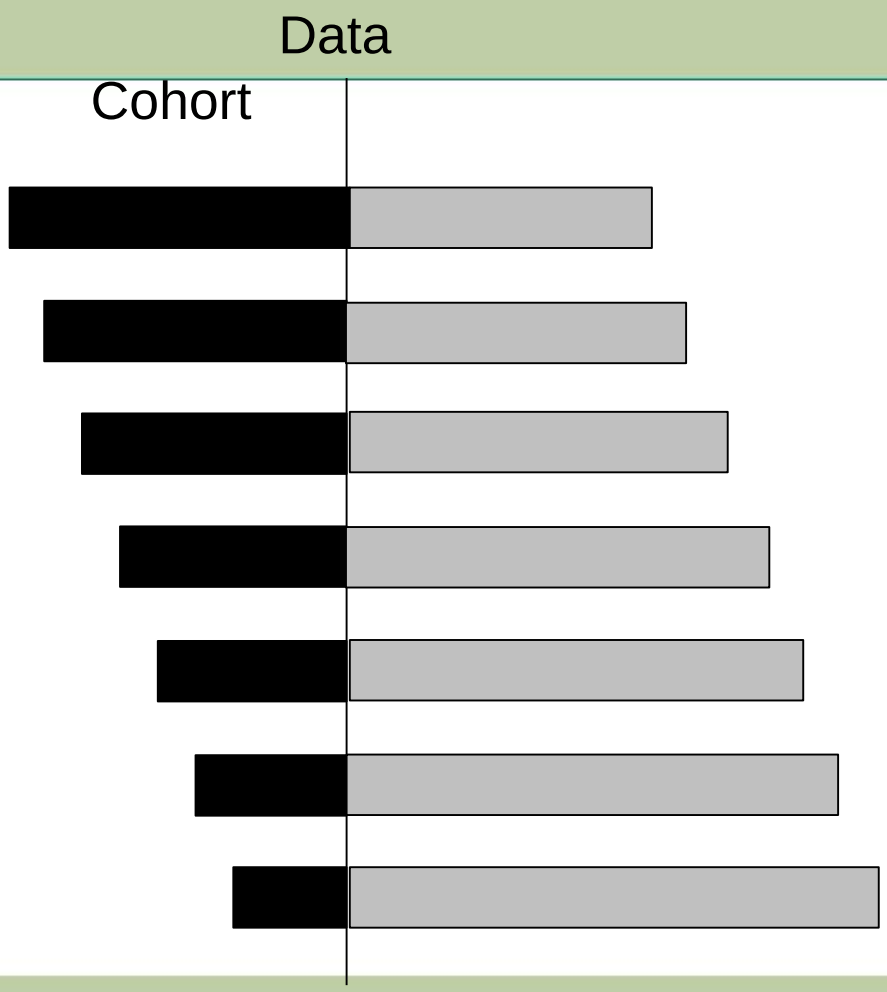
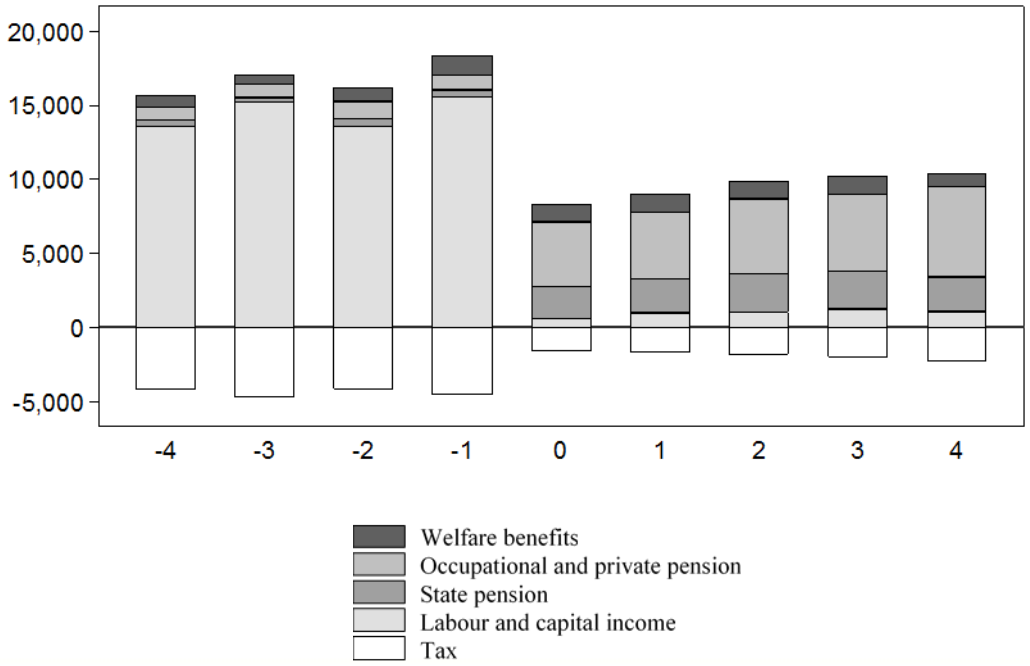


Simulating entitlement of time-dependent benefits in a single year

- Long-term historical dataset (typically administrative) allows for eligibility conditions to insurance benefits
- Li and O'Donoghue (2012) backcasted using retrospective labo market experience sufficient information to model current pensi
- Percentage of correctly Simulated Eligibility

Pension Type	*Correctly Simulated*
Contributory State Pension	96.08%
Occupational Pension	98.25%
Private Pension	97.36%

