Annex 1

Technical project document:
Assessing Development Strategies to Achieve the Millennium Development Goals in the Arab region

Terms of Reference

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1. Research Objectives

On September 6 – 8, 2000, the heads of State participating in the United Nations Millennium Summit approved a bold and wide-ranging agenda for reducing poverty and improving lives in the world. That agenda was embedded in the framework of the Millennium Development Goals (MDGs) (Table 1), most of them to be achieved by 2015, using 1990 as the starting benchmark. For each of these goals more specific targets and verifiable indicators have been defined.[1] Those goals and targets are interrelated, and if achieved, they would make the world a better place for humanity on a variety of economic, social, and political dimensions.

Table 1: Millennium Development Goals

1.	Eradicate extreme poverty and hunger
2.	Achieve universal primary education
3.	Promote gender equality and empower women
4.	Reduce child mortality
5.	Improve maternal health
6.	Combat HIV/AIDS, malaria and other diseases
7.	Ensure environmental sustainability
8.	Develop a global partnership for development

In trying to achieve those goals, developing countries have very different starting points, both initial conditions and historical experience. Also, the advance towards these goals since the 1990 benchmark and the 2000 Summit has been very uneven.[2]

To assess the different dimensions of development strategies that may help developing countries reach the expected goals, there are at least three crucial questions that must be answered. First, what is the trajectory that the country will follow under current policies and investments, and what is the likelihood of achieving the goals (or a subset of them) in those circumstances? If projections based on the continuation of the status quo suggest important departures from the desired outcomes, then the second question is: What changes in development strategy, institutions, policies, and investments may be needed to achieve the goals? To answer the second question requires analysis of the links between policy choices and economic outcomes—the subject matter of much of development economics. While much progress has been made in understanding these links, much more research needs to be done. Given the important roles of governments and international institutions in financing development programs, a related third question is: What are the costs of different strategies, policies, and investment alternatives?

In this project, we will seek to address these questions in the Arab region through a collection of case studies. The goals of the project are:

> to develop an integrated methodological framework to provide quantitative answers to those three questions in the context of the Arab countries, focusing on dynamic processes, given a wide variety in initial conditions, and links from global and economy-wide "shocks" and policy changes to results at the household level;
>
> to apply that methodology to the design of different strategies, including assessing related costs, to achieve the MDGs for a group of countries in the Arab region, in collaboration with local teams;

[1] See http://www.undp.org/mdg/goalsandindicators.html.

[2] See the progress report in http://hdr.undp.org/reports/global/2002/en/pdf/hdr_2002_feature_1_1.pdf.

to strengthen analytical capabilities in several Arab countries to evaluate and design alternative strategies for the achievement of the MDGs; and,

to provide national policy makers with a set of policy recommendations to: a) pursue timely achievement of MDGs, in particular, and b) integrate macroeconomic and social goals in policy formulation, more in general.

In view of the data limitations that may hamper the applicability of the economy-wide framework that will serve as the core methodology of this project, the following targets derived from the MDGs which countries will be attempting to reach by the year 2015 will be explicitly considered:

- **MDG 1 (Targets 1 and 2)**: Cut in half the proportion of people whose income is less than one dollar per day and cut in half the fraction of the population suffering from hunger.
- **MDG 2 (Target 3)**: Ensure that all children complete primary school, boys and girls alike.
- **MDG 3 (Target 4)**: Eliminate gender disparity in primary and secondary education.[3]
- **MDG 4 (Target 5)**: Reduce by two thirds the mortality rate among children under five.
- **MDG 5 (Target 6):** Reduce by three quarters the maternal mortality ratio.
- **MDG 7 (Targets 10 and 11):** Cut in half the proportion of people without access to safe drinking water. And, by 2020, achieve a significant improvement in the lives of at least 100 million slum dwellers, defined by a significant increase in the proportion of the urban population with access to improved sanitation.

Regarding **MDG 1**, the target of halving extreme poverty will be taken as a proxy for the reduction of the population suffering from hunger. Poverty lines of both one and two dollars per day will be used and extreme poverty will be approximated by using country-specific extreme (indigence) poverty lines. Since extreme poverty may not pose such a problem in some Arab countries, the achievement of reducing absolute poverty will also be part of the study - also using country-specific absolute poverty lines. The effect of income inequality on the goal of achieving reductions of both absolute and extreme poverty will also be taken into consideration for the analysis. Concerning **MDG 2**, complete secondary education shall be added as additional case to all country studies, and even the goal of increasing enrolment and graduation in tertiary education may need to be addressed in the case of some countries. As for **MDG 3**, tertiary education may need to be contemplated in some Arab countries that have already achieved gender equality in school attendance in the primary and secondary education levels. In the Arab region the sustainability of available water resources poses a serious challenge to the achievement of the goal of cutting in half the proportion of people without access to safe drinking water in **MDG 7**. Increasing amounts of available water resources is another dimension that will be taken into consideration – as much as data availability allows it - as existing indicators address networks that might not even be feeding at all from an available water

[3] Given the aggregate nature of the economy-wide framework that will be used as the core methodology, the issue of closing the gender gap in education will be answered through microeconomic cost-effectiveness analysis.

resource. The target for improving living conditions for slum dwellers of **MDG 7** will be approached through determining investments required to enhance coverage of adequate sanitation. In addition, environmental degradation may be built into the analytical framework in the case of countries where data are readily available and the severity of the problem poses constraints to sustainable economic development.

