Evaluation of public policies
Lecture 2

François Bourguignon
Paris School of Economics
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Second part of chapter 1
dynamic micro-simulation, incidence analysis of public spending
1.c Example: the Euromod model

- Comprehensive tax-benefit model for EU-15 with maximum comparability of data, instruments and performances
- Most helpful instrument to study possible integration – or the difficulty of integration - of EU tax or social policies
- Euromod: Immervoll- Sutherland, 1998
Figure 1: The Effect of Taxes and Benefits on Incomes in Poor Households, 2001
Figure 2: The Child Poverty Rate in EU-15 in 2001, with and without Child-contingent Incomes, all Transfers, and all Transfers and Taxes

Child poverty is defined as the proportion of households with children below the national poverty line (50% of the national median of equivalized household incomes, using the square root equivalence scale). Source: EUROMOD; Corak at al (2005)
1.d Other applications and extensions

- Mortgage tax relief (requires data on mortgage/interest payments)
- Gender issues (requires within household allocation rules)
- Population changes (re-weighing subgroups, e.g. age groups)
- Pension reforms (in a static sense)
- Basic income
- Average vs. Marginal effective tax rates (redistribution vs. incentives) …
Limitations of static arithmetic microsimulation

• The basic assumption of no behavioral response (including evasion and take-up) and the limited information delivered by marginal effective tax rates

• Mixed bag of policy instruments: contributory vs. non-contributory benefits

• How to handle unemployment benefits and public 'Pay as You Go' type of pensions?

• What to do with the public good counterpart of taxes?

• Applies mostly to households: what about firms
2. Dynamic micro-simulation models

• Extension of static models to take into account life-cycle and insurance aspects of tax-benefit systems:
  – Pensions
  – Unemployment benefits
  – Health insurance
  – Child benefits
  – Divorce and separations (lone parents, ..)
Theoretical assumptions

• No behavioral response equivalent here to saying that all life-cycle events are purely exogenous.
• Practically, they are modeled as random events with exogenous probabilities
• Let $s_{it}$ be the 'status' of individual $i$ at time $t$, status being defined as: alive/not, married/not, employed/not, earning level, earning of spouse, number of children, ...
• A tax-benefit system (TB) may be represented as the following mapping of the welfare index, $y$, on status:

$$y_{it} = F_{TB}(s_{it})$$  \hspace{1cm} (1)
Theoretical framework (2)

• Dynamics is then represented by a transition matrix $M_{s\sigma}$ which describes the transition from a status to another. This matrix is in general assumed to be stationary:

$$N_{s,t+1} = \sum_{\sigma} M_{s\sigma} N_{\sigma,t}$$

(2)

where $N_{s,t}$ is the number of individuals in status $s$ at time $t$.

• Combining (1) and (2), it is then possible to figure out the evolution of the distribution of welfare, $y$, within the population, the effect of the tax-benefit system at each point of time on the instantaneous and lifetime welfare of individuals and on the budget.
Theoretical framework (3)

• Note that the redistribution system may be path dependent (example = pensions):

\[ y_{it} = F_{TB}(s_{it}, s_{it-1}, s_{it-2}, \ldots) \]  (3)

• Note also that status \( s \) should also include the matching of individual earnings when there is more than one potential earners in a household. The dimension of \( s \) may thus become extremely large, and the transition matrix, \( M \), too!

• Transition matrix specification \( M \) may be replaced by a \( m \)-dimensional stochastic process on \( s_{it} \).

• Note that in view of (3) the Markovian assumption behind (2) may not be very satisfactory.
Practical implementation

• Numerous examples of such models – more or less sophisticated
  • Simulation models of pensions
  • Implications of ageing and other changes in demographic structures of societies
  • ..

• Based on initial structure of the population along the dimensions of s and on observations, 'guesstimates' or arbitrary values of some coefficients of the transition matrix M.