- Individual Income Change Before and After Retirement



NUI Galway
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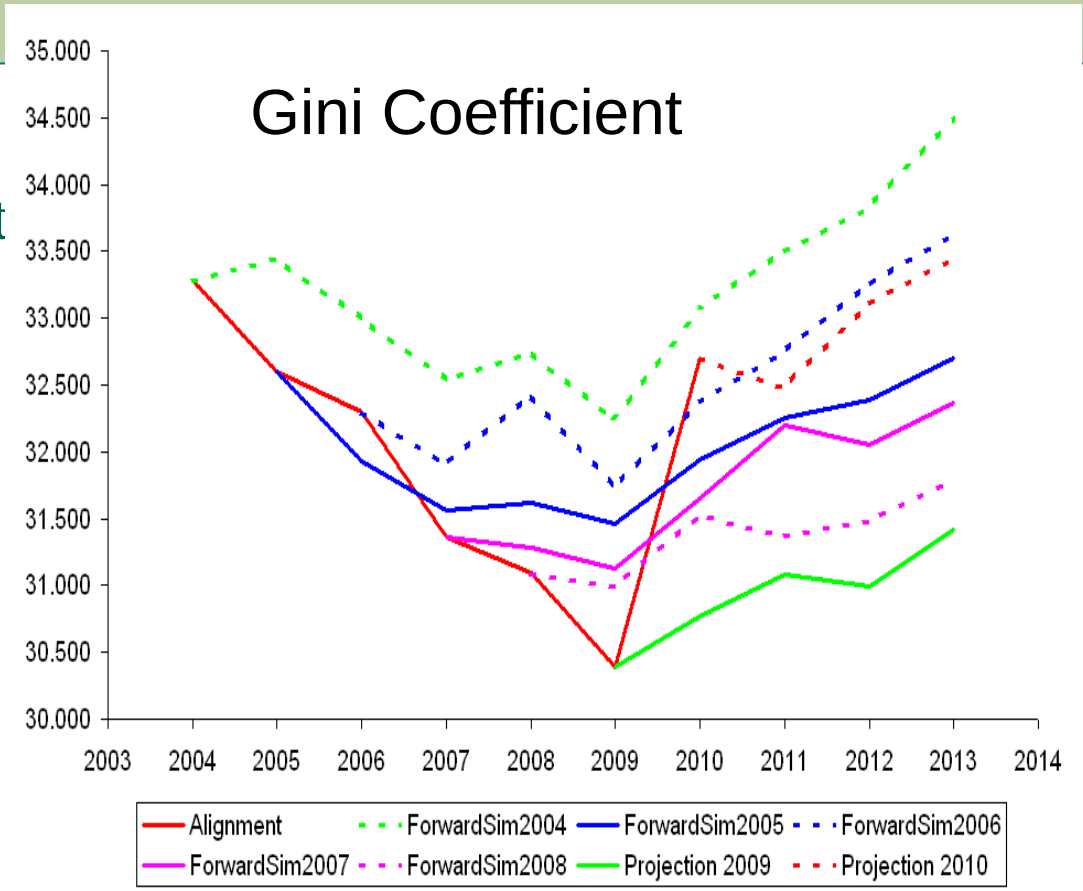
Li, J., & O'Donoghue, C. (2012). Simulating histories within dynamic microsimulation models. *International Journal of Microsimulation*, *5*(1), 52-76.

Example: Nowcasting

- Simulate historical distributional surveys to t present

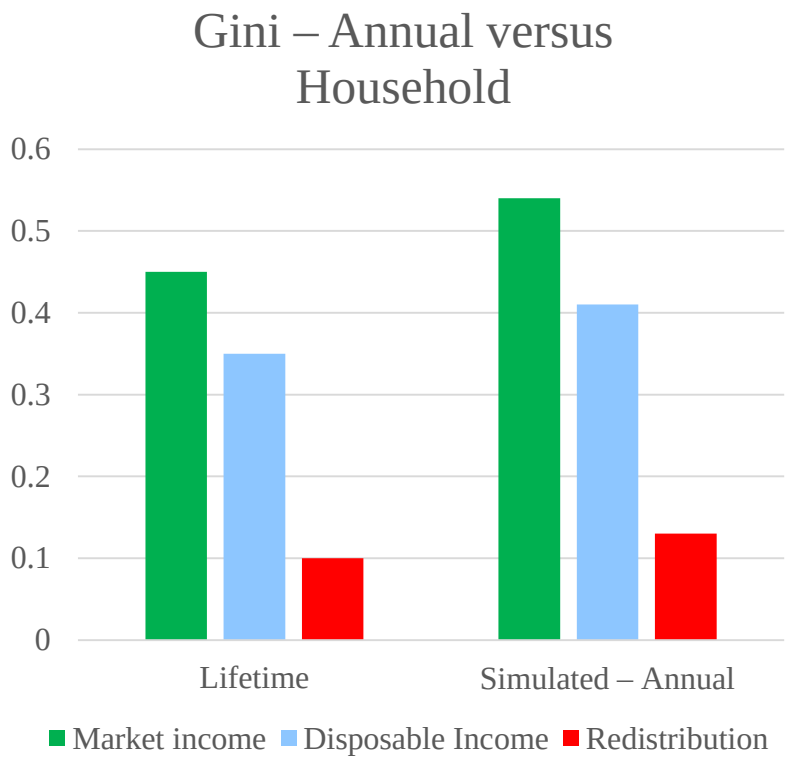


O'Donoghue, C. (forthcoming). Nowcasting in microsimulation models: A methodological survey. Journal of Artificial Societies and Social Simulation, 17(4), 12.

