General Equilibrium Modeling for Economic Policy Analysis

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Abstract: This paper explores the value concept for explaining the relationship between price and value in the market. This relationship is important in determining market equilibrium and general equilibrium of the economy. Based on theoretical base, the GDP formula is built upon the value added method, and the general equilibrium model is developed upon market equilibriums and macro balances. In addition, the conceptual framework is proposed with macro closures for the context of the policy analysis. The simulation experiment is to conduct changes in target sector structure and macro balances on economic growth and transition. The paper contributes an insight on the general equilibrium of the economy and changes in economic policy on economic growth and transition.

Keywords: value concept, market equilibrium, general equilibrium, policy analysis, economic growth

1. Introduction

Economic growth is always the most important topic in economic literature. Many researchers attempt to identify driven factors on the economic growth that forms the base of economic growth theories. To deal with this problem, economists must understand general equilibrium and GDP measurement of the economy. In addition, it also requires a standard tool to analysis economic policy or economic shock on the economic growth and transition.

Value concept plays a crucial role in determining relationship between demand and supply in markets, and resource allocation between firms and customers. Leon Walras (1874) and Alfred Marshall (1890) argued that both supply (cost of production) and demand (utility) are interdependent and mutually determinant of each other's values. While Alfred Marshall (1890) developed his analysis to explain value in terms of supply and demand. Leon Walras (1874) created his theoretical model of general equilibrium as a means of integrating both the effects of the demand and supply side forces in the whole country. Based on theoretical base, Arrow and Debreu (1954) developed computable general equilibrium (CGE) model to study how an economy react to changes in economic policy. The general equilibrium model is built upon institutions (households, firms, governments, and rest of world), markets (commodity market, factor market, and capital market), and macro balances (saving investment balance, government balance, and external balance). By changing in economic policy or economic shock, new macro balances and market equilibriums will be established for the economy. However, the traditional general equilibrium models use econometric techniques to estimate parameters that ignore inherent linkage of economic data and macro balances.

For that reason, this paper explores value concepts of price, utility and value, in which the utility function is formed with incorporation of price and value. From value creation perspective, the value added method is used for GDP measurement. The GDP formula not only presents driven factors for economic growth, but also is used for the general equilibrium model with constraints of market equilibriums and macro balances. The simulation experiment is to conduct changes in target sector structure and macro balances on the economic growth and transition.

2. Value concept

The concept of value has a very long history in economic and philosophical thought that attempt to explain two meanings of value: *value-in-use* (value) and *value-in-exchange* (price). The difference between value-in-use and value-in-exchange is important because it forms the base of value theories. Most economists tried to make a clear distinction between value and price of a good or service. Baier (1966) offered a broader definition such as "value is the capacity of a good, service, or activity to satisfy a need or provide a benefit to a person or legal entity". Value is something which is perceived and evaluated at the time of consumption (Wikström, 1996; Woodruff and Gardial, 1996; Vargo and Lusch, 2004; Grönroos, 2008). There is a common understanding that value is created in the users' processes as value-in-use (Grönroos, 2011). Since value-in-use (value) is more appreciate guide to well-being than value-in-exchange (price), should economists use the law of diminishing marginal utility to explain demand curve. Thus, the value concept needs to redefine and theory of value should be constructed upon a law of diminishing marginal value (Trinh, 2014a). The theory of value not only interprets relationship between value and price, but also redefines the utility concept in this relationship. Based on this theoretical base, the utility function is formed with the incorporation of value, price (Trinh et al., 2014) as follows.

$$TU = u \times Q = (v - p) \times Q = TV - TR \qquad (1)$$

Where, v, p, and u are unit value, unit price, and unit utility, respectively. TV, TR, and TU are total value, total revenue, and total utility, respectively.

From the value creation perspective, the value creation system involves three processes of production, exchange, and consumption as in Figure 1.

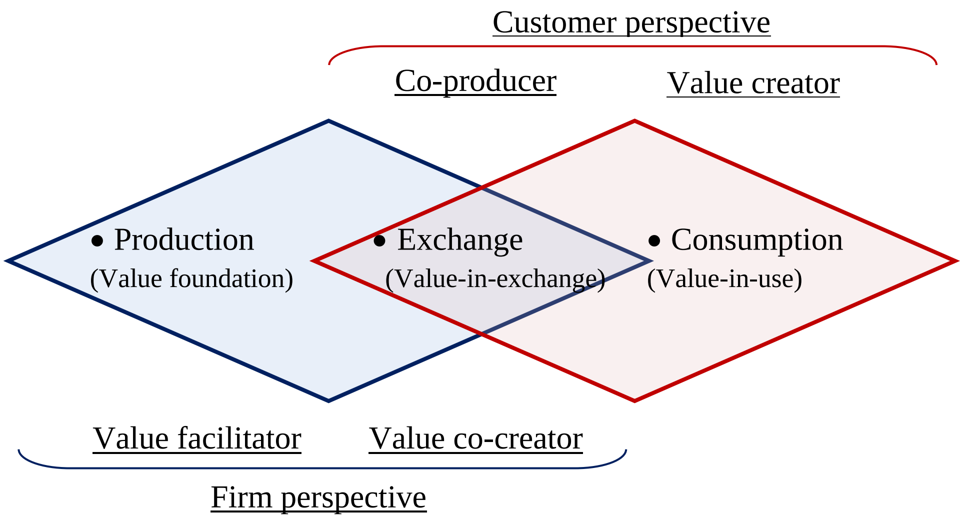

Figure 1: Value creation perspective

Source: Adapted from Grönroos and Voima (2012), Trinh (2014b; Trinh, 2014a)

In firm perspective, the firm takes on the role of value facilitator, and also joins the customer's value creation as a value co-creator. Firm's production function is defined under the form of Cobb Douglas production function as follows:

$$Q = f\left(K_1, L_1\right) = A_1 \times K_1^{\alpha_1} \times L_1^{\beta_1} \quad (2)$$

Where, Q is total output of production. A_1 is firm's total factor productivity. K_1 and L_1 are firm capital and firm labor, respectively. α_1, β_1, are the output elasticities of production input factors.

