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Determinants of MDG achievement

Cairo, 2-5 April, 2007

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Public policies for MDGs project

- **MAMS: Maquette for MDG Simulations.**
 - Economy-wide (dynamic CGE) simulation model to analyze MDG strategies in different countries.
 - Dynamic MDG module
- **Sector analysis of MDG determinants and of interventions** needed to achieve MDGs in education, health, water and sanitation
 - Microeconomic analysis of determinants of access to schooling, infant mortality, etc.
 - Costing exercise, considering household behaviour
- **Microsimulation methodology**
 - Translate labour market outcomes of CGE simulations into impact on poverty and income distribution at household level using micro datasets

Determinants of:

- MDG targets (from 1990 base year):
 - MDG-2: 100% primary school completion by 2015
 - MDG-3: Gender equality in access to education (primary and secondary by 2005 and all levels by 2015)
 - MDG-4: Reduce child mortality by two-thirds by 2015
 - MDG-5: Reduce maternal mortality by three-quarters by 2015
 - MDG-7: Halve proportion of people without access to drinking water and sanitation by 2015

Achieving MDGs

- No single route: country-specific determinants of MDGs
- Needs assessments and cost-effectiveness analyses
- Not just a matter of increasing public services in social sectors (i.e. more social expenditures)
 - Demand factors matter
 - Efficiency and quality of supply matters
 - Economy-wide effects

MDG determinants

- **What is needed to get all children in school and make them complete all grades?**
 - Build more school infrastructure?
 - Improve quality of other school inputs (teachers, textbook supplies)?
 - Increase access to school by improved household income and demand subsidies?
 - All of the above?
- **What is needed to reduce child mortality?**
 - Better nutrition?
 - Expansion of immunization programs?
 - Improving maternal-child health facilities?
 - Better education?
 - All of the above?
- **Are there synergies across the MDGs?**
- **What is the direct cost of interventions to achieve MDGs?**
- **Are there diminishing marginal returns to the inputs?**

Education – MDG2

- Target: 100% primary completion
- Identify actual determinants of access and graduation
- Use results in MAMS

Education in microeconomic studies of school enrolment

- Extended human capital model
 - Assess cost and benefits of going to school (or other schooling outcome)
 - Assess both supply and demand factors
- Costs:
 - Direct: tuition fees, books, uniforms, transportation, quality of teachers, test scores, health variables, etc.
 - Indirect: foregone earnings of child labour
- Benefits:
 - Addition to child's human capital and higher future earnings
- How these costs and benefits are assessed by individuals or households depends on:
 - **Demand factors:** household income, education level of parents, and so on.
 - **Supply factors:** physical accessibility to school, quality of school inputs (qualified teachers, test scores, pupil-teacher ratio, etc.)

Modeling education in MAMS

- Service measured per student in each teaching cycle (primary, secondary, tertiary).
- Model tracks evolution of enrollment in each cycle
- Educational outcomes (for each level, rates of: entry; pass, repeat, and drop out) as functions of a set of determinants
- MDG 2 (net primary completion rate) computed as product of 1st grade entry rate and primary cycle pass rates for the relevant series of years.

Education in MAMS

- Target: 100% completion of primary school
- What dependent variable(s)? Various!!
 - Probability of entering primary school (grd1entry)
 - Probability to graduate a given grade of primary education (grd),
 - Probability that students who completed one level of education (say, primary) will continue to the next (say, secondary) (grcont)
- The resulting parameter estimates enter a constant elasticity function defining student behaviour which determines the components of the primary completion rates (as well as the likelihood of continuing to the next level of education).
 - In MAMS this goes into an intermediate function which is then fitted into a logistic function (see equations 78 and 79) of model description

MAMS: Determinants of MDG outcomes

MDG	Service per capita or student	Consumption per capita	Wage incentives	Public infrastructure	Other MDGs
2-Primary schooling	X	X	X	X	4
4-Under-five mortality	X	X		X	2,5,7a,7b
5-Maternal mortality	X	X		X	2,4,7a,7b
7a-Water	X	X		X	
7b-Sanitation	X	X		X	

REQUIREMENTS OF THE MAMS MODEL FOR EDUCATION WITH RESPECT TO PARTICULAR VARIABLES

MDG	Variables for which an elasticity must be given					
Grade 1 entry	Household consumption per capita	Stock of other infrastructure capital	Indicator of education quality in each cycle	Wage premium for those with secondary education compared to those with less than secondary education		MDG4, Child mortality rate
Graduates from year of primary education	Household consumption per capita	Stock of other infrastructure capital	Indicator of education quality in each cycle	Wage premium for those with secondary education compared to those with less than secondary education		MDG4, Child mortality rate
Graduates from year of secondary education	Household consumption per capita	Stock of other infrastructure capital	Indicator of education quality in each cycle	Wage premium for those with secondary education compared to those with less than secondary education		MDG4, Child mortality rate
Graduates from year of tertiary education	Household consumption per capita	Stock of other infrastructure capital	Indicator of education quality in each cycle	Wage premium for those with tertiary education compared to those with secondary education		MDG4, Child mortality rate

How to estimate?