Example: Simulation of single cohort over a full-lifecycle

Av. Change in Inequality due to components

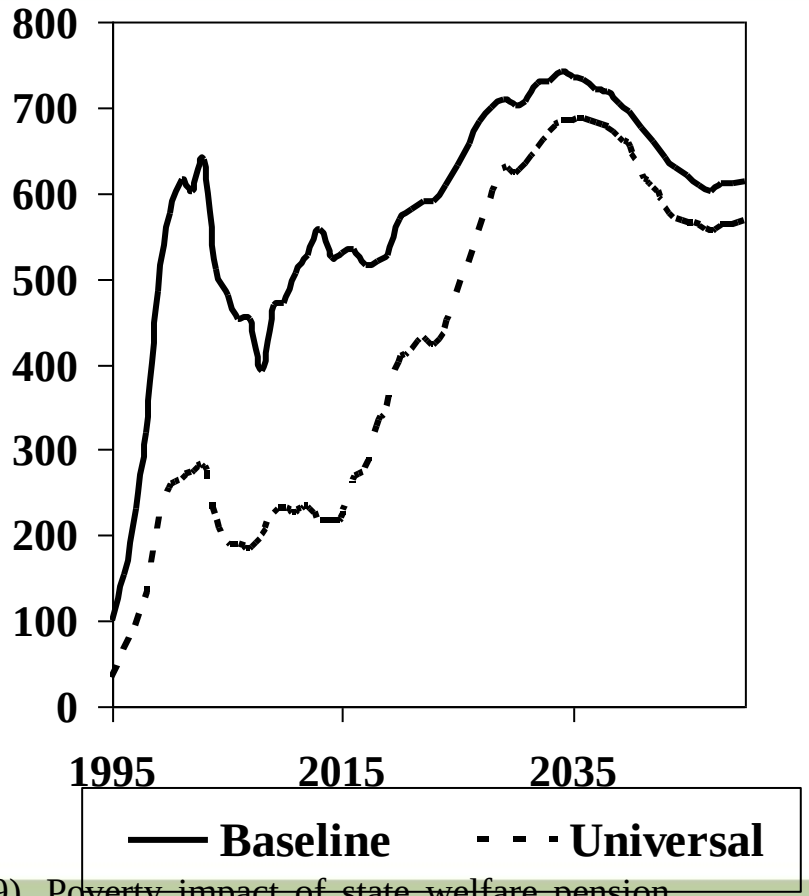
- Annual versus Lifetime Redistribution for a single cohort



O'Donoghue C., 2002, "Redistribution over the Lifetime in the Irish Tax-Benefit System: An Application of a Prototype Dynamic Microsimulation Model for Ireland", *Economic and Social Review*, Vol. 32, No. 3.

Example: Simulating full cross-section over time

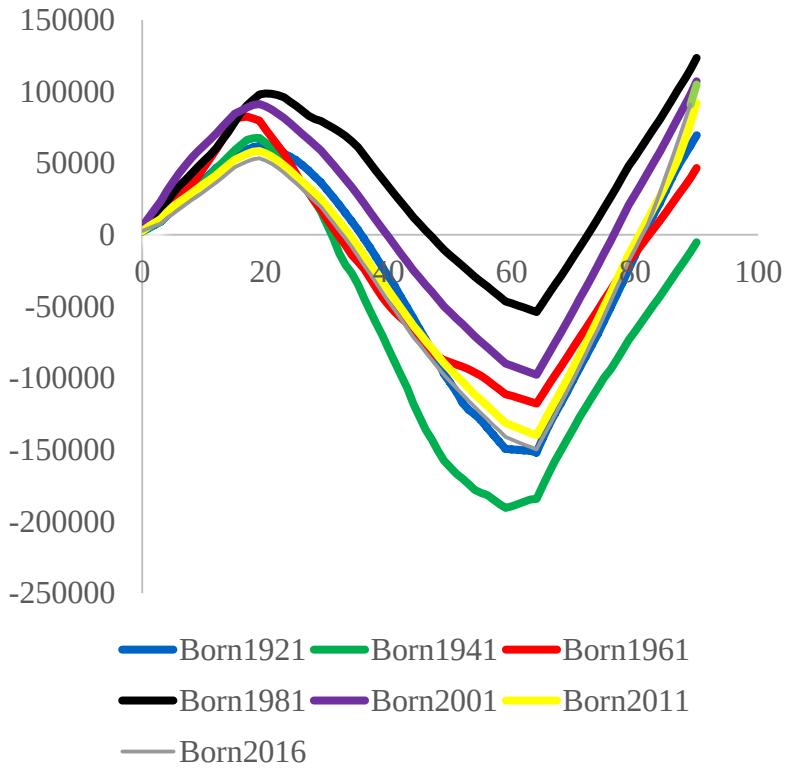
- Simulation of pensioner poverty over time for existing and universal pension plan



94.Baroni, E. & O'Donoghue, C. (2009). Poverty impact of state welfare pension reform on the elderly: An analysis of the reform proposals in the 2007 Irish Green Paper (Research Report No. 09/09). Retrieved from Combat Poverty Agency website: http://www.combatpoverty.ie/publications/workingpapers.htm

Example: Simulating Inter-generational impacts

- Cumulative net gain from welfare state by generation over lifetime



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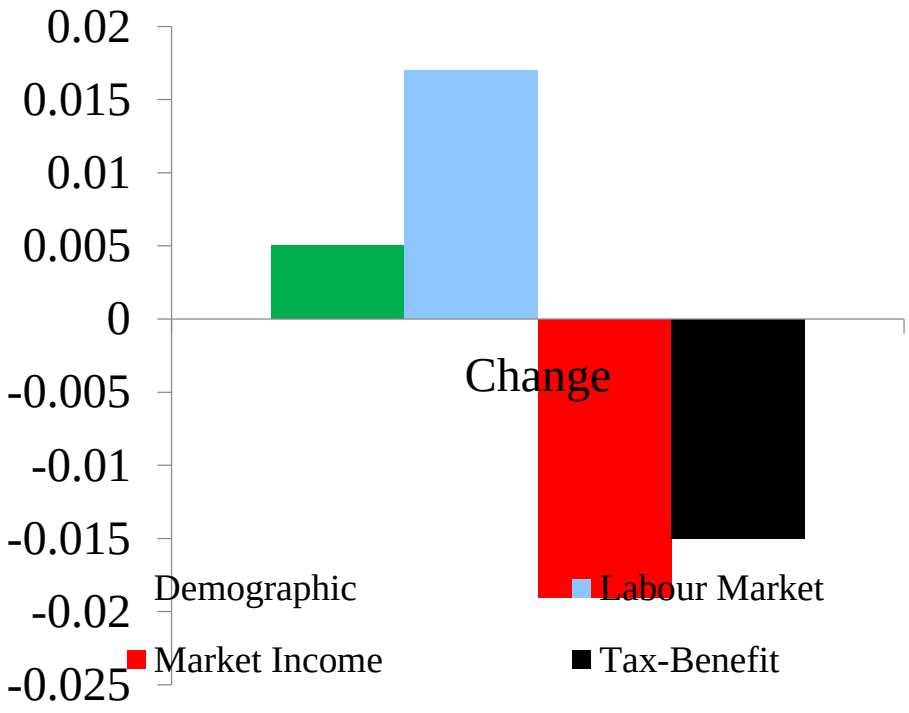
OÉ Gaillimh