By using the least-cost combination of production inputs, firm's cost function (TC_1) can be determined as a function of output, depending on input prices and the parameters of the firm's production function as follows:

$$TC_1 = K_1 \times w_{K_1} + L_1 \times w_{L_1} \quad (3)$$

Where, TC_1 is firm's total cost, w_{K_1} and w_{L_1} are unit costs of firm capital and firm labor.

Firm's profit function is determined by the following formula.

$$\Pi = TR - TC_1 = p \times Q - K_1 \times w_{K_1} - L_1 \times w_{L_1} \tag{4}$$

Where, Π is firm profit and TR is total revenue ($TR = p \times Q$).

In customer perspective, the customer is always a value creator. The customer also takes part in the firm's production process as a co-producer. Since the value is created in the consumption process, customer capital (K_2) and customer labor (L_2) are added in the consumption function as follows:

$$Q = f(K_2, L_2) = A_2 \times K_2^{\alpha_2} \times L_2^{\beta_2} \tag{5}$$

Where, Q is total output of consumption. A_2 is customer's total factor productivity. α_2, β_2, are the output elasticities of consumption input factors.

By using the least-cost combination of consumption inputs, customer's cost function (TC_2) can be determined as a function of output, depending on input prices and the parameters of the customer's consumption function as follows:

$$TC_2 = K_2 \times w_{K_2} + L_2 \times w_{L_2} \tag{6}$$

Where, TC_2 is customer's total cost, w_{K_2} and w_{L_2} are unit costs of customer capital and customer labor.

Customer's utility function is determined by the following formula.

$$U = TU - TC_2 = (v - p) \times Q - K_2 \times w_{K_2} - L_2 \times w_{L_2} \tag{7}$$

Where, U is customer utility and TU is total utility ($TU = u \times Q = (v - p) \times Q$).

From the value creation perspective, value is created in the consumption process, both firm cost and customer cost have to consider in value creation. The joint cost function and the joint value function are determined as follows:

$$TC = TC_1 + TC_2 = K_1 \times w_{K_1} + L_1 \times w_{L_1} + K_2 \times w_{K_2} + L_2 \times w_{L_2} \tag{8}$$

$$V = \Pi + U = v \times Q - \left(K_1 \times w_{K_1} + L_1 \times w_{L_1} + K_2 \times w_{K_2} + L_2 \times w_{L_2}\right) = TV - TC \tag{9}$$

Where, V is joint value, TV is total value ($TV = v \times Q$) and TC is total joint cost. w_{K_1} and w_{L_1} are unit costs of firm capital and firm labor. w_{K_2} and w_{L_2} are unit costs of customer capital and customer labor.

In economics, the concepts of value, utility and price are important in the definition of value that has influence on how GDP is measured. The production (value added) approach measures GDP by summing up production value added $\left(p_i Q_i\right)$ of industries in the economy as in Figure 2. The value added method determines production value added $\left(p_{ij} Q_{ij}\right)$ in the industry *i* through exchange processes between the firm and the customer.

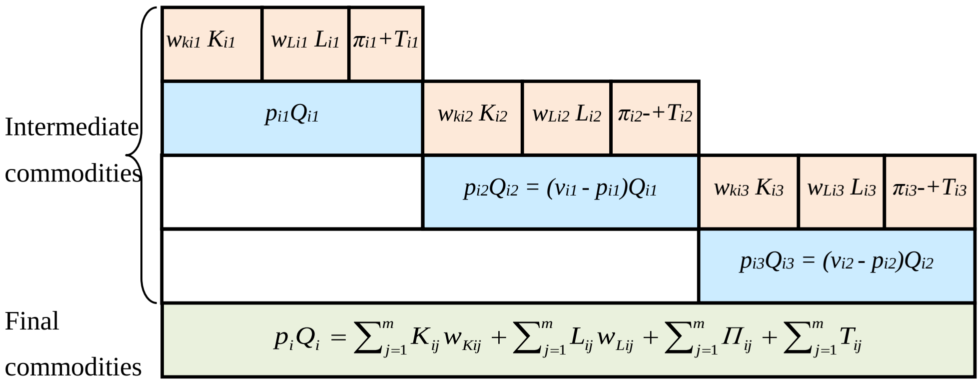

Figure 2: The GDP approaches for industry *i*

For the intermediate exchanges, intermediate firms play dual roles of the firm and the customer. In the initial exchange, firms provide the commodities to customers. Firm profit $\left(\Pi_{i1}\right)$ and customer utility $\left(U_{i1}\right)$ are determined as follows:

$$\Pi_{i1} = p_{i1} \times Q_{i1} - K_{i1} \times w_{K_{i1}} - L_{i1} \times w_{L_{i1}} - T_{i1} \tag{10}$$

$$U_{i1} = (v_{i1} - p_{i1}) \times Q_{i1} - K_{i2} \times w_{K_{i2}} - L_{i2} \times w_{L_{i2}} - T_{i2} \tag{11}$$