The economy-wide framework will allow us to indirectly address some of the targets of **MDG 8** - on development of a partnership for development, especially those related to external debt and official development assistance (targets 13 and 15), on the one hand, and decent and productive work for youth (target 16), on the other. The analytical framework will be flexible enough as to identify alternative financing avenues for MDG achievement such as foreign debt and grants, among others. It will also indicate the extent to which financing the achievement of the MDGs may (or may not) compromise the external debt position of Arab countries over time. On the other hand, the full modeling of a labor market in which human capital is added over time as MDG 2 is being achieved shall shed light on: a) the actual possibilities that skilled young workers may have to access the more productive sectors of the economy, and b) unemployment. These labor market issues will also ultimately be connected with the achievement of MDG 1.

2. Background and Analytical Framework

This project builds on the ongoing experience of a similar venture for 19 Latin American and Caribbean countries that is sponsored by UNDP, UN-DESA, and the World Bank, among other international and local institutions. Not only does the Latin American and Caribbean project provides us with an state-of-the-art analytical framework to fulfill this current project's purposes but countries in that region of the world also share a lot of commonalities with many Arab countries.[4]

Furthermore, this current project will be linked to the UN-DESA/DPAD development account project entitled "Realizing the Millennium Development Goals through socially inclusive macroeconomic policies". The latter is at its very initial stage and shares the same objectives and methodology of this current project for the Arab region, but it expands its applications to countries in other regions of the developing world. There will be gains from learning from the broader experience with the methodology as it is being more extensively applied and the policy insights from countries in different continents.

The Latin American and Caribbean project uses as core framework for analysis an economy-wide model labeled as MAMS: ***MA****quette* for **M**DG **S**imulation. The latter is an innovative type of dynamic computable general equilibrium (CGE) model especially designed by the World Bank to determine effective public investments and interventions

[4] Most Arab states are classified as "middle income countries" like most Latin American and Caribbean countries. There are also evident similarities particularly in relation to issues of income distribution, employment and labor markets. Like in the Latin American region – with very few exceptions - and despite variations in poverty estimates, in the Arab region most countries have not managed to afford sustained declining poverty rates in recent years. Furthermore, income inequality is escalating in almost all Arab states undermining the possibility to experiencing a steady reduction of poverty like it does in Latin America.

for MDG achievement and how these affect macroeconomic balances, sectoral economic growth, and the labor market at the country level.

The static solution of MAMS essentially builds from the standard CGE model of the International Food Policy Research Institute (IFPRI).[5] A recent UNDP-IFPRI-ISS project used that standard CGE model and complemented it with a microsimulation methodology to develop comparative static exercises aimed at determining the impact of trade and capital account liberalization on poverty in 16 countries in Latin America and the Caribbean.[6] The analysis involved constructing comparable social accounting matrices (SAMs) and using existing household surveys for all the project countries.

The SAM will be of fundamental importance in the framework of the project. Not only will the construction of the SAM enable participant countries to better organize the national accounts and other macroeconomic information, but it will also provide the accounting framework and more structural parameters of the MAMS. Thus, the better the construction of the SAM, the more realistically will MAMS help reproduce the functioning of the economies being modeled.

MAMS basically takes the standard static CGE model of IFPRI and adds a essentially recursive dynamic module in which key variables (such as factor supplies, population and factor productivity, among others) are updated to analyze the impact of policies over time and an MDG module with determinants of MDG achievements for education, health, water and sanitation.[7] The MDG module has feedbacks into the rest of the economy via the government budget constraint and the labor market, among others.

The project will use MAMS as the core framework for analysis. An economy-wide approach like that MAMS provides us with is needed in MDG analysis for the following reasons. Many of the key-related policies and required financing mechanisms for timely MDG achievement have effects across the various sectors of the economy. These effects feed back into processes of labor market adjustment, relative prices, government resources, household incomes, macroeconomic adjustments and so on, which in turn determine MDG achievement.

Broadly speaking, the application of MAMS to a number of Arab countries will enable realization of projections of output, employment, and poverty (see complementary methodology below) under different investment and sectoral growth strategies, as well as alternative assumptions about social spending on education and health. More specifically, the dynamic modeling analysis will enable determination of investment requirements for Arab countries to achieve growth and meet various MDGs in the year 2015 or eventually before, considering links between investment of various kinds (public, private, sector, and type), productivity growth, changes in the size and skill composition of the labor force, and economic performance over time. “Investment” should be viewed broadly as

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5 For more details on this standard CGE model, see Löfgren, Lee Harris and Robinson (2002).

6 See Vos *et al.*, 2006.

7 For a technical description of MAMS, see Löfgren (2004) and Appendix A.1 to this document. For an empirical application to Ethiopia of this modeling framework, see Bourguignon *et al*., 2004.

expenditures to increase the stocks of physical, human, and social capital to boost the productive capacity of the economy. Private capital formation and public investments in physical infrastructure (e.g., roads, public utilities, irrigation projects, etc.) and technology (research) are clearly important, and achieving an appropriate balance among these categories that maximizes growth is an important part of a country's choice of development strategy. Expenditures to improve education, health, and the environment, while directly improving welfare and meeting some of the MDG goals and targets, also have an investment component in that they also increase the productive capacity of the economy. Estimating benefits and costs of these different types of investment must take into account linkages, externalities, and complementarities.

The core MAMS framework will be complemented by two related pieces of empirical work. First, cost-effectiveness studies in education, health, safe water supply and sanitation will be used in order to identify the determinants of access to these services and the costs related to the most effective provisioning of such services in terms of achieving MDGs 2, 3, 4 and 7 (school enrolment, gender equality in education, child mortality and drinking water and sanitation). The aim of this part of the work is to establish country and sector (education, health, sanitation) specific determinants of education and health outcomes and realistic initial estimates of the costs of the required investments to reach the MDGs.[8] The results of this part of the work will be used to calibrate the country-specific MDG module of MAMS and to define the simulation of the additional public investment requirements onto the rest of the economy and back into the MDG achievements. Second, alike in the two previous projects for the Latin American and Caribbean region mentioned earlier results from the MAMS-CGE model will be combined with a microsimulation method to assess the impact of changed employment, earnings and education conditions on (extreme) poverty at the household level (MDG 1). The microsimulation methodology permits to determine the extent to which changes in poverty are due to variations in the distribution of income at the household level.

