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Development and Applications of a Novel Global Economic Model

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Background and purpose of this research

This paper aims at developing a new approach for global economic modeling; specifically, a local currency-based global multi-sectoral model and a model on international finance.

The history of the world economy shows that economic interdependence of nations has been strengthened through trade and investment. Project LINK is a pioneering macroeconometric model which describes a global economy in the context of economic interdependence. Subsequently, many institutions and scholars construct multi-county macroeconometric models. However, recent economic deregulation enables firms to investment overseas. In fact, firm-level foreign direct investment is growing rapidly. Therefore, macroeconometric models are not necessarily adequate for global economic analysis. Instead, a global model at sector level is more appropriate for analyzing the current world economy. Regarding multi-country multi-sectoral models, the following four types of models have been developed: 1) computable general equilibrium (CGE) model, 2) the INFORUM system which interlinks national input-output models with a trade linkage model, 3) single-period international input-output model, and 4) price-linked multi-country multi-sectoral model. However, the first three models have shortcomings: a typical CGE model lacks statistical foundations of parameters; the INFORUM system might have inconsistency between classifications in input-output tables and trade matrix; a single-period international input-output model has limitations in specifications and estimation of behavioral equations due to the use of only a single-period international input-output table. A price-linked multi-country multi-sectoral model improves the flaws of these three models, yet it has a drawback: that is, a currency problem. The model is denominated in international dollars.

In reality, however, economic agents make their decisions by focusing on economic performance of their economies in their currencies rather than a foreign currency. In addition, goods and money flow interdependently, not independently. These models can analyze international trade; however, they cannot deal with international monetary flows. This shows that we must build a local currency-based global model in order to analyze issues on both international trade and finance.

This research is composed of two parts. One is construction of a model on international trade. The other is construction of a model on international finance.

Part I: Construction of a Model on International Trade

International Input-Output Tables in Local Currencies and Constant Prices

In order to develop a global multi-sectoral model, we first constructed our adequate data set.

Currency Conversion

International input-output tables are typically denominated in a single currency: e.g., the OECD

Intercountry Input-Output Tables are evaluated in U.S. dollars. In contrast, local currency-based international input-output tables consist of variables in currencies *h* (country which supplies goods) and *k* (country which demands goods). Following the double deflation technique, intermediate goods, final demand, exports to the third world, statistical discrepancies, and output are denominated in currency *h*. On the contrary, value added is converted into that in currency *k*. In order to hold the consistency between the summation of inputs and demands, intermediate goods are evaluated by currency *k* as well: i.e., we have two sets of intermediates (one is evaluated by currency *h* and the other is by currency *k*).

Deflation

Previous studies show that the RAS approach is more appropriate than the double deflation. However, on many occasions, it is not easy to obtain the required data to employ the RAS approach even for developed countries. Therefore, we apply simpler approach which uses the principles of double deflation. The double deflation method requires price data for each sector and economy prior to deflation: however, it is rare to find proper set of these data. Viewing sectoral GDP deflator as the corresponding sector's value added deflator in the international input-output framework, sectoral price is computed by backtracking the double deflation method.

The Theoretical Structure of the Model

The structure of the model is similar to that of a CGE model: however, economies of scale, imperfect competition and disequilibrium in labor market are included.

Total output is determined by adding up all demand components (i.e., intermediate demand and final demand). Intermediate input by sector, labor demand and capital stock are explained by a generalized Ozaki cost function. Intermediate input by sector is determined by the fixed proportion: however, economies of scale are allowed for labor and capital demands. Intermediate input by sector and country is explained by the Armington approach.

Household income is a function of compensation of employees. Household consumption by sector and that by sector and country are explained by the Cobb-Douglas function and the Armington approach, respectively.

The aggregate investment is explained by capital stock. The Armington approach is employed to determine investment by sector and country.

Following the Phillips curve, the wage rate is explained by price deflator for household consumption and labor productivity. Sectoral price is determined by marginal cost multiplied by markup.

Estimation and Test of the Model

International input-output tables in local currencies and constant prices are constructed by using the OECD Intercountry Input-Output Tables 2015 Edition. Sector is aggregated to 7 sectors and countries are also aggregated to 29 endogenous countries.

Most parameters of the model are econometrically estimated by applying panel data method to

international input-output tables in local currencies and constant prices. Regarding the Armington approach, the base-year fixed proportion is applied for the case of wrong sign on relative price. Approximately 34 percent, 32 percent and 61 percent of intermediates, private consumption, investment are explained by the fixed proportions, respectively.

For the test of the model, we computed the root mean square percentage errors (RMSPEs) of the weighted average of sectoral price and aggregate output. The RMSPEs of the average price are greater than 10 percent for Australia, Ireland, Japan, Mexico, Turkey, the United Kingdom, Indonesia and India while we also found critical errors regarding aggregate output for Australia, Belgium, Ireland, Mexico, Spain, Turkey, the United Kingdom, the United States and China. Although the model shows certain performance, further accuracy is required.

Part II: Construction of a Model on International Finance

Background and purpose of this research

This paper attempts to construct a financial model, linked to a macroeconometric model, which reflects the central bank's balance sheet. In concrete, this model contains several factors in the decision-making of central banks and depository banks, including the determination of long-term and short-term interest rates, the money supply, and stock prices. The two linked models, a financial/macroeconometric model, provide a better guide to explaining how a central bank's monetary policy generates impacts on the real economy via depository banks. Besides, by undertaking a comparative assessment of the cases of Japan and the USA, this study conducts scenario simulation using the two linked models. It thereby offers an alternative solution to current monetary policy that aims to tackle the problem of deflation.

The Theoretical Structure of the Model

The structure of our model consists of two sectors: monetary sector and real sector. The economic activities in the financial sector are composed of a central bank, depository institutions, non-depository institutions/private sectors (households and industries). In particular, the decision make of a central bank is based on the optimal control monetary policy. The depository institutions is explained by the maximization of profit.

Estimation and Test of the Model

The model for Japan consists of 33 simultaneous equations, and the model for the United States consists of 35 simultaneous equations. We conducted the final test from the first quarter 2009 to the third quarter 2016 (Quarterly). While some endogenous variables might not be satisfactory, the overall performance of this system is acceptable.

Besides, we used the two linked models to examine improvement of wage rate and their impact on the movement of GDP price deflator. As a result, it found that the rise of wage rate would become an alternative solution to current monetary policy that aims to tackle the problem of deflation,

especially in Japan.

In a series of this study, it became apparent that macroeconometric model should be modified into more applicable framework for analyzing real economy sufficiently. The traditional macroeocnometric model is so simple and intuitive that it couldn't pursue the detailed causes about global economic issues. In order to address the core of causes, macroeconomic sector would be required to replace to a multi-country/multi-sector econometric model which applies the International Input-Output Tables as database. In particular, in order to analyze global monetary policy, a local-currency-based multi-country multi-sectoral model would be necessary.