• Computationally cumbersome in the past but much less of a problem today

An Example

DYNACAN, the Canada Pension Plan (CPP) Model

- Within government model, devt started 1994
- Base data is 1% census sample (200,000 people)
- Model concentrates on CPP
  - Demographics, labour market, disability, CPP contributions and benefits, now being expanded to include private pensions and income tax

From: Harding (2007)
http://www.canberra.edu.au/centres/natsem/publications?sq_content_src=%2BdXJsPWh0dHAIM0EIMkYIMkZhbmItYWwuY2FyymVycmEuZWR1LmF1JTNBNTwgJTJGbmbF0c2VtJTJGaW5kZXgucGhwJTNGbW9kZSUzRHB1YmxpY2F0aW9uJTI2cHVibGljYXRpb24IMOQxMDUxJmFsbD0x
Nature of Standard Results - 1

- **Size:** 1600+ tables and graphs
- **Scope:** Types include: Beneficiaries, Emerging beneficiaries, Contributors, Family impacts, Longitudinal Impacts
- **Substance:** Tables and graphics show --Average Impacts, Dispersions, Winners/losers, Aggregates, Gender mix, Distributions of sizes of impacts
Nature of Standard Results - 2

- **Longitudinally:** Multiple special interest groups -- e.g., ever-widowed, ever-single parent, immigrant
- **Breakouts:** age, gender, earnings level, marital status, benefit types (e.g., regular vs early retiree) or combinations
- **Foci:** Pre-tax impacts, after-tax impacts, and a reconciliation of the two
OPTION: Receipt Patterns for CPP Survivor Benefits
Emerging Beneficiaries: Benefit Decreases of Loser Beneficiaries for Age Group "65-69" (Post-tax)
Average Decrease in Benefits by Gender over Selected Years
Showing +/- One Standard Deviation about The Average

Source: This slide extracted directly from Morrison (2006)
Limitations

• Difficult to imagine that behavior is not responding not only in a given period but throughout the life-cycle.

• Savings, fertility, even life expectancy are affected by the degree of social protection and pension system.

• Yet, dynamic micro-simulation interesting to show the likely implications of tax-benefit systems due to exogenous changes in the structure of the population by status, s.

• Also interesting to study the intertemporal government budget constraint in Pay as You GO systems.
3. Evaluating the distributional effects of public spending

- From a redistributive point of view, tax-benefit systems seem to be negative sum games.

- This is because taxes cover the cost of numerous goods provided freely by the public sector (public goods or 'publicly provided private goods': education, health care, defense, justice, ...).

- When evaluating a tax increase aimed at financing an improvement or an extension in the quality of education, the analyst should consider both the welfare effect of the tax and how much education improved.
Delivery of public goods

- Reforms that increase the quality of service delivery without change in tax payments do increase welfare, an effect to be taken into account when evaluating public policies.
- It is to be expected that the beneficiaries of these policies will be the users of public services.
- Distributional impact of public spending depends on who the consumers of public services are.
Examples of distributional issues in the debate on public goods

- Free public university education benefits the top of the income distribution but is paid by the whole community
- Fear of the privatization of the health care system that would diminish its powerful egalitarian role
- Geographical distribution of public spending (police) on security
- Subsidizing opera houses,
- .....
How to evaluate public provision and financing of specific goods

• The distinction between the provision and the consumption side
  – The State may finance health care services provided by private agents, but it may also provide those services itself
  – The discussion of the 'voucher' system in education is equivalent to the State financing education supplied by private providers.
  – …

• What follows considers only the financing role of the government in these fields.

• Evaluation of reforms on the provision side will be examined later
a. Incidence analysis of spending on public goods

• Fundamental questions:
  – 'Value' of the goods provided or financed by the State:
    1. Willingness to pay approach: objective or subjective
    2. Accounting cost-side approach (National Accounts convention)

• In the first case, an issue is that of a possible aggregate discrepancy between cost and value

• In both cases, an important issue is that of who benefits from the public goods

• Most common solution to the welfare evaluation of public spending is to allocate total value according to consumption
Examples of incidence analysis of public spending: education in Malaysia

Table 4. Incidence of educational expenditures in Malaysia (1974)

<table>
<thead>
<tr>
<th>Distribution of income</th>
<th>Quintiles</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income shares (%)</td>
<td></td>
<td>5.8</td>
<td>9.9</td>
<td>14.7</td>
<td>21.4</td>
<td>48.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Standard incidence analysis</td>
<td></td>
<td>38.1%</td>
<td>20.0%</td>
<td>15.0%</td>
<td>9.0%</td>
<td>4.0%</td>
<td>10.2%</td>
</tr>
<tr>
<td>Gross benefit of schooling as a proportion of initial income</td>
<td>7.2%</td>
<td>10.8%</td>
<td>15.3%</td>
<td>21.1%</td>
<td>45.5%</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>

Source: Meerman (1976)
Examples of incidence analysis of public spending in education
(European countries, Callan, Smeeding and Tsanoglou, 2007)
Examples of incidence analysis of public spending in education
(European countries, Callan, Smeeding and Tsanoglou, 2007)