These analytical tools altogether will be developed further within the framework of the current project for Arab countries with the purpose of: a) adapting them to specific conditions of Arab countries, and b) enhancing them methodologically for selected country cases by adding new dimensions to the existing framework – especially in those cases where environmental degradation and other MDG-related issues need to be studied in depth.

This project's idea is to generate answers to a set of common questions and to use as much as possible common methodologies in the country case studies, focusing on the heterogeneity of initial conditions, historical experience, and past policy choices. We do, however, recognize that the different country cases in this study may differ more significantly in terms of policy priorities (across the MDGs), data resources, and need for original micro analysis (of determinants of MDG outcomes). Given this, our emphasis is

[8] Estimations from sector needs assessments by the UN Millennium project that may be available for some countries may form an input for this part of the project, although they may likely need some further transformation to make them meaningful for the calibration of MAMS and for addressing the economy-wide implications.

on a minimum standard in terms of issues addressed and MDG coverage. Beyond this, the studies may differ in various details, such as functional forms and division of labor between the MAMS and microsimulation models.

Using the proposed methodologies, each country case study will investigate: a) how to meet the different MDGs that are covered, b) the trade-offs in macroeconomic policy-making towards achieving the MDGs, if any, as well as the synergies between different goals, and c) how much it is likely to cost to meet each or all of the goals.

3. Project Strategy and Implementation Terms

The standard trajectory of the project will develop in seven steps that are briefly described as follows:

1. A brief historical account of major economic trends, economic and social policy reforms and trajectory towards reaching the MDGs; that is, a country narrative. This analysis will also include an account to what extent the growth pattern in the economy has been pro-poor or not.
2. Following a workshop training in the analytics and practical use of the MAMS modeling system, country authors will implement the modeling framework as specified in Appendix A.1 and calibrate the static (within-period) and recursive dynamic (between-period) modules to their country context. The development of the MDG block will come in step 4. This calibration task will involve in first instance: a) the construction or updating of a Social Accounting Matrix to an appropriate base year (around 2000), and b) the adaptation of such a matrix to explicitly account for non-standard capital and investment accounts that are needed for the calibration of MAMS. As a second step this will involve finding from existing studies or own econometric estimations plausible values of key behavioral parameters and elasticities, as well as base line values and assumptions for exogenous variables of the dynamic module (covering the period from the base year to 2015). For the period from the base year to 2005, the growth rates for macro aggregates (GDP and the absorption components) and MDG-related service provision should follow observed data or forecasts.
3. Calibration of the MDG module. This step will involve several tasks:
    a) Identify determinants of schooling performance (measured by rates of enrollment, graduation, and continuation to higher grades) for primary and secondary education, and tertiary education if possible. Schooling determinants may be differentiated by relevant socio-economic groups also identified in the MAMS framework (urban/rural; poor/non-poor). The MDG target for education addresses primary education. When this target is close to being reached in a country, the analysis shall also cover secondary and tertiary education since these higher levels of education can play a critical role for growth and poverty reduction. The analysis should lead further into identifying cost-effective interventions, thereby providing appropriate parameters for the education component of the MDG block, as

well as the public expenditure requirements related to the cost-effective interventions (such as school subsidy programs, improved teacher quality, school infrastructure and so on). This analysis maybe based on existing studies if available or else would involve the estimation of a cost-effectiveness model of schooling determinants. An example of such an analysis can be found, for instance, in Vos and Ponce (2004) (see reference list to Appendix A.2). The basic framework is given in Appendix A.2 and would involve a microeconometric analysis using household survey and educational input data.

b) Identify the determinants of access to health care (more specifically those related to maternal care and child delivery) and the determinants of child mortality. Typically we would expect professionally assisted child delivery, along with coverage of vaccination programs, disease control and good sanitary conditions to increase child survival rates. These factors interact with individual and household characteristics and behavior. The precise weight of such determinants and degree of effectiveness of health interventions may differ from one country context to another and thus should be estimated specifically for each country context. Vos *et al*. (2004) (see references to Appendix A.3) provide an example of a two-stage modeling of determinants of access to maternal health services and child survival and linking the outcomes to unit costs of (public) health interventions. Appendix A.3 provides a description of this modeling approach and would involve the use of Demographic and Health Survey data and health input data.

c) Cost estimates of the provisioning of drinking water and sanitation systems as well as demand elasticities for these services, using public expenditure and household survey data.

4. Calibration of the complete MAMS model and a policy simulation analysis of how to reach the MDG goals. The CGE models will be used to estimate the aggregate structure of the economies in 2015 required to meet the MDG, including needed levels of capital (human and physical), labor, increased productivity and financing constraints and needs (including foreign assistance).

5. Labor market results from the MAMS-CGE modeling will be imposed into a microeconomic database to develop a microsimulation analysis aimed at exploring the distributional implications of different scenarios. Those projections will be translated into estimates of poverty and the distribution of income using the microsimulation methodology developed by Almeida and Paes de Barros, and used in the previous phase of the UNDP-IFPRI-ISS project (see Appendix A.4).

6. Country papers will be written integrating steps 1-5 into a consistent story and spelling out the policy options and growth-distribution trade offs in the short and long run of trying to reach the MDGs.

7. A comparative country analysis will be conducted highlighting the cross country differences and similarities as well as conducting an aggregate analysis of the requirements of reaching the MDGs for the Arab countries in a regional context.