Customer then plays a role of the firm in the next exchange. The customer utility (U_{i1}) in the initial exchange is also the firm profit (Π_{i2}) in the next exchange.

$$\Pi_{i2} = p_{i2} \times Q_{i2} - K_{i2} \times w_{K_{i2}} - L_{i2} \times w_{L_{i2}} - T_{i2} \tag{12}$$

$$U_{i2} = (v_{i2} - p_{i2}) \times Q_{i2} - K_{i3} \times w_{K_{i3}} - L_{i3} \times w_{L_{i3}} - T_{i3} \tag{13}$$

For the final exchange, customers are the final consumers that buy the final commodities from the last firms in the exchange processes. Firm profit (Π_{im}) is given as follows:

$$\Pi_{im} = p_{im} \times Q_{im} - K_{im} \times w_{K_{im}} - L_{im} \times w_{L_{im}} - T_{im} \tag{14}$$

Total joint value (value added) of industry *i* is determined by the following formula.

$$\sum_{j=1}^{m} \Pi_{ij} = \sum_{j=1}^{m} p_{ij} \times Q_{ij} - \sum_{j=1}^{m} K_{ij} \times w_{K_{ij}} - \sum_{j=1}^{m} L_{ij} \times w_{L_{ij}} - \sum_{j=1}^{m} T_{ij} \tag{15}$$

From above formula, total production value of industry *i* $\left(p_i \times Q_i + I_i = \sum_{j=1}^{m} p_{ij} \times Q_{ij} + \sum_{j=1}^{m} I_{ij} \right)$ is defined as a sum of production value of intermediate firms, in which total expenditure $\left(\sum_{j=1}^{m} p_{ij} \times Q_{ij} + \sum_{j=1}^{m} I_{ij} \right)$ is equal to total income $\left(\sum_{j=1}^{m} K_{ij} \times w_{K_{ij}} + \sum_{j=1}^{m} L_{ij} \times w_{L_{ij}} + \sum_{j=1}^{m} \Pi_{ij} + \sum_{j=1}^{m} T_{ij} + \sum_{j=1}^{m} I_{ij} \right)$, in which $\sum_{j=1}^{m} I_{ij}$ is capital investment of industry *i*. By setting $K_i \times w_{Ki} = \sum_{j=1}^{m} K_{ij} \times w_{K_{ij}}$, $L_i \times w_{Li} = \sum_{j=1}^{m} L_{ij} \times w_{L_{ij}}$, $\Pi_i = \sum_{j=1}^{m} \Pi_{ij}$, $T_i = \sum_{j=1}^{m} T_{ij}$, $I_i = \sum_{j=1}^{m} I_{ij}$, total production value of industry *i* can be expressed as follows:

$$p_i Q_i + I_i = K_i \times w_{K_i} + L_i \times w_{L_i} + \Pi_i + T_i + I_i \tag{16}$$

Total production value (GDP) of the economy with *n* industries is determined as follows:

$$GDP = \sum_{i=1}^{n} p_i \times Q_i + \sum_{i=1}^{n} I_i \tag{17}$$

$$GDP = \sum_{i=1}^{n} K_i \times w_{K_i} + \sum_{i=1}^{n} L_i \times w_{L_i} + \sum_{i=1}^{n} \Pi_i + \sum_{i=1}^{n} T_i + \sum_{i=1}^{n} I_i \tag{18}$$

By setting $\sum_{i=1}^{n} S_{Fi} = \sum_{i=1}^{n} \Pi_i + \sum_{i=1}^{n} I_i - \sum_{i=1}^{n} D_i$, in which $\sum_{i=1}^{n} S_{Fi}$ is firm savings and $\sum_{i=1}^{n} D_i$ is capital depreciation. Thus, GDP from Equation (18) can be rewritten as follows:

$$GDP = \sum_{i=1}^{n} K_i \times w_{K_i} + \sum_{i=1}^{n} L_i \times w_{L_i} + \sum_{i=1}^{n} S_{Fi} + \sum_{i=1}^{n} D_i + \sum_{i=1}^{n} T_i \tag{19}$$

From Equation (17), setting $PQ = \sum_{i=1}^{n} p_i \times Q_i$ and $I = \sum_{i=1}^{n} I_i$, in which total expenditure on final commodities (PQ) includes personal expenditure (*C*), government expenditure (*G*), and net export (*NX*). GDP measurement under the expenditure approach can be expressed as follows:

$$GDP = C + G + I + NX \tag{20}$$

From Equation (19), setting $LW_L = \sum_{i=1}^{n} L_i \times w_{Li}$, $KW_K = \sum_{i=1}^{n} K_i \times w_{Ki}$, $S_F = \sum_{i=1}^{n} S_{Fi}$, $D = \sum_{i=1}^{n} D_i$, and $T = \sum_{i=1}^{n} T_i$, GDP measurement under the income approach can be expressed as follows:

$$GDP = KW_K + LW_L + S_F + D + T \tag{21}$$

GDP is measured through total income that includes capital interest (KW_K), labor wage (LW_L), firm savings (S_F), capital depreciation (*D*), tax and subside (*T*).

3. General Equilibrium Modeling

Understanding the economy requires a basic knowledge of key flows that influence economic activity. How does government policy influence GDP? It requires some knowledge of economy's structure that includes three main elements: markets, institutions, and macro balances. Figure 3 illustrates a basic structure of the economy that shows how institutions (households, enterprises, governments, and rest of world) interact in markets (commodity market, factor market, and capital market) under macro balances (saving investment balance, government balance, and external balance).