Econometric specifications

- Probability model of different forms (MNL, logit, probit)
 - Probability of attending school given socio-economic conditions of household, individual characteristics (gender, ethnicity, nutrition) and quality of supply inputs
 - MNL if there is a choice between, say, private and public education
- Proportions model: estimate rate of enrolment or graduation rate directly
 - Logit quasi-maximum likelihood methodology (OLS not appropriate)
 - Estimate proportions, e.g. across provinces, municipalities or districts. You may lose some variability

Data requirements

- Household survey data
- Education input data (administrative records, special surveys)

Ecuador - Logit model	Marginal effect	Elasticity	p-value
Prob of primary enrolment (grdentry)			
Consumption per capita	0.00000046	0.126	0.001
MDG4	-0.00004750	-0.035	0.166
Education quality (services)	0.00077250	0.111	0.143
Public Infrastructure	0.18224220	0.162	0.023
Wage premium (W_2 / W_1)	0.03375350	0.059	0.193
Prob of graduating primary (grdp)			
Consumption per capita	0.00000012	0.030	0.005
MDG4	-0.00001930	-0.013	0.169
Education quality (services)	0.00036280	0.050	0.052
Wage premium (W_2 / W_1)	0.02430020	0.041	0.027
Prob of continuing to secondary (grdcons)			
Consumption per capita	0.00000027	0.087	0.000
MDG4	-0.00002670	-0.019	0.157
Public Infrastructure	0.10860630	0.086	0.048
Wage premium (W_2 / W_1)	0.02436420	0.034	0.119
Prob of continuing to tertiary (grdcont)			
Consumption per capita	0.00000017	0.097	0.148
Public Infrastructure	0.74773540	0.821	0.016
Wage premium (W_3 / W_2)	0.06347780	0.203	0.199
Prob of graduating secondary and tertiary			
MDG4	-0.00003100	-0.025	0.144
Education quality (services)	0.01011030	0.253	0.003
Public Infrastructure	0.09554830	0.080	0.255
Wage premium (W_3 / W_2)	0.02661770	0.046	0.136

Other determinants in model specification:

- Education input indicators (pupils/class room;
- quality teachers; degree of school autonomy)
- Parents education
- Other control variables (urban/rural, residence, ethnicity, and others)

Nicaragua: Alternative estimations of entry to primary

Table 13
ELASTICITIES FOR ENROLMENT IN EDUCATION, PRIMARY LEVEL, 2001
(various units)

Variable	Logit model		Proportions model	
	Elasticity	P value	Elasticity	P value
Sex (1=Male)	-0.0251	0.023	-0.0685	0.422
Consumption per capita	0.0791	0.000	0.0000	0.564
Number of members of the household	0.0326	0.073	0.0091	0.829
Average infrastructure in municipality (measured by rent)	0.0049	0.535	-0.0809	0.000
Proportion of population living in urban area	0.0232	0.001	-0.0063	0.656
Years of study of head of household	0.0455	0.000	0.0413	0.123
Wage premium for primary/secondary education	0.5167	0.087	0.4578	0.033
Average municipal mortality rate	0.0001	0.964	0.0006	0.794
Education spending	-0.1311	0.386	-0.1139	0.290
Education spending squared	0.0195	0.197	0.0141	0.214
Average time to travel to school	0.0055	0.865	-0.0077	0.773
Proportion of children that receive school bag	0.0225	0.004	0.0195	0.000
Average teachers per school	0.0063	0.674	0.1085	0.000
Average student teacher ratio	-0.1402	0.007	-0.0268	0.436
Proportion of children attended by school meal programme	0.0204	0.011	-0.0037	0.477

Source: Author's calculations based on INEC household survey LSMS 2001 Nicaragua..

Some problems

- Estimates of elasticities maybe sensitive to model specification
- Deal with possible endogeneity problems (e.g. distribution of public education spending may be determined by enrolment rates)
- Deal with multicollinearity (e.g. per capita consumption and infant mortality may be correlated).
- ...but further ...