Steps 1-6 will be the task of the country research teams. Step 7 will be undertaken by the coordination team with feedback from the country research teams, and it will also include the participation to an international workshop. This last step is also expected to form the basis for the development of a toolkit to make the methodology and its application for policy purposes more easily transferable to other country contexts and policy scenarios.[9]

4. Milestones and Time frame

The project will be implemented by UNDP/RBAS in partnership with UN-DESA, the World Bank, the League of Arab States, and ESCWA. UNDP/RBAS, UN-DESA and the World Bank will form the coordinating team. UNDP/RBAS will be responsible for the management of the project. The technical backstopping in modeling will be mostly provided by UN-DESA and the World Bank. The League of Arab States and ESCWA are expected to play a crucial role for the effective implementation of the project in the region. These institutions will be involved in all the activities of the project as setup in the following tentative time frame:

Tentative

Identification and formation of country teams*	July-November 2006
Preparation of training materials and homework request (to country teams) for inception workshop	December 2006-January 2007
Inception/initial training workshop†	February 2007
Contracting of country research teams	February 2007
Completion of Step 1 (Country narrative)	1 April 2007
Completion of Step 2 (SAM, database, basic MAMS calibration)	1 June 2007
Completion of Step 3 (Micro/sector analysis)	1 July 2007[10]
Completion of Step 4 (Full MAMS/CGE calibration, first run of policy scenarios)	1 August 2007
Workshop 2 on CGE model results and training micro-simulations	7-10 August 2007
Completion of Step 5 (microsimulation results)	15 October 2007
Regional/national training workshop‡	1 November 2007
Completion of Step 6a (Full draft country papers)	15 November 2007

[9] The toolkit will essentially consist of the following: (a) a package of methodologies, i.e. economy-wide model system, microsimulation methods to assess the impact on income poverty at the household level, and microeconomic costing exercises for MDG analysis (in education, health, water and sanitation, etc.); (b) a manual and guide for both expert and non-expert users on how to apply the methodologies to specific country contexts; and, (c) guidelines as to how to use the methodologies and interpret the results for policymaking purposes.

[10] This assumes the country research team can make a distribution of labor involving social sector specialists and micro-economists in conducting the cost-effectiveness analyses.

Final project Workshop 3	1-4 December 2007
Completion Step 6b (Final version Country paper)	15 January 2008
Completion of Step 7a (Comparative Analysis)	1 March 2008
Completion of Step 7b (International workshops)	15 -31 May 2008
Completion of Step 7c (Development of toolkit)	15 May – July 31, 2008

[*] The country teams will be trained in the project methodology to empower them to adapt it to the country context and needs. These teams will need to be formed through partnerships of national researchers (consultants) from respected research institutes and government experts so as to ensure future sustainability of the capacity building. Each team is expected to consist of at least two competent national researchers and one to two experts from government agencies. When research capacity in a country will be deemed to be non-sufficient, it may be necessary to contract a regional or an international expert to conduct the study and provide more intensive training to local counterparts in the interpretation of the project methodology. Since the project methodology covers both macro and micro aspects in an economy-wide framework, country teams will ideally be composed of at least one macroeconomist familiarized with macro modeling and one expert in the fields of microeconomic data analysis and/or cost-effectiveness analysis. Government experts are expected to engage in macroeconomic policy making and/or the design of poverty reduction and human development strategies in interaction with the other research experts.

[†] Regional/national training workshops have been planned but permanent training will be provided by the coordination team to country teams in the form of backstopping via email and telephone/video conferences. Unplanned additional national training workshops financed by government agencies or other donors may also be organized.

[‡] To be defined (at this date or any other alternative date) according to country-specific needs.

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A.1 MAMS: An Economy-wide Model for the Analysis of MDG Country Strategies

[See file Lofgren and Díaz-Bonilla, 2006.pdf at:
http://www.un.org/esa/policy/cairo_mdgs.html]

A.2 Framework for Education Cost-Effectiveness Analysis[11]

In order to know by how much the education budget would need to increase or how to make that spending more effective to reach the given goals, we need to analyze in greater detail the determinants of school enrolment. These determinants may be found in the physical accessibility of schools and the quality of school inputs (such as availability of textbooks, qualifications of school teachers, and so on). However, problems of access to schooling likely are not merely related to factors on the supply side, but important constraints are typically also found in the household conditions of the children. The education of their parents typically influences the decision to attend school, as much as the economic situation of the household. If a family is poor and there are significant direct costs to the household for each child attending school (school fees, uniforms, educational material, transportation costs), parents may decide not to enroll (some of) their children. Such circumstances may also lead to a situation where the contribution of children to family income is significant (especially in rural areas) and accordingly the opportunity cost associated with school attendance may be substantial. Attendance will suffer when parents perceive that the return associated with time spent in school does not justify the loss of a child's economic contribution. Also, parents tend to value the quality of educational outcomes. That is, if the quality of education is rated to be poor (for instance as measured through test scores), parents may be less likely to send their children to school.

We apply a schooling determinants model for Ecuador identifying the importance of such factors and quantify the impact of changes in such variables on school outcomes. Our approach follows a basic extended human capital model formulated by Glewwe (1999) and adapted, among others, by Bedi et al. (2004). An important advantage of these models as compared to the more traditional "willingness-to-pay models"[12] is that they include variables of school inputs and educational quality, next to demand variables associated with costs and income. In addition to supply side variables, our model also considers institutional variables, such as school autonomy and decentralized teacher appointments. This dimension is of some importance, as discussed below, for the policy design of more cost-effective interventions in education.