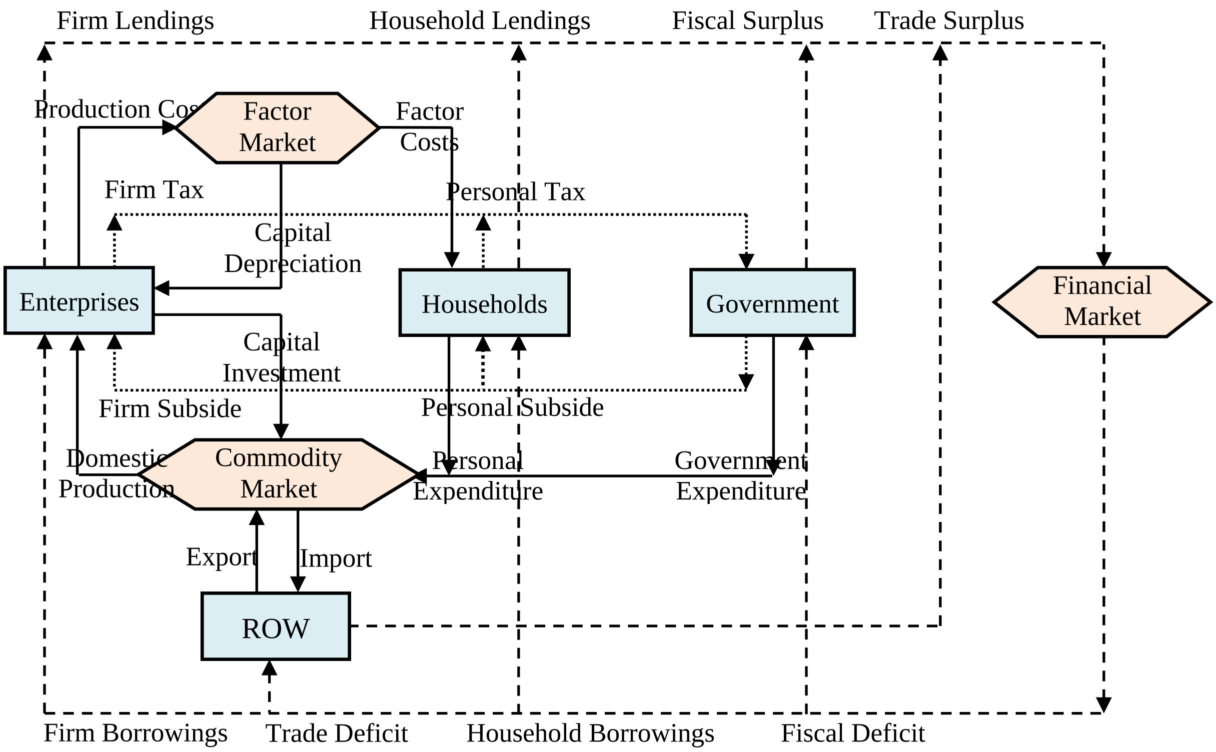

Figure 3: Circular flow diagram of the economy

The circular flow diagram is a simplified representation the structure of the economy that shows the flows of money, commodities, and factors through the economy. The underlying principle is that the flow of money into each market or institution (inflow) is equal to the flow of money out of that market or institution (outflow).

The economy contains four institutions: households, enterprises, governments, and rest of world.

Households receive income from factor markets in form of wages, profit, interest, and rent fees. Households spend for buying goods and services from commodity markets. Households may send their saving or borrow money for their spending from capital markets.

Enterprises receive revenue from providing goods or services for households, governments, rest of world (ROW) on commodity markets. Enterprises also spend on costs of capital and labor on factor markets. Enterprises also need a required capital for their investment. Enterprises may send their profits to capital market or make loans from capital market.

Government collects tax from enterprises and households imposing on goods and services from commodity markets. Government may borrow money for their deficit from capital market or send their surplus to capital market. In addition, government returns a portion of the money it collect from tax in form of subsides that supports for enterprises and households.

A social accounting matrix (SAM) is an economy – wide data framework that presents the real economy of a country. SAM is an accounting framework that assigns numbers to the inflow (income) and outflow (outflow) in the circular flow diagram. A SAM is laid out as a square matrix in which each row and column is called an “account”. Table 1 shows the SAM that corresponds to the circular flow diagram in Figure 3. Each of the boxes in the diagram is an account in the SAM. Each cell in matrix presents by convention, a flow of funds from a column account to a row account. The underlying principle of double-entry accounting requires that for each account in the SAM, total revenue equals total expenditure. This means that an account’s row and column totals must be equal.

