INT DYNAMIC CGE MODEL UPDATE: 2011

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The best possible quantitative policy evaluations require two key elements: (i) cutting-edge models, which are built to best fit for the intended studies far beyond the standard framework; and (ii) accurate and high-quality data to meet the requirements of the studies.

The INT global recursive dynamic CGE model is a full-scale extension of the INT prototype trade-focused, multi-region, static model with the geographic focus on Latin America. While been applied to high profile policy applications-international migration (2010), transport costs (2010/11) and LAC infrastructure (2011), the model has been continuously updated and improved in order to meet the following key objectives: (i) to provide the best possible evaluations with high quality for the relevant policy questions, accommodating uniqueness and specificities for countries and regions under study; and (ii) maintain the state-of-the-art models as the leading institution in CGE modeling in the region, relative to other global and regional institutions. The model sizes are as follows. International migration model comprises 30 countries (16 LAC), three countries of origin (native, high-income and low-income) and three labor categories. The models for transport costs and infrastructure consist of 20 countries (12 LAC) and 30 sectors plus 3 labor categories.

In 2011, together with the updates of the Social Accounting Matrix (SAM) database, the model is being upgraded and elaborated in the following areas.

First, the model explicitly specifies a set of investment-related equations. In this regard, investment is distinguished between the sectors of origin and destination. As in the SAMs, the aggregate investment quantity is specified in a familiar Cobb-Douglas function. The agent's optimization process yields the optimum allocation of sectoral demand of investment by sector of origin. This optimization also generates the aggregate price of capital or price index of investment. Regarding the investment in a dynamic CGE modeling, two key issues arise: (i) how new investment is allocated among sectors?; and (ii) how it is determined by or linked with new capital stock? In the model, these issues are carried out by the introduction of an investment demand function. Following Bourguignon, Branson and de Melo (1989), Fargeix and Sadoulet (1990), and Jung and Thorbecke (2003), the investment demand by sector of destination is specified in the second order quadratic functional form. The speed of investment, defined as the ratio of investment by sector of destination over capital stock in each sector, is an increasing function of rental rate of capital and the inverse of product of price of capital (or price index of investment) times interest rate. The model strictly guarantees two balancing conditions: (i) saving-investment equality; and (ii) the aggregate investment between the sectors of origin and destination in the current value term.

Second, production is modeled in a nested structure with several stages. In particular, labor markets are decomposed into several categories, depending upon the objectives and the nature of the studies. For migration model, labor market is differentiated by natives plus country of origins (developed vs. developing) and skills. For transport costs and infrastructure, it is disaggregated into three labor categories: low, mid and high. This is because labor market is considerably heterogeneous among countries in Latin America on one hand; and mid-skill labor accounts for a substantial share in labor force in the region, in particular mid-size and large countries. Besides, labor-related issues are tremendously critical in Latin America for any policy studies. In order to capture large heterogeneity, segmentation, inflexibility and rigidity in labor market, it is better to accommodate labor market in a greater decomposition. For a Peruvian study, labor market is disaggregated into 96 categories, by skill, gender age and administrative department. For a Colombian study, it is decomposed by 144 categories by skill and administrative department. Due to high labor disaggregation, the static models tailored for each country are applied.

Third, households' consumer preferences are specified by the combination of a Linear Expenditure System for the composite goods, which are in turn expressed in a Constant Elasticity of Substitution (LES-CES) between domestic supply and the aggregate imports. This functional form allows us to capture non-homothetic behavior due to changes in income and non-unitary income elasticities. The supernumerary income for each regional household in the LES function is derived from applying Frisch parameters (Frisch, 1969) , which are estimated from per capita income in each department on the basis of Loughrey and Fellow (2007) and Lluch, Powell and Williams (1977). The advantage of the LES function is that it does not imply the unitary income elasticity of demand. As with demand system expressed by Cobb-Douglas or CES functions, the LES maintains straight Engel curve, but starting from a positive coefficient of the demand space, not from the origin, thereby deviating from the unitary income elasticities.

Fourth, the model has been updated to accommodate two key endogenous between-period equilibrating variables to precisely attain or reach the macro target variables in each period to serve as a baseline scenario: one for macroeconomic projection and the other for labor market. Because the model is recursive dynamic, it operates in a two-stage sequential dynamic formation. . In the first stage, a static module is solved for one period at a time: *within-period* equilibrium. In the second stage, inter-temporal equations linking time-paths update endogenous and exogenous variables as well as parameters for the static module, which then finds a new equilibrium for the next period: *between-period* equilibrium. In order to reach the target real GDP growth trajectory in the baseline, the aggregate total factor productivity (TFP) is computed endogenously in each period. Then because the static module incorporates endogenous labor supply function, labor supply adjustment factor (LADJ) for each labor category is also computed over the projection period. These variables are endogenized in the baseline simulation to meet the macroeconomic and labor force projections, whereas both variables are fixed in the subsequent policy simulations.

Fifth, several macro-related and demographic variables are projected over the period 2020, target year for the standard dynamic simulation exercises. Based on the ILOSTAT projections, population and the aggregate labor force are first projected each year. Based on the changes in skill compositions in the past, labor force is disaggregated into three skill categories (low, mid and high) in each year. The projection of real GDP for each country or region is based on the World Economic Outlook (IMF). In the model, the *subsistence minima* (or committed expenditures) are updated in each period in proportion to the population growth. However, it is assumed that marginal rate of consumption is held constant, implying that household consumption patterns or preferences remain unchanged over the periods. On the other hand, most exogenous variables are projected either on the basis of the population growth or long-term growth trajectory.

Sixth but not the least, **some behavioral model parameters are updated**. Based on a per-capita GDP in the base year, Frisch parameters are updated for each country. Frisch parameters are equal to the ratio of total expenditure to supernumerary expenditure and used to estimate the *subsistence minima*. In addition, elasticity of trade is also updated, on the basis of the INT flagship study on transport costs in Latin America by Moreira, Volpe and Blyde (2008). Elasticity of trade significantly matters for the outcomes of trade-related policy shocks. For the studies on transport costs and infrastructure, trade elasticity for each sector is estimated as a simple average, based on the estimates by Moreira, Volpe and Blyde (2008).

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