Modeling the access to schooling

We start from a conventional human capital model to understand *the main factors that determine school enrolment* of children.[13] In this theoretical approach education is viewed as an investment that depends on the costs and benefits associated with enrolment. The costs associated with schooling are direct and indirect. The direct costs include inter alia uniforms, books, tuition fees and transportation. Indirect costs are defined as the reduction in household income due to the reduction of child labor. The expected addition to a child's human capital and its impact on future earnings are among the main benefits associated with schooling. A household will decide to send children to

[11] Excerpt based on Vos and Ponce (2004).
[12] See Gertler and Glewwe (1990) and Gertler and Van der Gaag (1988).
[13] See Schultz (1971) and Becker (1964).

school if the (expected) marginal benefit to an additional year of education equals the marginal costs.

This initial theoretical formulation has been extended using dynamic models of earnings and the importance of human capital investments (Ben-Porath 1967 and Heckman 1976). Specifically for developing countries, Glewwe (1999) has formulated an "extended human capital model" to understand government investments on school quality and its impact on future earnings. We adopt this model to formulate an "extended human capital" model to school enrolment.

According to this approach, households will maximize the following utility function conditional to school enrolment:

$$U_1 = U(b, c_1) \quad (1)$$

where, U is the household utility conditional on school enrolment (denoted by subscript 1), b is a vector of benefits associated with attending school, and c is household consumption.

The main benefits associated with schooling, b, are defined by:

$$b = B(h, w, z) \quad (2)$$

where, h is a vector of individual child characteristics, w is a vector of households characteristics, and z is a vector of school characteristics (including quality of school inputs and institutional aspects).

The household maximizes utility against the following budget constraint:

$$y = c_1 + p \quad (3)$$

where y is household income, and p represents the total cost associated with enrolment. The utility function associated with not attending school yields:

$$U_0 = U(c_0) \quad (4)$$

The budget constraint is $y = c_0$. The household will choose the option associated with the highest possible utility, i.e.:

$$U^* = \max(U_1, U_0) \quad (5)$$

where U^* is the maximum utility. In this case the solution to the maximization problem is the probability that an alternative is chosen.

Empirical Specification

Three different specifications of the utility function can be found in the literature: a linear form (Bedi et al., 2004), a semi-quadratic function (Gertler and Glewwe, 1990), and a logarithmic form (Younger et al., 1997). In our case, we decide to use a linear form because it is easier to interpret and there is a direct price effect, while in the others the price effect is either squared and/or interacted, making interpretation difficult.

In this case the utility function takes the following form:

$$U_1 = \beta_1 b + \beta_2 c_1 + \varepsilon_1 \quad (6)$$

where β's are the coefficients to be estimated and ε_1 is assumed to be a zero mean, normally distributed error term. From equation 3 we see that $c_1 = y - p$, the utility function can therefore be rewritten as follows:

$$U_1 = \beta_1 b + \beta_2 (y - p) + \varepsilon_1 \quad (7)$$

The utility function for not being enrolled in school is:

$$U_0 = \beta_2 y + \varepsilon_0 \quad (8)$$

Thus, an individual attends school if the utility associated with school enrolment is higher than that of not attending. In other words, an individual attends school if the following equation is satisfied.

$$\beta_1 b - \beta_2 p + \varepsilon_1 - \varepsilon_0 > 0. \quad (9)$$

The chances of attending school thus can be expressed as a function of socio-demographic individual and household characteristics, the quality of school inputs and the direct and indirect cost of school enrolment. In terms of a linear probability model this functional relationship may be written (after using equation 2) as:

$$\Pr[a = 1] = \Pr[\beta_1 B(h, w, z) - \beta_2 p + \varepsilon_a > 0] \quad (10)$$

where *a* is a binomial variable that takes the value of 1 for enrolment and 0 for non-enrolment.

References to Appendix A.2

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A.3 Framework for Health Cost-Effectiveness Analysis[14]

The approach to studying determinants of child mortality follows a two step procedure. It explores first what motivates individuals when selecting among different health services (either public or private or no service at all). Once these determinants are known, the effects of access to health services on infant mortality are analyzed. As a result, public health policy strategies are linked with the key development goal of infant mortality reduction. This link is two-fold: one shows the effects of private and public interventions on infant mortality directly; the other shows the impact on infant mortality through its induced change on health demand.

An innovative element of our analysis is to connect methodologically access to health services during delivery with the phenomenon of infant mortality. Traditionally, the health demand literature has focused on separating the effects of price-related and socioeconomic-related variables determining access to services (see e.g. Gertler, Locay and Sanderson, 1987; Gertler and van der Gaag, 1990; more recent approaches to be added**)** In addition, most of the existing infant mortality studies have emphasized the likely mutual causation between infant mortality and fertility decisions (Hanmer and White, 1998). However, a combined specification of infant mortality and the choice of health services is not being attempted before.

The traditional emphasis in the previous literature is not completely overlooked in this study, though. Price considerations are not directly included although controlling for affiliation (if any) to alternative health insurance systems and presence of private and public health providers may well convey price differences faced by health users. The relation between fertility and infant mortality is taken into account implicitly since many of the determinants of fertility are also factors affecting mortality. In addition, possible forms of household behavior in relation to infant mortality such as "replacement" (higher fertility due to higher mortality) and/or resource-competition among household members are controlled for in the proposed child survival specification. This is believed to capture the consequences of an intertwined relation between fertility and mortality.

Theoretical Underpinnings

Access to health services during child delivery

Given data limitations, the use of health care is not measured in terms of the quantity of health care consumed, but in terms of choices among alternative health care providers. We use the standard framework employed in several studies of the determinants of access to health care services as a starting point (see Gertler, Locay and Sanderson, 1987; Mwabu, Ainsworth and Nyamete, 1993). The framework is a short-run static model with a utility function defined over health status and the consumption of all other goods.