Table 1: Basic structure of a SAM

	Commodity C1	**Factor C2**	**Capital C3**	**Households C4**	**Enterprises C5**	**Government C6**	**ROW C7**	**Total**
Commodity R1				Personal Expenditure (C)	Capital Investment (I)	Government Expenditure (G)	Export (X)	Total Demand
Factor R2					Production Costs (KW_K+ LW_L+D)			Factor Demand
Capital R3				Household Lendings (Sc >0)	Firm Lendings ($\Pi > 0$)	Fiscal Surplus (G < T)	Trade Surplus (X < M)	Capital Demand
Households R4		Factor Costs (KW_K + LW_L)	Household Borrowings (Sc < 0)			Personal Subside (S_{bP})		Household Inflow
Enterprises R5	Domestic Production (GDP)	Capital Depreciation (D)	Firm Borrowings ($\Pi < 0$)		Firm Tax (T_F)	Firm Subside (S_{bF})		Enterprise Inflow
Government R6			Fiscal Deficit (G > T)	Personal Tax (T_P)				Government Inflow
ROW R7	Import (M)		Trade Deficit (X > M)					ROW Inflow
Total	Commodity Supply	Factor Supply	Capital Supply	Household Outflow	Enterprise Outflow	Government Outflow	ROW Outflow	

Commodities are supplied by domestic production [R5-C1] and imported from ROW [R7-C1]. This total supply must be equals to total demand that include personal expenditure [R1-C4], capital investment [R1-C5], government expenditure [R1-C6], and export [R1-C7]. Factors are supplied by households [R4-C2] and capital depreciation [R5-C2]. This factor supply is also equal to production costs [R2-C5] demanded by enterprises. Capitals are supplied by household savings [R3-C4] and firm profits [R3-C5]. The capital supply is demanded by government [R6-C3] and rest of world [R7-C3].

Households receive income from providing capital and labor [R4-C2], and used for personal expenditure [R4-C1]. Households may send their savings to capital market [R3-C4] or borrow their deficit from capital market [R4-C3]. Enterprises paid out for production costs [R2-C5], capital investment [R1-C5], and tax [R6-C5]. Enterprises also receive revenue from domestic production [R5-C1] and capital depreciation [R5-C2]. Enterprises may send their profit to capital market [R3-C5] or borrow money from capital market [R5-C3]. Government collects tax from households [R6-C4] and enterprises [R6-C5], and returns personal subside

[R4-C6] and enterprise subside [R5-C6]. It also spends for government expenditure [R1-C6]. Government either borrows money for fiscal deficit [R6-C3 from capital market, or send fiscal surplus to capital market [R3-C6]. ROW pays for export [R1-C7] and receives from import [R7-C1]. ROW send trade surplus [R3-C7] to capital market, or borrow trade deficit [R7-C3] from capital market.

The economy is constructed under macro balances including government balance, external balance, and saving-investment balance.

Government balance is a constraint choice between government savings (the difference between government revenue and government expenditure) and tax rates. Closure (GOV-1) is that government savings is a flexible residual while all tax rates are fixed. Under another closure (GOV-2), tax rates are adjusted endogenously to generate a fixed level of government saving.

External balance is a constraint choice between net export (the difference between export and import) and exchange rates. Closure (ROW-1) is that net export is a flexible, while the exchange rate is fixed. Under another closure (ROW-2), the exchange rate is fixed to generate a fixed level of trade balance (net export).

Saving-investing balance is a constraint choice between investment drivers or saving drivers. Closure (SI-1) is that investment quantities are flexible, while savings is fixed. For another closure (SI-2), investment is fixed to generate a fixed level of saving.

Table 2 shows combinations of closure from macro balances. The proper choice between the different macro closures depends on the context of the policy analysis. There are 8 macro closures that is used to explore the impact of economic policy under simulation experiments. The results provide important insights into the real world tradeoffs, and impacts of macro policies on the economy of a country.

Table 2: The combinations of macro closures

Government Balance	**External Balance**	**Saving-Investment Balance**
GOV-1: Flexible government savings, Fixed tax rate	**ROW-1:** Flexible trade balance, Fixed exchange rate	**SI-1:** Flexible investment, Fixed savings
GOV-2: Fixed government savings, Flexible tax rate	**ROW-2:** Fixed trade balance, Flexible exchange rate	SI-2: Fixed investment, Flexible savings

In the real economy, the economy is expanded with economic policies, such as international trade (NX), tax or subside (T), government expenditure (G), capital investment (I), and capital depreciation (D). Under conditions of market clearance and value balance, the basic general equilibrium model is developed with main assumptions as follows:

1. Households (customers) consume *m* offerings (products or services) with the same preference or consumption parameters.

2. Firms (producers) provide m identical offerings with the same production parameters.

3. The economy has m sectors, and each sector produces only one offering.

4. Demand function is given for each offering under the experiment.

5. International trade (NX), tax or subside (T), government expenditure (G), capital investment (I), and capital depreciation (D) are given parameters in the model.

In order to conduct changes in economic policy, the simulation experiment is carried out on the hypothetical economy with *m* sectors, each sector produce an offering ($j = 1..m$) by using total capital (K_j) and total labor (L_j).The demand function of offering *j* is defined as follows:

Price demand: $$p_j = f\left(Q_j\right) \qquad (22)$$

Market equilibrium condition imposes a condition to equilibrate total supply (Q_j) and total demand $(Q_{Cj} + Q_{Gj} + Q_{NXj})$ for all offerings *(j = 1..m)*.

Market equilibrium: $$Q_j = Q_{Cj} + Q_{Gj} + Q_{NXj} \quad (23)$$

Production function (Q_j) of offering *j* are given as follows:

Production function: $$Q_{Sj} = A_j \times K_j^{\alpha_j} \times L_j^{\beta_j} \quad (24)$$

Total profit function (Π) of all offerings in the economy are determined as follows:

Profit function:

$$\Pi = \sum_{j-1}^{m} p_j \times Q_j - \sum_{j=1}^{m} K_j \times W_{Kj} - \sum_{j=1}^{m} L_j \times W_{Lj} - \sum_{j=1}^{m} T_j \quad (25)$$

Where, T_j is tax or subside of the offering *j* (*j = 1..m*).