O'Donoghue C., 2002. The Generation Game: All Gain No Pain? Ageing, Intergenerational Equity and Generational Accounts. *Journal of the Statistical and Social Inquiry Society of Ireland*, Vol. XXX. (Updated)

Example: Decomposing Change in Inequality 2007-2012

Av. Change in Inequality due to components

- Decomposing inequality changes into effects 2007-2012
  - Market Income and Demographic changes have been pushing inequality upwards
  - Labour market structure and policy have been pushing in the other direction



Example: Decomposition of Impact of Crisis between the UK and Ireland

	Pre-Crisis	Post Crisis
UK Gini	0.317	0.305
IE-UK Gini	-0.042	-0.034
MC	0.019	0.018
Returns	0.016	0.031
TB	-0.02	-0.052

- The cross-country differentials in disposable income have narrowed during the crisis compared to 2007,
- Due to a larger drop in inequality in the UK than in Ireland,
- Despite a widening gap in redistributive impact of TB system
- Due to a large increase in market income inequality in Ireland

Sologon, Van Kerm, O'Donoghue et al., (forthcoming)

How to Implement in EUROMOD

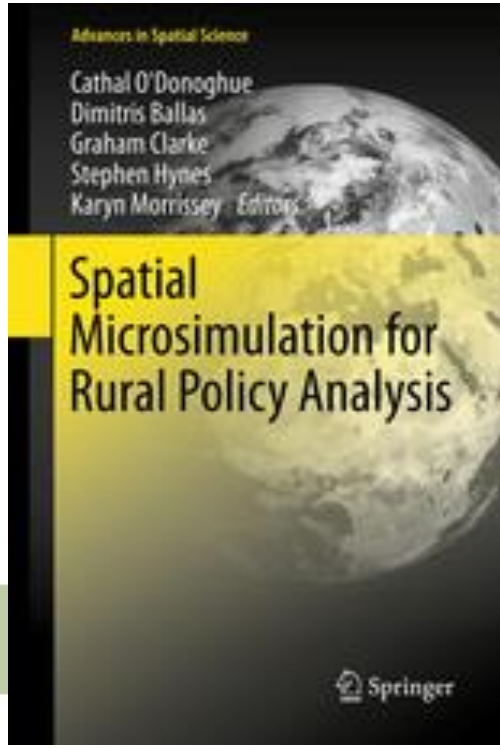
- It was one time...
  - The LIAM framework was built using the same algorithms and philosophy as EUROMOD –
  - Both have diverged LIAM2 and later EUROMOD
- Use dynamic microsimulation model to produce future panels
- Use EUROMOD to simulate policy
- Synergies in cross-country development

Philippe Liégeois and Gijs Dekkers (2009) Combining EUROMOD and LIAM tools for the development of dynamic cross-sectional microsimulation models : a sneak preview. in A. Harding, P Williamson and A Zaidi (eds.) *New Frontiers in Microsimulation Modelling*. Farnham: Ashgate.

How to Implement in EUROMOD

- However
  - Family not Household Unit of Analysis
  - Lack of comparative long-term panel data since ECHP
  - Relatively expensive

Spatial


Advances in Spatial Science
Cathal O'Donoghue
Dimitris Ballas
Graham Clarke
Stephen Hynes
Karyn Morrissey Editors
Spatial Microsimulation for Rural Policy Analysis
Springer