This description of the manner in which an individual makes a choice concerning health care provision may be formalized by considering utility conditional on receiving care from health care provider (HCP) *j*. Utility conditional on choosing provider *j* is given by,

[14] Excerpt based on Vos *et al.*, 2004.

$$U_{ij} = U(H_{ij}, C_{ij}, T_{ij}) \quad (1)$$

where H_{ij} is the expected health status of the individual conditional on receiving treatment from provider *j*, C_{ij} is the consumption of all other goods except those associated with health care, T_{ij} represents the non-monetary costs of access to provider *j*. The expected improvement in health care status is unobservable but is assumed to depend on the characteristics of an individual (health status, habits, etc.) and the quality of health care received by the individual. This allows us to write a health production function defined over X_i, the attributes of an individual and Z_j, the attributes of the provider *j*. Hence,

$$H_{ij} = H(X_i, Z_j) \quad (2)$$

Turning to the level of consumption, it depends on the income of the individual and the costs associated with buying health care. If the user fee associated with provider *j* is P_j and *Y* is an individual's income then, this yields a function where utility is given as,

$$U_{ij} = U(X_i, Z_j, Y_i, P_j, T_{ij}) \quad (3)$$

Thus, the benefits from visiting a particular health care provider depend on individual characteristics, the attributes of the provider, individual income, user fees faced at provider *j* and non-monetary costs associated with visiting provider *j*.

An individual's health care provider (HCP_i) choice may now be expressed as

$$HCP_i = j \quad \text{if } U_{ij} > \max\{U_{ik}\}, \qquad j = 1 \ldots J, \; k \neq j, \quad (4)$$

The parameters of (3) and the probability that individual *i* chooses health care provider *j* may be obtained by estimating a multinomial discrete choice model. The selection rule (4), combined with the assumption that the stochastic error term follows a Weibull distribution, defines a multinomial logit model where

$$P_{ij} = \Pr(HCP_i = j) = \exp(\alpha_j' W_i + \beta' K_j) / \sum_{k=1}^{J} \exp(\alpha_k' W_i + \beta' K_k) \quad (5)$$

Determining child survival

On the other hand, duration models have been extensively used in socioeconomic analysis in issues such as unemployment spells, education enrolment or social benefit schemes. (Nickell et al, 1991) There is also a rather extensive epidemiological literature on the duration of health conditions, among others, infant, child or adult mortality (Masset and White, 2003). Following Greene (2001) notation, let '*T*' be a random continuous variable with a probability function *f( )*. This probability function indicates the number of periods elapsed until the incumbent event takes place in a period 't'. This probability function is dependant on a set of variables, x_i, capturing from socioeconomic

conditions to individual characteristics or any other factor that affects the duration of the studied event. Let *F( )* be the cumulative probability of the duration variable, *T*. The probability that an event takes place in a period '*t*' is given by:

$$F(t) = \int_0^t f(x)dx = \Pr ob(T \le t) \tag{6}$$

Conversely, an underlying survival function indicates the probability that the duration of the process unfolding in the observed event takes '*t*' periods to materialize is given by:

$$S_u(t) = 1 - F(t) = \Pr ob(T \ge t) \tag{7}$$

The survival function in (7) indicates that each period is independent of the previous as far as the probability of observing the event is concerned. This is typically not true in the kind of socioeconomic events such as infant mortality or unemployment spells. More appropriately, a survival function can be expressed as a process of intertwined relations of x_i upon *F(t) conditional* to survival in previous periods:

$$S_c(t) = (T = t | T \ge t) \tag{8}$$

In the case of infant mortality, '*t*', typically represents the number of successive months in the first year after birth during which the infant stays alive. Thus, the survival probability of remaining alive in the, say, fourth month of life for an infant is the conditional probability that that infant survived the first, second and third month after birth. This (*conditional*) survival function in (8) can be expressed conveniently in the form of a hazard rate, that is, the ratio between the probability of failure (death) and success (survival) of an event taking place. As Jenkins (1995) shows, (8) can be re-arranged in the following way:

$$S_u(t) = \Pr ob(T = t \left| T > t) = h(t) \cdot \prod_{k=1}^{t-1} (1 - h(k)) = \frac{h(t)}{1 - h(t)} \prod_{k=1}^{t} (1 - h(k)) \right. \tag{9}$$

Cox and Oakes (1984) parameterized this conditional probability in the form of proportional hazards with respect to a baseline individual leading to the Cox Proportional Hazard model (CPH) explained below. Using maximum likelihood estimation, the CPH can estimate the unknown coefficients, β_i, of a set of determinants, x_i, on infant mortality.

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A.4 Microsimulation methodology

Analysis macro-micro linkages

A major focus of the analysis is to translate changes at the macro or economy-wide level to resulting impacts on the distribution of income and poverty. The methodological issue we need to tackle is how to track the mechanisms by which economy-wide shocks involving macro variables work their way through the economy, finally affecting household livelihoods. Figure A4.1 provides a schematic picture of the mechanisms involved.