The following general equilibrium model is to maximize gross domestic product (GDP) under market equilibrium and macro balances.

The basic general equilibrium model:

Max $$GDP = \sum_{j=1}^{m} P_j \times Q_{Cj} + \sum_{j=1}^{m} P_j \times Q_{Gj} + \sum_{j=1}^{m} P_j \times Q_{NXj} \times EX_j + \sum_{j=1}^{m} I_j \quad (24)$$

Subject to

$$p_{\mathrm{j}} = f(Q_j) \quad \forall j = 1..m \quad (26)$$

$$Q_j = A_j \times K_j^{\alpha_j} \times L_j^{\beta_j} \quad \forall j = 1..m \quad (27)$$

$$Q_j = Q_{Cj} + Q_{Gj} + Q_{NXj} \quad (28)$$

$$P_j \times Q_j = X_j \quad \forall j = 1..m \quad (29)$$

$$\sum_{j=1}^{m} P_j \times Q_{Gj} - \sum_{j=1}^{m} T_j \leq A \quad (30)$$

$$\sum_{j=1}^{m} P_j \times Q_{NXj} \times EX_j \leq B \quad (31)$$

$$\sum_{j=1}^{m} P_j \times Q_{Gj} + \sum_{j=1}^{m} P_j \times Q_{NXj} \times EX_j - \sum_{j=1}^{m} T_j \geq C \quad (32)$$

$$\forall K_j, L_j, P_j, Q_j, Q_{Cj} \; \forall j = 1..m$$

Notations:

Indices:

j: index of sector (j = 1..m)

System parameters:

A_j : Total factor productivity of sector j

w_{Kj} : Unit cost of capital of sector j

w_{Lj} : Unit cost of labor of sector j

α_j : Output elasticity of capital of sector j

β_j : Output elasticity of labor of sector j

Policy parameters:

T_j : Tax or subside impose on sector j

Q_{NXj} : Net export output of sector j

Q_{Gj} : Government expenditure output of sector j

I_j : Capital investment of sector j

D_j : Capital depreciation of sector j

X_j : Target GDP of sector j

EX_j : Ratio between export price and import price

A : Upper bound value of government balance

B : Upper bound value of external balance

C : Lower bound value of saving-investment balance

Variables:

Q_j : Total production output of sector j

Q_{Cj} : Personal expenditure output of sector j

P_j : Unit price of sector j

K_j : Total capital of sector j

L_j : Total labor of sector j

The basic general equilibrium model is developed with the objective function of *GDP*. GDP formula is built upon the value added method. The model is based on equilibrium of total supply and total demand (constraints of (27) and (28), target sector structure (constraint (29), and macro balances (constraints of (30) to (32)). The simulation experiment is carried out on the hypothetical economy with m sectors. Each sector *j* (*j = 1..m*) produces one offering (product or service) with total production output of Q_j (*j = 1..m*) by using total capital (K_j) and total labor (L_j). The domestic price for offering j is given by the demand function $P_j = f(Q_j)$. Net export price is adjusted with a ratio of EX_j (ratio of export price and import price), which depends on exchange rate, export price and import price for the offering *j*.

In order conduct changes in economic policy on the economy, policy constraints of (29), (30), (31), and (32) are added to the general equilibrium model. Constraint (5) sets a target structure of GDP for each sector of the economy $(P_j \times Q_j = X_j)$ (*j=1..m*). Constraint (30) sets an upper bound value (A) for government balance, which is equal to government expenditure $\left(\sum_{j=1}^{m} P_j \times Q_{Gj}\right)$ minus tax and subside $\left(\sum_{j=1}^{m} T_j\right)$. Constraint (31) sets an upper bound value (B) for external balance, which is equal to $\sum_{j=1}^{m} P_j \times Q_{NXj} \times EX_j$. Constraint

(32) sets a lower bound value (C) for saving-investment balance $\left(\sum_{j=1}^{m} P_j \times Q_{Gj} + \sum_{j=1}^{m} P_j \times Q_{NXj} \times EX_j - \sum_{j=1}^{m} T_j\right)$ which equals sum of government balance $\left(\sum_{j=1}^{m} P_j \times Q_{Gj} - \sum_{j=1}^{m} T_j\right)$ and external balance $\left(\sum_{j=1}^{m} P_j \times Q_{NXj} \times EX_j\right)$. From these constraints and combinations of macro closures from Table 2, the model provides optimal solutions for the transformation from the current economy policy to the new economic policy with target sector structure of the economy.

4. Economic Policy Analysis

The simulation experiment assumes that the hypothetical economy has only three sectors (Industry, Agriculture, Service) ($j = 3$). Parameters of the economy are given in Table 3 and Table 4.

Table 3: System parameters of the economy

Sector j	Sign	Industry	Agriculture	Service
Total factor productivity	A_{Sj}	1	1.1	0.9
Unit cost of capital	w_{Kj}	5	4	3
Unit cost of labor	w_{Lj}	4	3	3
Output elasticity of capital	α_j	0.6	0.5	0.7
Output elasticity of labor	β_j	0.4	0.5	0.3

Table 4: Policy parameters of the economy

Sectors j	Sign	Industry	Agriculture	Service
Tax or subside	T_j	30	20	10
Capital investment	I_j	10	15	20
Capital depreciation	D_j	20	15	10
Price Ratio of Export and Import	EX_j	1	1.1	1.2

In order to evaluate changes in sector structure and macro policy, the experiment assumes the same macro closures (GOV-1, ROW-1, SI-1), policy parameters and macro constraints, in which government balance is less than or equal to 100, external balance is less than or equal to 500, and saving-investment balance is greater than or equal to 300. There are three 3 experimental models of the economy as follows:

Model 1: The economy has the current sector structure of 30% Industry, 35% Agriculture, and 30% Service.