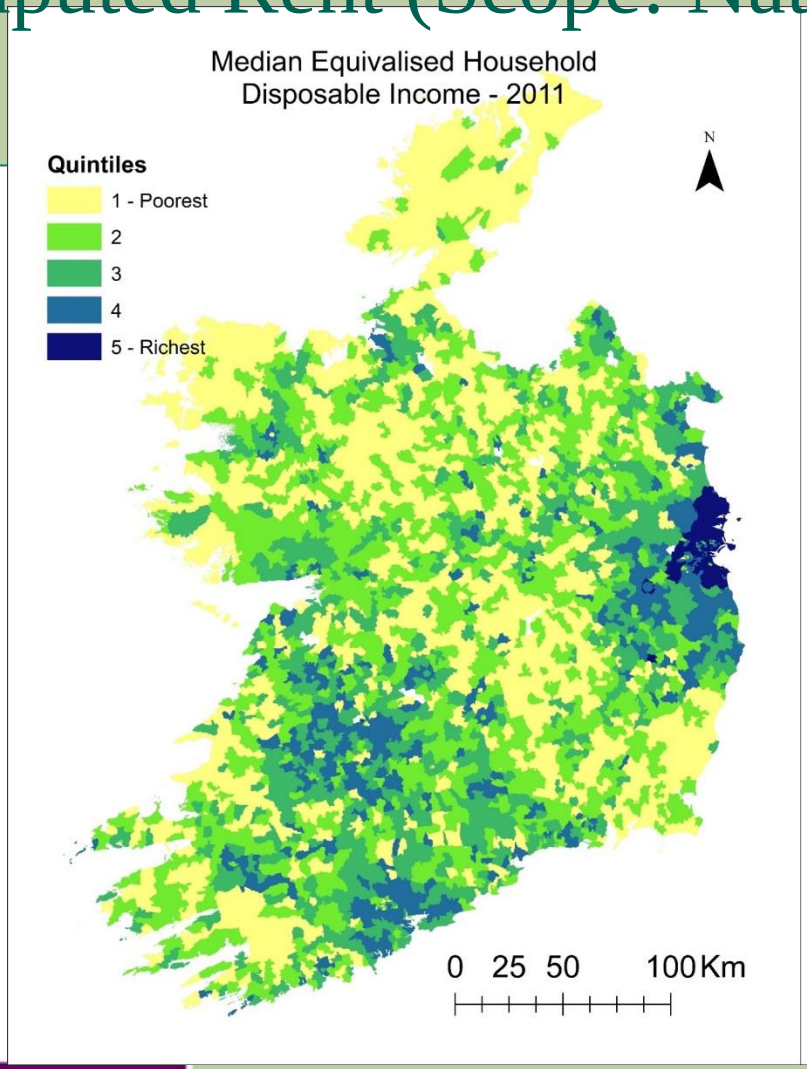
Issue

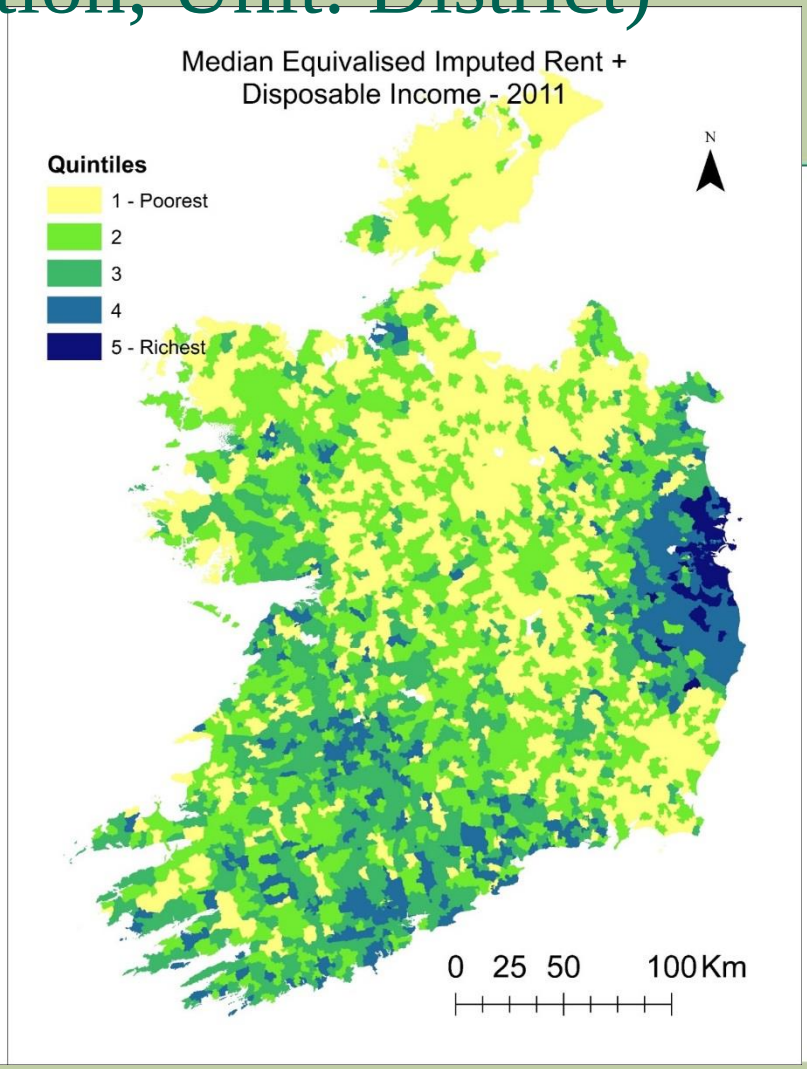
- Sub-national unit such as Region of particular interest to EU. Cohesion, Regional Development and Rural Development Policy
- Statistical method to generate spatially referenced data, combining small area Census Information and Household Micro Data
- Scope
  - National – NATSEM (Australia) SMILE (Ireland)
  - City – SimLeeds (Leeds); UrbanSim (Berkeley)
- Spatial Unit
  - Address
  - District
  - County/Region etc.

Issue

- Techniques
  - Statistical Matching in World Bank Poverty Mapping Literature linking Micro Income/Exp Survey Data to Census Micro Data
  - Reweighting to County control totals (Australia)
  - Simulated Annealing (Leeds)
  - Quota Sampling (Ireland)
- Issues with
  - Small Cell Sizes and Weights
  - “top 1%”

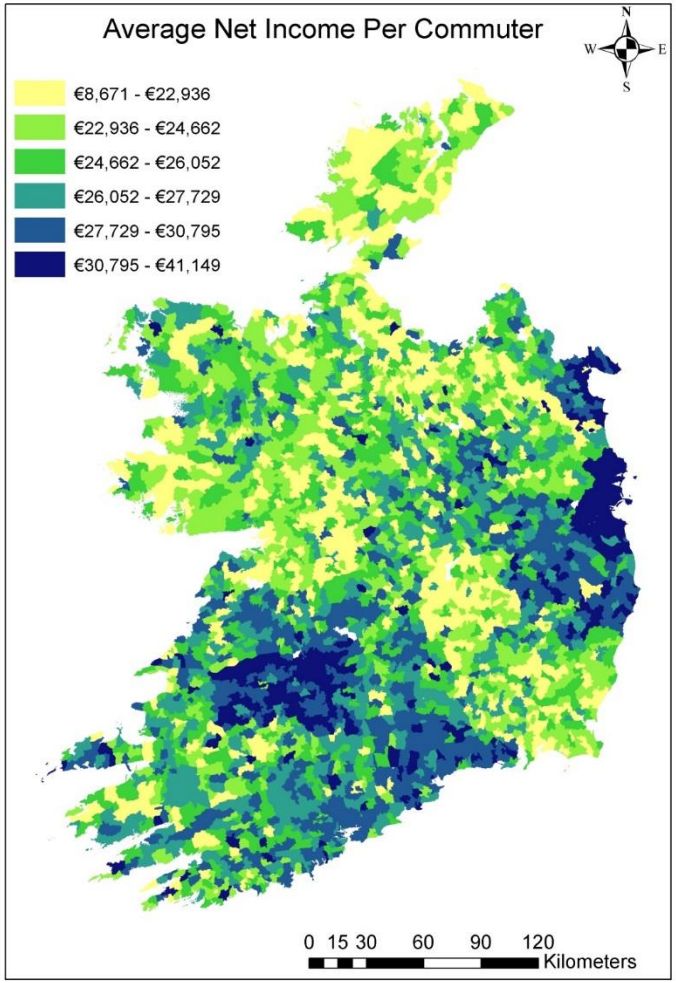
Example Analysis - Improving Income Quality – Imputed Rent (Scope: Nation; Unit: District)