Graph 6. Relative mean transfer per capita

- **Relative mean transfer per capita: Primary**
- **Relative mean transfer per capita: Secondary**
- **Relative mean transfer per capita: Tertiary**
- **Relative mean transfer per capita: Tertiary (excl. stud. away)**
Examples of incidence analysis of public spending in education (European countries, Callan, Smeeding and Tsanoglou, 2007)
b) A missing dimension in incidence analysis of education spending: intergenerational effects

- Standard incidence analysis apparently consistent with the use of the envelope theorem in tax incidence (no behavioral response).
- But it misses the intergenerational nature of the budget constraint linked to educational expenditures:
  - Benefits of universal basic education accrue only to future generations.
  - But costs are incurred today, through increased taxation on current generations.
Justification of standard incidence analysis of educational spending with the 'dynastic model'

- **Dynastic model** (Barro & Becker 1989)

- **Objective:** each agent maximizes the discounted utility of self and descendents

\[
\text{Max } \sum_{t=0}^{\infty} u(c_t). (1 + \rho)^{-t}
\]

- **Budget constraint:**

\[
b_{t+1} = (1 + r)\cdot b_t - c_t + (w_t - T_t)
\]

where \(b_t\) is bequest (human and financial capital) to generation \(t\), \(w_t\) is income with basic (universal) education of homogeneous quality, \(T_t\) is lump-sum tax
Intergenerational model (2)

• Result: Dynamics of wealth and consumption in a steady state (with $\rho=r$) are
  \[ c_t = c^* = r.b_0 + (w - T) \quad b_t = b_0 \quad \text{for all} \ t \geq 0 \]
  – So the \textit{optimal consumption path gives same consumption for all generations}

• Now assume that government improves \textit{education quality}:
  – Improvements are financed by an \textit{additional tax} ($\tau$)
  – Increase in human capital $\rightarrow$ greater productivity increases wage of \textit{future} generations by $\omega$
Result:

\[ c_t = c^* = r b_0 + (w - T) + \left( \frac{\omega}{1 + r} - \tau \right) \text{ for all } t \geq 0; \quad b_t = b_0 - \left( \frac{\omega}{1 + r} - \tau \right) \text{ for all } t > 0 \]

- Interpretation:
  - All generations share equally the discounted increase in revenue
  - Current generation borrows to increase its consumption, while future generations will have to repay out of their increased incomes
  - Alternatively, current generation will bequeath less to its children
  - If education improvement is actuarially neutral, then \( c_t \) is unchanged (for homogeneous agents)
What standard incidence analysis does

• Ignores the financing (τ)
• Consider only the current generation taken to reproduce itself identically ad infinitum
  – With "willigness to pay":
    \[ c_0 = r \cdot b_0 + (w - T) + WTP \]

Is WTP the same as \( \omega/(1+r) \)?
  – With cost:
    \[ c_0 = r \cdot b_0 + (w - T) + \tau \]

  – When taking into account financing (tax), redistribution takes place from those households without (or a few) children to those with (or many) children.
Limitations

- Dynastic model predicts a **Ricardian equivalence**
  - Parents reduce their bequests to pay current taxes that are financing higher incomes of their children

- *But in practice, improving education quality may be costly to poorer parents* – even if their children benefit – due to:
  1. Imperfect capital markets (they cannot borrow and leave no bequest to their children anyhow)
  2. Inefficiencies of spending (interacting with availability of private-sector alternatives)
  3. Financing takes place through taxes that will be shared with the poor households
Limitations (2)

- Direct and opportunity cost of education
- Missing behavioral response = private/public schooling choice
  - Quality rise in schooling (or lower direct cost) increases number of students in public schools
  - With constant capacity, this should have a negative impact on quality (general equilibrium effect)
  - Quality and capacity should be increased at the same time
Final remarks on evaluating public spending

- Other examples of application include health care, (especially in the case of non-universal systems as in developing countries), infrastructure, etc...

- Other side of evaluation of public goods is about the efficiency of the provision of these goods – particularly in health care

- This includes incentives to civil servants, regulation of providers, etc... (public choice approach).
References chapter 1


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Chapter 2
Behavioral micro-simulation models: the case of labor supply

François Bourguignon
Paris School of Economics
M2-PPD, M2-APE, 2009-10
Introduction

• "Behavioral": behavioral response of agents is taken into account in the evaluation of policies

• Policies being evaluated: mostly those which modify the budget constraint of agents: taxes and benefits, some public goods

• Nature of the behavioral response that is taken into account: labor supply, schooling demand, consumption/saving behavior, factor combination in firms etc...