Model 2: The economy has the target sector structure of 35% Industry, 30% Agriculture, and 30% Service.

Model 3: The economy has the target sector structure of 35% Industry, 25% Agriculture, and 35% Service.

In order to conduct how the economy allocates resources under macro balances, market demand of the sectors (Industry, Agriculture, Service) are given under the law of diminishing marginal value as follows:

Industry demand: $p_1 = \frac{1}{5}Q_1 + 20$

Agriculture demand: $p_2 = \frac{1}{2}Q_2 + 25$

Service demand: $p_3 = \frac{1}{8}Q_3 + 15$

Table 5: Simulation results of the economy

Models	Formula	Model 1	Model 2	Model 3
Total output	$Q_j = Q_{Cj} + Q_{Gj} + Q_{NXj}$	71.20	86.58	119.46
Firm profit	$\Pi = \sum_{j-1}^{m} p_j \times Q_j - \sum_{j=1}^{m} K_j \times W_{Kj} - \sum_{j=1}^{m} L_j \times W_{Lj} - \sum_{j=1}^{m} T_j$	10	159.11	24.57
Personal expenditure	$C = \sum_{j=1}^{m} p_j \times Q_{Cj}$	598.42	585.23	659.63
Government expenditure	$G = \sum_{j=1}^{m} p_j \times Q_{Gj}$	79.16	46.44	96.77

Customer saving	$S_C = \sum_{j=1}^{m}(K_j \times w_{Kj} + L_j \times w_{Lj}) - \sum_{j=1}^{m} p_j \times Q_{Cj}$	295.16	327.33	462.05
Firm saving	$S_F = \Pi + \sum_{j=1}^{m} I_j - \sum_{j=1}^{m} D_j$	10.00	159.11	24.57
Total saving	$S = S_C + S_F$	305.16	486.44	486.62

Sources: These above formulas are adapted from Trinh (2014b)

Table 6: Results of changes in GDP and macro balances

Models	Formula	Model 1	Model 2	Model 3
% Industry	X_1	30%	35%	35%
% Agriculture	X_2	35%	30%	25%
% Service	X_3	35%	35%	40%
GDP	*GDP*	1008.57	1176.67	1251.25
Government Balance	$\sum_{j=1}^{m} P_j \times Q_{Gj}$ - $\sum_{j=1}^{m} T_j$	19.16	-13.56	36.77
External Balance	$\sum_{j=1}^{m} P_j \times Q_{NXj} \times EX_j$	286.00	500.00	449.85
Saving-Investment Balance	$\sum_{j=1}^{m} P_j \times Q_{Gj} + \sum_{j=1}^{m} P_j \times Q_{NXj} \times EX_j - \sum_{j=1}^{m} T_j$	305.16	486.44	486.62

The expenditure approach measure GDP by using data on personal expenditure, capital investment, government expenditure, and net export. GDP using in the expenditure approach is the sum of personal expenditure (*C*), capital investment (*I*), government expenditure (*G*), and net export (*NX*). Table 6 shows the expenditure approach for GDP measurement of the economy.

$$GDP = C + I + G + NX \quad (33)$$

Table 7: The expenditure approach for GDP measurement

Items	Symbol	Model 1	Model 2	Model 3
Personal expenditure	C	598.42	585.23	659.63
Capital investment	I	45.00	45.00	45.00
Government expenditure	G	79.16	46.44	96.77

Net export	NX	286.00	500.00	449.85
Gross Domestic Product	GDP	1008.57	1176.67	1251.25

The income approach measures GDP by summing up the incomes that firms pay households for the resources they hire such as labor wage ($L \times W_L$), capital interest ($K \times W_K$), firm saving (S_F), capital depreciation (D), tax and subside (T). GDP using the income approach is the sum of personal expenditure (C), capital depreciation (D), total saving (S), tax and subside (T). Table 7 shows the expenditure approach for GDP measurement of the economy.

$$GDP = C + D + S + T \tag{34}$$

Table 8: The income approach for GDP measurement

Items	Symbol	Model 1	Model 2	Model 3
Capital interest	$K \times W_K$	406.96	539.02	551.41
Labor wage	$L \times W_L$	486.61	373.54	570.27
Firm saving	S_F	10.00	159.11	24.57
Capital depreciation	D	45.00	45.00	45.00
Tax and subside	T	60.00	60.00	60.00
Gross Domestic Product	GDP	1008.57	1176.67	1251.25

Table 9: SAM results for Model 3

	Commodity C1	**Factor C2**	**Capital C3**	**Households C4**	**Enterprises C5**	**Government C6**	**ROW C7**	**Total**
Commodity R1				659.63	45	96.77	677.04	**1478.44**
Factor R2					1166.68			**1166.68**
Capital R3				462.05	24.57			**486.62**
Households R4		1121.68						**1121.68**
Enterprises R5	1251.25	45						**1296.25**
Government R6			36.77		60			**96.77**
ROW R7	227.19		449.85					**677.04**
Total	**1478.44**	**1166.68**	**486.62**	**1121.68**	**1296.25**	**96.77**	**677.04**	

SAM result indicates that total supply is equal to total demand for all markets. Saving-investment balance ($\Pi + S_c = 486.62$) comes from firm profit ($\Pi = 24.57$) on the commodity market and customer saving ($S_c = 462.05$) on the factor market. Government balance and external balance is adjusted on the capital market, in which saving-investment balance (486.62) is also equal to sum of government balance (36.77) and external balance (486.62).