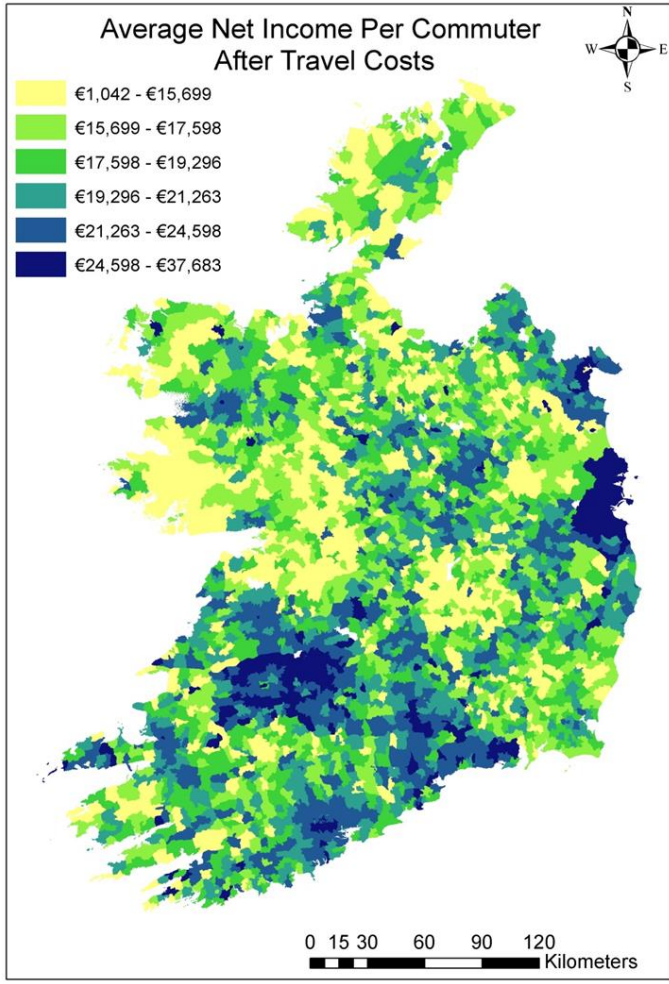




Kilgarriff, Paul, Martin Charlton, Ronan Foley, Cathal ODonoghue The Impact of Housing Consumption Value on the Spatial Distribution of Welfare, *Journal of Housing Economics*.

Example Analysis - Improving Income Quality – Commuting Cost (Scope: Nation; Unit: District)

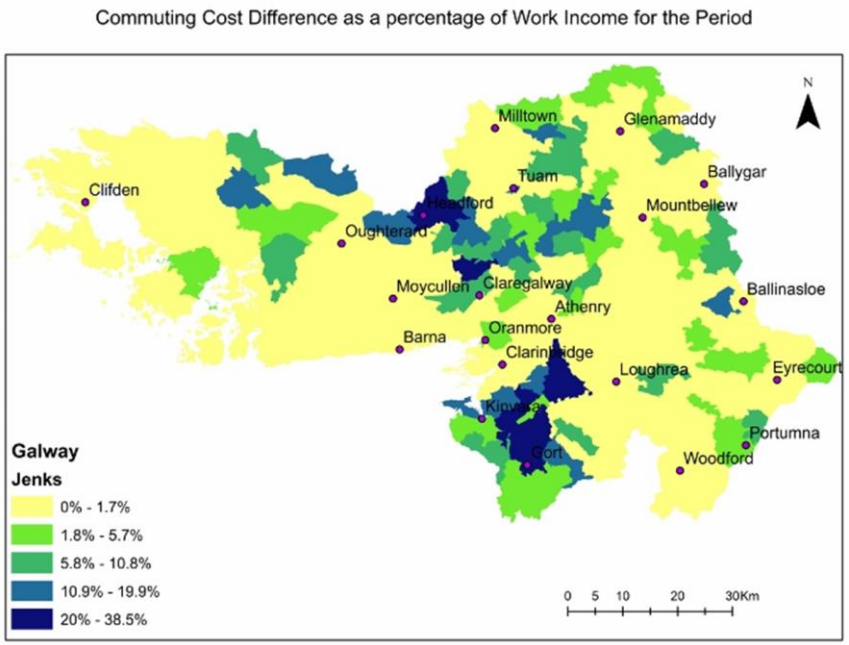




Vega, A., Kilgarriff, P., O'Donoghue, C., & Morrissey, K. (2016). The spatial impact of commuting on income: a spatial microsimulation approach. *Applied Spatial Analysis and Policy*, 1-21.