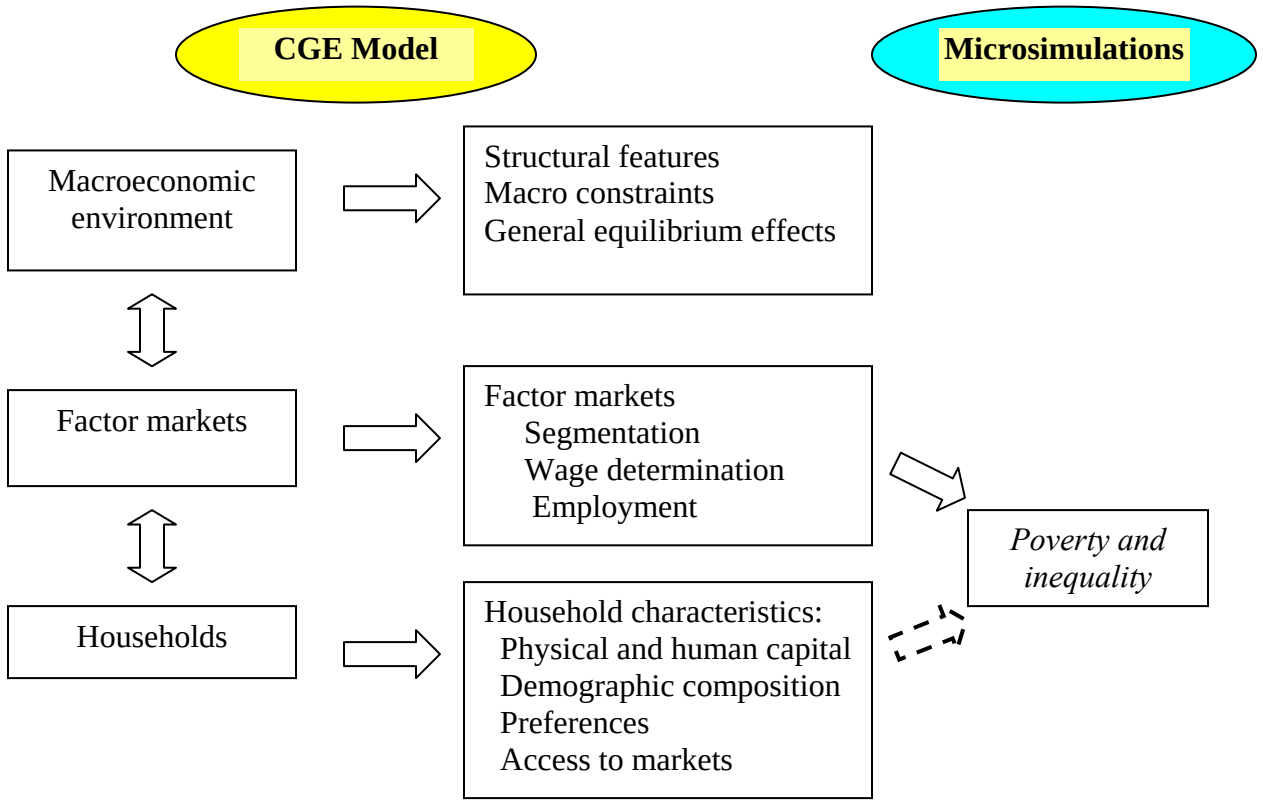
The 'top-down' causal chain works from macro shocks through the operation of factor and product markets yielding prices, wages, and employment, and finally to household income and expenditure. A crucial part of analyzing and modeling distributional outcomes at the household level, is the specification of the various sources of income at the household level and how those sources are linked to the operation of factor and product markets. In terms of the SAM data framework and SAM-based analysis, it is crucial to disaggregate the factor markets, including data on the ownership of factors by households. In various settings, it may be important to disaggregate production and employment by categories such as region, sector, skill category, gender, age, and nature of employment (e.g., self employed, informal sector, or formal sector), all of which could be relevant in determining how households earn their income. In addition, the extent to which households operate in commercial or formal markets can be important — for example, home consumption can represent a significant part of real income and consumption for poor farmers.

The analysis is 'top down' in that the goal was to translate from economy-wide changes to outcomes at the household level. No attempt was made to determine feedbacks from changes at the household level back through the operation of factor markets to macro variables.[15] A major advantage of the top-down approach is that the analysis and modeling of households, based on survey data, can be done separately from the economy-wide analysis, and there is no need to reconcile the household data with the national data. The communication between the two strands is in the form of information about changes in prices, wages, and employment — there is no need to reconcile data on levels.[16] The microsimulation analysis at the household level is discussed in more detail below.

[15] To the extent the CGE differentiates various groups of households, it does account for the feedback effects of changes in their relative incomes and consumption levels on the rest of the economy through differences in spending behavior across those household groups.

[16] Such an integrated analysis requires a modeling framework that can accommodate many households, using the household survey data. It is not necessary to model all the households in a sample survey. For a discussion of the use of "representative" households in models, see Löfgren, Robinson, and El-Said (2003).

Figure A4.1: Mapping From Macro Changes to Poverty Outcomes



Microsimulation methodology

The country analyses in this study focus on the labor market as the main transmission channel of the modeled impact of trade reforms on poverty and distribution. To go from the counterfactual labor market effects simulated with the CGE model to poverty and income distribution at the household level we need to deal with two methodological issues. First, how to incorporate both between and within group effects into the distribution analysis? That is, how can we account for the full distribution and thus for the heterogeneity of the population within households when assessing the poverty and inequality effects? Second, people may change position in the labor market (hence also affecting household income) due to trade reforms, external shocks or other simulated macro changes. Workers may shift from one sector to another, change occupation or lose their job. The methodological issue is to find a procedure that can account for such labor market shifts and identify which individuals are most likely to shift position in order to be able to simulate a new, counterfactual income distribution.

Various microsimulation methodologies have been proposed in the literature to deal with these problems.[17] We mention two types that try to answer the type of questions raised in

[17] See Bourguignon, Pereira da Silva and Stern (2002) for an overview of related methods. It should be noted that the approach is fairly new in its application to developing country context, but that combinations

this study. The first involves the estimation of a microeconomic, partial-equilibrium household income generation model through a system of equations that determine occupational choice, returns to labor and human capital, consumer prices, and other household (individual) income components (see for instance, Bourguignon, Fournier and Gurgand 2001, Bourguignon, Ferreira and Lustig 2001). Combining this methodology in "top-down" fashion with a CGE model has been probed by Bourguignon, Robilliard, and Robinson (2002) for the case of Indonesia.