We have an Unhappy Marriage

- ... between ECONS (econometrics) and MAMS (CGE model)
- Prenuptial agreement: all is on MAMS' (CGE model's terms)
 - Drop stochastic elements of the estimation (i.e. all becomes deterministic)
 - Forget about other determinants that are not in CGE model
 - Don't worry about explanatory power
- If you can accept these prenuptial terms, it might be a good marriage after all (happy it will never be...)

Health

- Dependent variable: Infant or child mortality?

How to model infant (child) mortality?

- Many factors, most tend to be interdependent.
 - Personal and biological factors
 - Sex, birth order, premature birth, etc.
 - Health behaviour and characteristics of mother
 - Breastfeeding, use of health services, anti-conceptive use
 - Household characteristics
 - Fertility, household size, mother's education, access to drinking water and sanitation, income/consumption level
 - Community characteristics
 - Overall public health conditions of community, vaccination coverage, distance to health centers, etc.

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7b-Sanitation	X	X		X	

How to model infant mortality?

- One approach (microeconomic health models): two-step modeling
 - Demand for maternal-infant health services
 - Survival model for infant mortality (use of health services is one of determinants)
- Step 1 - Demand for services:
 - Willingness to pay literature – cost-benefit assessment of using health services
 - Depends on demand factors (price, income, socio-economic characteristics and expected health benefits) and supply characteristics

How to model infant mortality?

■ Step 2: survival model

- Model number of months that child survives after birth
- *Cox Proportional Hazard (CPH)* survival model

$$H_j(t) = e^{\sum \beta_j x_i} H_0(t)$$

- $H_j(t)$: risk of infant 'j' to die in period (t) before reaching one year of age;
 $H_0(t)$: risk of infant of reference group to die in period (t) before reaching one year of age; x_i : determinants of infant mortality.
- ## ■ Data: Demographic and Health Survey (possibly with need to merge with health input data)

Is there a simpler way?

- Yes, but more limited
- Simple logit model (proportions model)

Data requirements:

- Demographic and Health Survey
- Population Census
- Health sector data (supply health services)

Ecuador - logit (proportions) model of child mortality	Elasticity	p-value
Public infrastructure	-0.194	0.179
Access to drinking water & sanitation	-0.403	0.005
Per capita consumption	-0.989	0.015
Health services	-0.297	0.000

Other determinants in model specification:

- Coverage of immunization programs
- Share women practicing breast feeding
- Premature births
- Mother's education
- Other control variables (ethnicity, and others)

Drinking water and sanitation

- Little economic theory of determinants
- Partly issue of public policy decision
- Likely relationship with per capita income
- Also, provision more likely if also other basic infrastructure exists (e.g. roads, electricity)

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ESTIMATES OF POOLED LOGIT MODEL ELASTICITIES FOR ACCESS TO ADEQUATE WATER AND SANITATION IN NICARAGUA, 1998 AND 2001

(various units)

	Coefficient	Significance	Elasticity
Access to Adequate Water			
Per capita consumption	0.0001282	0.000	0.112
Water and Sanitation Infrastructure	0.0047267	0.000	0.036
Other infrastructure	0.0000558	0.538	0.002
Region (Urban=1/Rural=0)	1.479817	0.000	0.109
Dummy variable (Year 1998=1)	-0.0544625	0.064	-0.003
Constant	-0.0078274	0.000	
Predicted Value	0.860		
Pseudo R2	0.15		
Number of Observations	39942		
Access to Adequate Sanitation			
Per capita consumption	0.0000756	0.000	0.265
Water and Sanitation Infrastructure	0.0052415	0.000	0.160
Other infrastructure	0.0004561	0.0000	0.084
Region (Urban/Rural)	0.7055045	0.000	0.210
Dummy variable (Year 1998=1)	0.0868544	0.000	0.022
Constant	-1.573124	0.000	
Predicted Value	0.434		
Pseudo R2	0.11		
Number of Observations	39942		

No single model, yet:

- First, make good assessment of sector needs and studies explaining deficiencies and determinants and whether existing policies enact on these or not
- Second, check for existing microeconomic studies which may provide evidence on elasticities and main determinants
- Third, seek adequate data sets
- Fourth, carefully explore data and test for alternative specifications; be aware of endogeneity problems and alike
- Fifth, carefully interpret results and link back to steps 1 and 2, and check whether elasticity is plausible or not, before settling on final results

Further reading

- See workshop materials, especially papers by:
 - Matt Hammill (2006)
 - Rob Vos, Ruth Lucio, Mauricio Leon, Jose Cuesta (2004) (Health)
 - Rob Vos and Juan Ponce (2004) (Education)
 - And references to literature made in those papers.