Example Analysis -– Flood Impact (Scope: County; Unit: District)

- Direct and Indirect household impacts of Storm Desmond
- County Galway



Kilgarriff, Paul, Thomas McDermott, Amaya Vega, Cathal O'Donoghue, Karyn Morrissey. "The impact of a flooding disruption on the spatial distribution of commuter's income". *Journal of Environmental Economics and Policy*.

How to Implement in EUROMOD

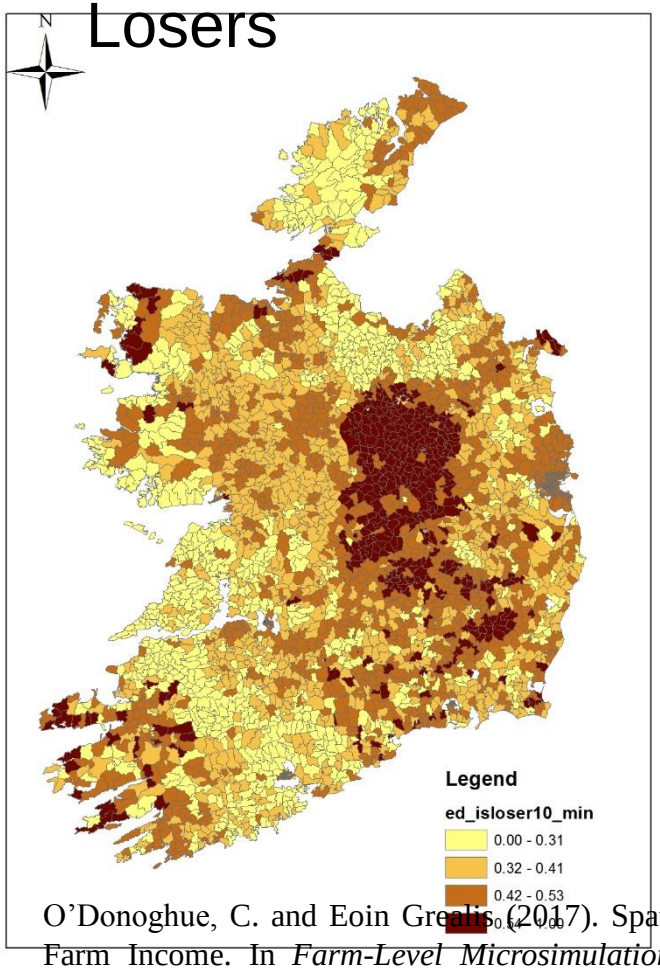
- EUROMOD is already a Spatial Microsimulation Model
  - Scope European Union
  - Spatial Unit – Country (Region)
- To disaggregate Spatial Unit Further
  - Source Small Area Census constraint Data or micro data
  - Select Reweighting, Re-sampling or Statistical Matching as appropriate to “spatialize” EU-SILC.
  - E.g. NATSEM, SMILE

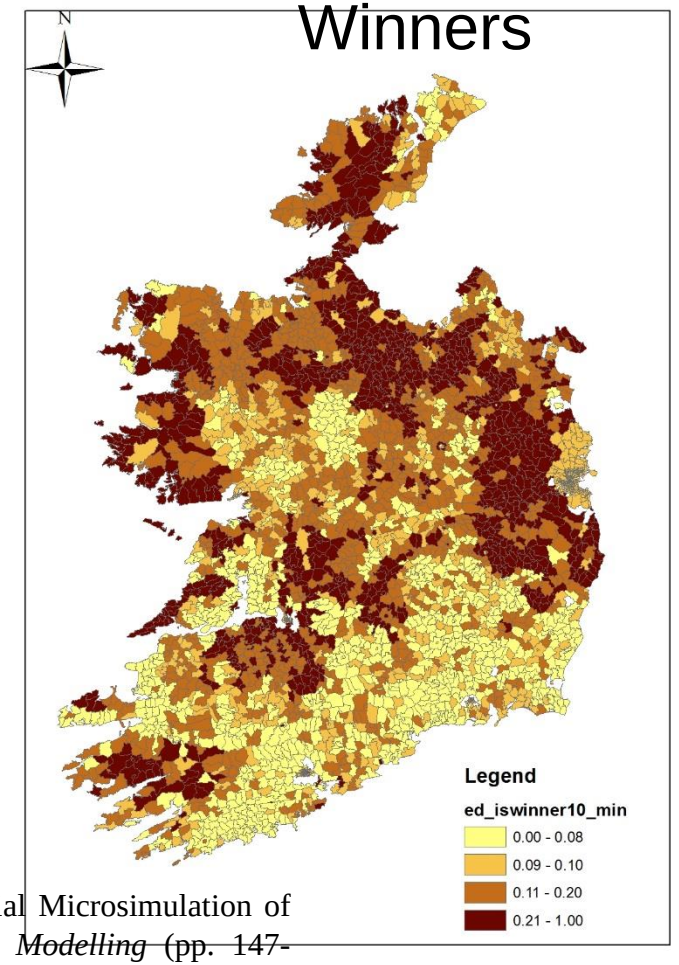
Unit of Analysis

Issue

- Farm Unit of Analysis
- Agriculture and Food
  - EU Responsibility for policy
- Significant financial resources
- Large distributional dimension
- Policy driven industry
- Currently modelling mainly focuses on gross incomes
  - However general and farm specific MT benefits and taxation has major incentive implications

Example Analysis: Distributional Analysis of CAP Reform - Winners and Losers Analysis from post 2014 CAP analysis