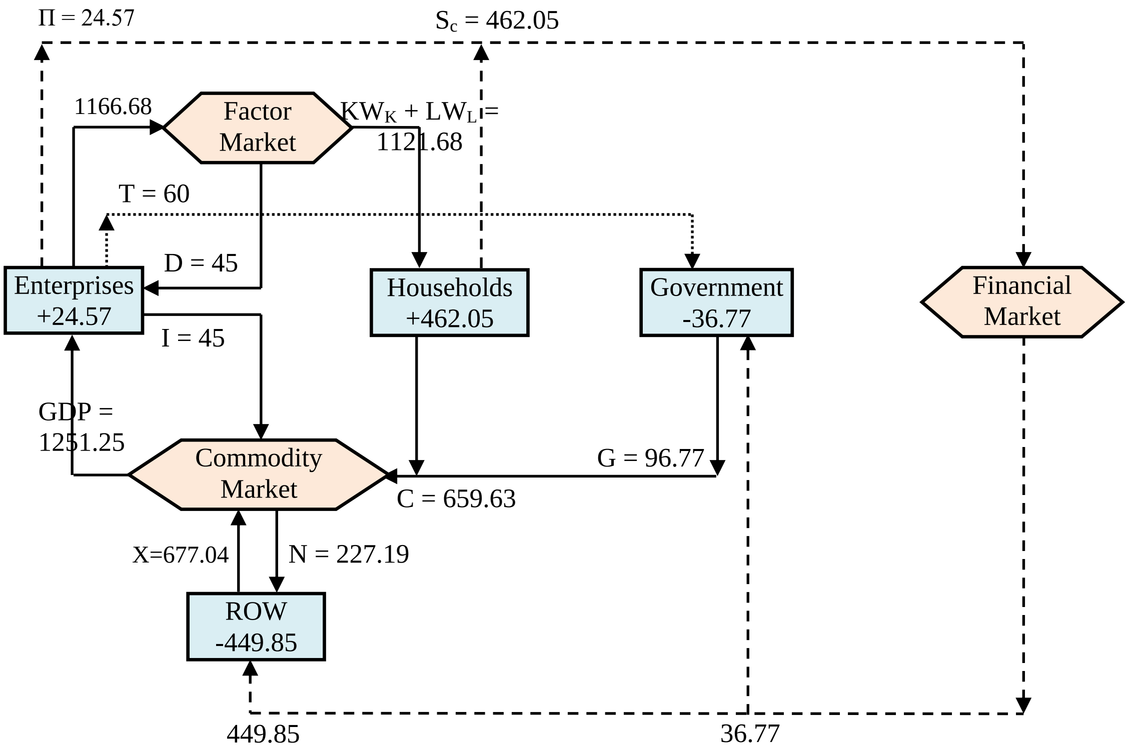

Figure 4: The circular flow of the Model 3

Figure 4 illustrates the circular flow of income and expenditure. Households receive capital interest and labor wage ($K \times W_K + L \times W_L = 1121.68$) from the factor market, and make personal expenditure ($C = 659.63$) in the commodity market. Firms make capital investment ($I = 45$) and get capital depreciation ($D = 45$), government purchases commodities ($G = 96.77$), and the rest of the world purchases net export ($NX = 449.85$). Total saving ($S = 486.62$) includes customer (householder) saving ($S_C = 462.05$) and firm saving ($S_F = 24.57$).

Customer saving (S_C = 462.05) and firm profit (Π = 24.57) would lend in the financial market, where government and the rest of the world would borrow to finance their deficits.

5. Conclusions

Theory of value encompasses all the theories within economics that attempt to explain meanings of value and price. Neoclassical economists argue that the value has origins in exchanged and used process and price is depended on its utility. However, the utility is still a conceptual that economist is used to explain demand curves. In fact, the utility concept has also the same meaning with the value concept in modern economies, in which the value is created in consumption. Since the value concept is more appreciate guide to well being than the price concept, the theory of value refines the relationship between value and price. In addition, the utility function is formed with incorporation of value and price that is also used for GDP measurement. The GDP formula is important to not only explain endogenous and exogenous variables, but also analyze economic growth and transition in the general equilibrium model.

In order to analyze how economic policy or economic shock has influence on the economy, the general equilibrium model is developed with the objective function of GDP, and constraints of market equilibriums and macro balances. A framework of economic policy analysis is proposed with the different macro closures that depend on the context of the policy analysis. The simulation experiment is carried out on the hypothetical economy with three typical sectors (Industry, Agriculture, and Service). The experiment is to conduct changes in economic policy (target sector structure, government balance, external balance, saving-investment balance) on the economic growth and transition. The paper contributes an insight on general equilibrium of the economy, conceptual framework for policy analysis on economic growth and transition.

However, the study has some limitations that also suggest for further researches: (1) since the general equilibrium model is developed upon economic data from SAM, linkage of national accounts and SAM should be studied in future; (2) the demand function is assumed in the general equilibrium model, the further researches need to analyze determinants of demand and forecast market price; (3) it also assumes market equilibriums, in which total production output are totally consumed by households, governments, and rest of world; (4) the research should expand with multiple sectors and with SAM data for the economy.

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