• This chapter focuses on labor supply by households, an issue which has received considerable attention.
Outline

1. The case of labor supply
   a) The problem of the non-linear budget constraint
   b) Simple linear approaches
   c) Continuous non-linear rational models
   d) Discrete non-linear models
   e) Example: the WFTC in UK

2. The case of child labor and the demand for schooling in developing countries
   Example: the Bolsa Familia program in Brazil

3. Other types of behavior
1. Modeling labor-supply behavior under non-linear budget constraints

The standard labor-consumption model

\[ L = \text{labor} \]

\[ C = \text{Consumption} \]

Wage rate

Indifference curve

Budget constraint

\[ L^* \]

\[ L = \text{labor} \]
a) Labor supply under non-linear budget constraint

Non-linear budget constraint due to tax-benefit system
Types of equilibrium with non-linear budget constraint

- \( C = \text{Consumption} \)
- \( L = \text{Labor} \)
- \( W = \text{Wage rate} \)
- Guaranteed minimum income
- Indifference curves
- Budget constraint
- Wage rate

\( L^* = 0 \)
b) Estimating labor-supply behavior: limitation of the linear model

- Modeling labor supply with linear model estimated on a sample of households (individuals): \( w = \text{wage rate} \)

\[
L_i = aw_i + b z_i + \varepsilon_i \quad (z, \varepsilon: \text{obs. and unobs. indiv. attributes})
\]

But tax-benefit policy is not explicit: policy simulation impossible
Some representation of the main policy parameters behind the budget constraint is needed

- Extending the linear model to take into account marginal tax rates \( t \):

\[
L_i = aw_i.(1 - t_i) + b z_i + \varepsilon_i
\]

Policy embedded in marginal tax rates. But endogeneity of \( t_i \) and circularity when simulating a change in policy.
c) Estimating labor-supply behavior with non-linear continuous models

- Solution to the preceding model is to explicitly model utility maximization behavior under the budget constraint:

$$\text{Max } u(C_i, L_i; z_i; \beta, \varepsilon_i) \quad s.t. \quad C_i \leq y_{0i} + w_i L_i - TB(y_{0i}, w_i L_i, L_i; z_i; \gamma); \quad L_i \geq 0$$

where $\beta$ and $\gamma$ are respectively preference and tax-benefit parameters, $y_0$ is non-labor income and $TB( )$ the net tax as given by the tax-benefit system (ref. micro-simulation). Solution of preceding problem writes:

$$L_i = F(y_{0i}, w_i; z_i; \varepsilon_i; \beta; \gamma)$$
Non-linear continuous models (2)

• Econometric estimation (minimizing the variance of the idiosyncratic term $\epsilon$ after linearization) yields estimates $\hat{\beta}$ and $\hat{\epsilon}_i$.

\[ L_i = F(z_i, w_i, y_{0i}; \hat{\beta}, \hat{\epsilon}_i; \gamma) \]

Simulating a reform in the tax-benefit system is then equivalent to modifying the set of parameters $\gamma$:

\[ L^s_i - L_i = F(z_i, w_i, y_{0i}; \hat{\beta}, \hat{\epsilon}_i; \gamma^s) - F(z_i, w_i, y_{0i}; \hat{\beta}, \hat{\epsilon}_i; \gamma) \]

\[ C^s_i - C_i = w_i(L^s_i - L_i) - TB(y_{0i}, w_i L^s_i, L^s_i; z_i; \gamma^s) + TB(y_{0i}, w_i L_i, L_i; z_i; \gamma) \]

where $L^s$ and $C^s$ are simulated values
Non-linear continuous models: limitations

• Pre-determined functional form of preferences (possibly leading to linear labor-supply functions, so that $F(\cdot)$ will be linear in $\varepsilon$).
• How to impose rationality through the $\beta$s?
• Econometric estimation difficult because of corner solution $L = 0$, angulous points, and non-convexity (Hausman, 1980, 1985; MaCurdy et al, 1990)
• Pre-determined functional form of $TB(\cdot)$ may be inadequate. Reforms of the tax-benefit system may not be limited to changes in a few parameters
• General case. $TB(\cdot)$ may have any functional form and simulated labor supply obtained from the maximization problem (1) under $TB(\cdot)$ function (with $\hat{\beta}, \hat{\epsilon}_i$ given)