A second microsimulation approach of less modeling intensity assumes that occupational shifts may be proxied by a random selection procedure within a segmented labor market structure. This procedure allows one to impose counterfactual changes in key labor market parameters (participation rate, unemployment, employment composition by sectors, wage structure, etc.) on a given distribution derived from household survey data and estimate the impact of each change on poverty and income distribution at the household level. This type of methodology of counterfactual microsimulations originated with Orcutt (1957) for tax incidence analysis in developed countries and Oaxaca (1973) and Blinder (1973) for between-group differentials in mean earnings and, more recently, with Almeida dos Reis and Paes de Barros (1991) for an analysis of inequality in the full distribution of earnings.[18] The latter approach was subsequently generalized to analyze total per capita household income inequality and poverty (see Paes de Barros and Leite, 1998; Paes de Barros, 1999; Frenkel and González, 2000; and Ganuza, Paes de Barros and Vos, 2002).

In both types of methods, total per capita household income is defined as:

$$ypc_{hi} = \frac{1}{n_h}\left[\sum_{i=1}^{n_h} yp_{hi} + yq_h\right] \qquad (1)$$

where n_h is the size of household h, yp_{hi} the labor income of member i of household h, and yq_h the sum of all non-labor incomes of the household, defined as:

$$yq_h = \sum_{i=1}^{n_h} yqp_{hi} + yqt_h \qquad (2)$$

In equation (2), yqp_{hi} = individual non-labor income of member i of household h and yqt_h = other household incomes. In the simulations yp_{hi} is altered for some individuals i of household h as a result of changes in the labor market parameters.

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of macro or CGE policy models and microsimulations, for instance to assess distributional effects of tax reforms, are quite common in applications in developed countries.

[18] It should be noted that both Orcutt and Oaxaca-Blinder essentially involve accounting methods assuming fixed positions of workers and household groups. For a recent overview of applications of microsimulation approaches for assessing the impact of government policies in OECD countries, see Gupta and Kapur (2000).

The second microsimulation approach, which will be the minimum standard for the present project and as applied in Ganuza, Barros and Vos (2002) defines the labor market structure in terms of rates of economic participation (P_j) and unemployment (U_j) among different groups j of the population at working age defined according to sex and skill, the structure of employment (defined according to sector of activity S and occupational category O) and remuneration W_1, as well as overall level of remuneration W_2. The skill composition of the population is represented by variable M. The labor market structure can be written as $\pi = \pi(P,U,S,O,W_1,W_2,M)$.

For all types of individuals, the unemployment rates determine part of the labor market structure. The latter is further determined by the structure of employment. The employed workforce is classified according to segment k, defined on the basis of sector of activity and occupational category. For both skill groups within segments k in the labor market, the average remuneration is calculated and these averages are expressed as a ratio of the overall average. The effect of alteration of parameters of the labor market structure on poverty and inequality can now be analyzed using the accounting identities of equations (1) and (2). The impact of changes in the labor market can be analyzed both separately and sequentially.

The Ganuza-Barros-Vos approach introduces a number of important assumptions about the labor market. First, as indicated, for lack of a full model of the labor market, a randomized process is applied to simulate the effects of changes in the labor market structure. That is, random numbers are used to determine: which persons at working age change their labor force status; who will change occupational category; which employed persons obtain a different level of education; and how are new mean labor incomes assigned to individuals in the sample. Hence, the assumption is that, on average, the effect of the random changes correctly reflects the impact of the actual changes in the labor market.[19] Because of the introduction of a process of random assignation, the microsimulations are repeated a large number of times in Monte Carlo fashion.[20] This allows constructing 95% confidence intervals for the indices of inequality and poverty, except in the case of the simulations of the effect of change in the structure and level of remuneration, which do not involve random numbers. In each simulation, the incidence, depth and severity of poverty and the Gini and Theil coefficients of the distribution of both per capita income and primary incomes are calculated.[21]

[19] The possibility of incorporating conditional probabilities to decide which individuals change status within the labor force will be explored in future research.

[20] Experiments with the methodology for several household survey data sets show that about 30 iterations are sufficient. Repeating the simulations a larger number of times does not alter the results.

[21] Mean incomes per decile are calculated in the simulations. These means are subsequently assigned to new employed individuals or to already employed persons who changed sector of employment, occupational category or moved from one educational group to another. In principle, to assess the impact of changes in the labor market structure, one would have to calibrate the data base prior to simulating the effect of said changes – that is, replace the original labor incomes by mean incomes per decile. A test showed that both the direction of change and the magnitude of the effect do not change if one uses the original values of the labor incomes instead of calibrated values.

The alternative microsimulation approach as in Bourguignon, Robilliard and Robinson (2002) would add a probabilistic specification of household labor supply behavior, adding an additional link as represented by the arrow with the *dotted* lines in Figure A4.1. In addition, rather than randomly selecting the individuals in the simulations as done by Ganuza et al. (2002), a probability function is estimated to determine who, given personal characteristics, is most likely to move and which is the likely income he or she will obtain as a result of the shift. Subsequently, the estimated parameters replace the randomized procedure in the Ganuza et al. methodology, thereby moving closer to the first type of microsimulations. In terms of Figure A4.1, there is a *closed-line* arrow from labor market outcomes to poverty and inequality at the household level, representing the link as established through the Ganuza-Barros-Vos approach.

As indicated, the latter approach will be used as the minimum standard in the project. More specific instructions will follow regarding the precise procedure and the application of the method when using outcomes of a dynamic CGE.

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