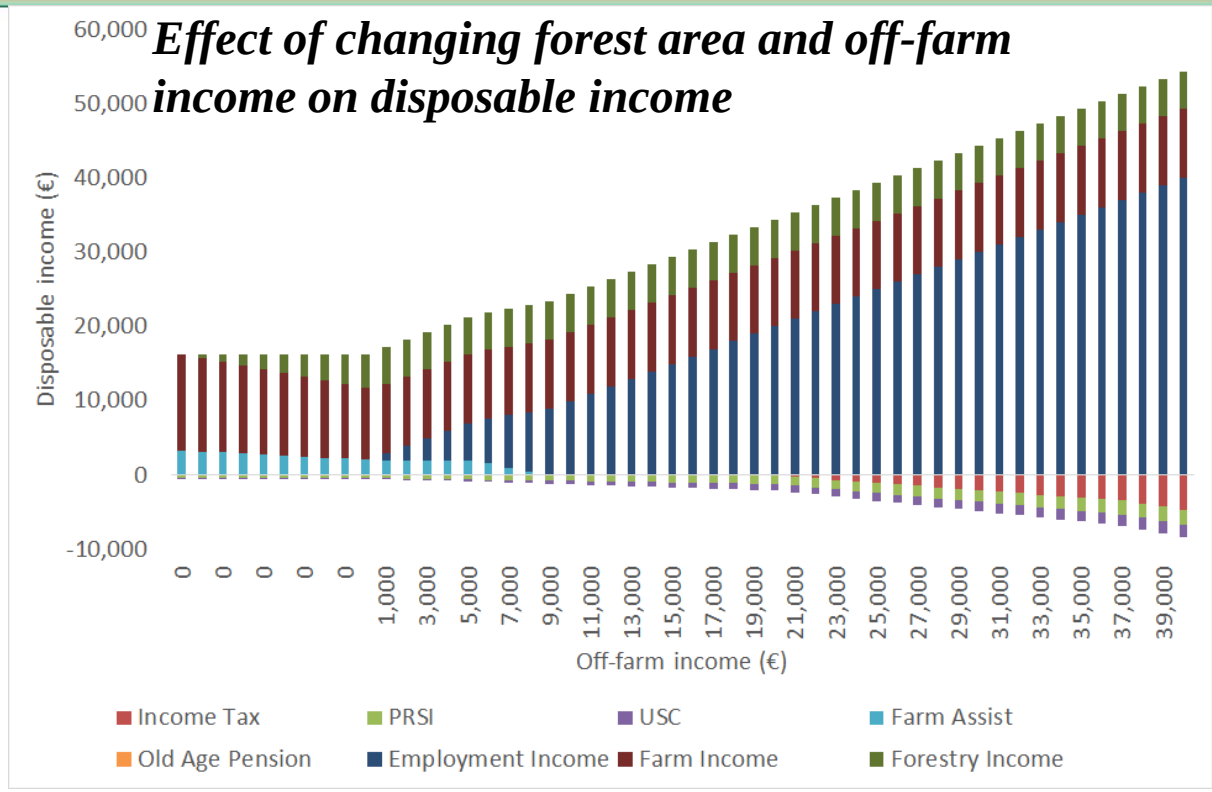


NUI Galway
OÉ Gaillimh

O'Donoghue, C. and Eoin Grealis (2017). Spatial Microsimulation of Farm Income. In *Farm-Level Microsimulation Modelling* (pp. 147-175). Palgrave Macmillan, Cham.

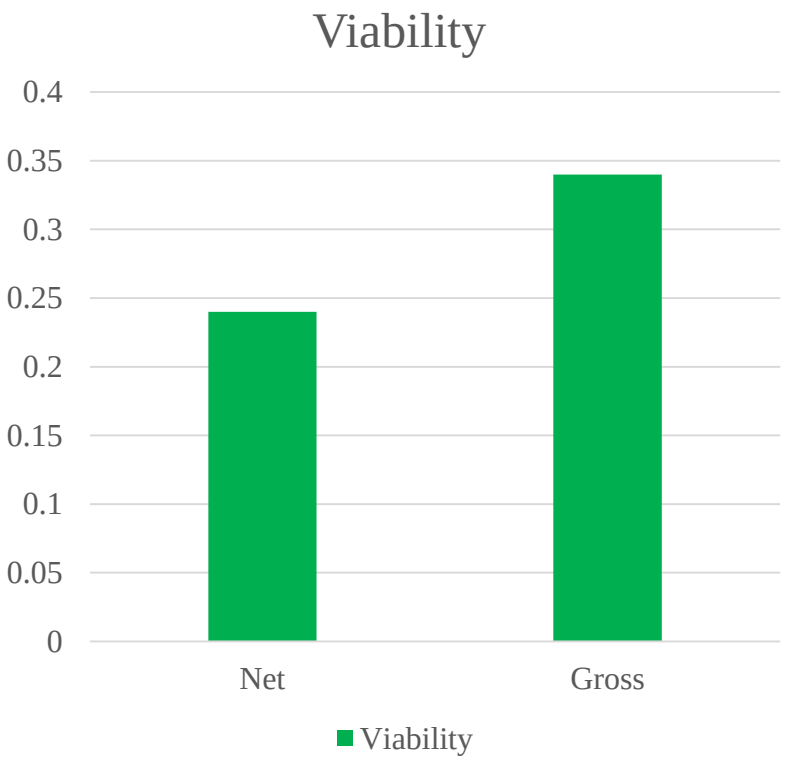
Example Analysis: Impact of Tax-Benefit System on Policy Incentives

- Policies that aim to incentivise
  - Food security
  - Environmental Improvement
  - Land Use Change
- Severely impacted by means tested benefits



Example Analysis: Farm Household Viability

- Incorporating Tax and Benefits alter the level of viability (Farm income relative to working off farm etc)



How to Implement in EUROMOD

- DG-Agri collects comparable micro data (since the Treaty of Rome) on farm incomes and characteristics – FADN
- Contains data to simulate capital, investment deductions and other business taxes
- Need to statistically match to FADN data to Household Data (SILC) to do distributional and tax analysis, particularly in the case of joint taxation

Caution

- Move to increase complexity of models
- Complexity→ More costly, time consuming, harder to interpret
- All Models are wrong – some are useful (Box)
- KISS → Simpler may be better
- Just because we can do it doesn't mean we should
- Challenge is to have enough complexity to produce a Model that is Useful

Forthcoming

- Practical Microsimulation Modelling (Oxford University Press)