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Thai Economic Development and Optimal Tax on Economic Sectors (Multisectoral Dynamic Model Analysis)

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This paper studies the linkages of each economic sector to the rest of Thailand's economy, utilizing a dynamic multi-sector general equilibrium with government intervention. In the model, agriculture functions as a provider of food for consumption, a provider of labor to other sectors, and a provider of intermediate factors of production to manufacturing. All coefficients and parameters are directly or otherwise adjusted and calculated from real data. Then, the results of the calibration of neo-classical growth model with infinite time horizon and results of the optimal tax thresholds are reported.

Field of Research: Macroeconomics, Quantitative Economics, Economic Growth and Development, Economic Policy

1. Introduction

"It is our contention that 'balanced growth' is needed in the sense of simultaneous efforts to promote agricultural and industrial development. We recognize that there are severe limitations on the capacity of an underdeveloped country to do everything at once. But it is precisely this consideration which underscores the importance of developing agriculture in such a way as to both minimize its demand on resources most needed for industrial development and maximize its net contribution required for general growth." Johnston and Mellor (1961)

This paper examines the role of government tax on economic sectors in the development of the Thai economy. During the 1950s, Thailand's three major exports were agricultural products: rice, teak, and rubber. In 1960, the agricultural sector accounted for 40% of Thailand's GNP and employed the majority of the Thai work force. At the time, many of the nation's manufacturing facilities were involved in processing agricultural products. Sawmills, rice mills, ice factories, tobacco-curing plants, sugar-processing facilities, and canneries employed large numbers of people. In this regard, it is perhaps not an overstatement that agriculture played an extremely significant role in the Thai economy and could be considered the primary force driving the economy during those years. Once reforms were enacted and continuously exercised, the agricultural sector went into decline. In 1993, agriculture accounted for

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only 12% of the GNP, even though the sector employed 57% of the work force. Today, Thailand's fastest growing economic sector is the manufacturing industry. However, Thailand remains one of the world 's leading exporters of rice and tapioca, and the nation is a major producer of canned pineapples, frozen shrimp, sugar, natural rubber, and a multitude of fresh fruits and vegetables.

In this paper, of interested are at last aimed at policy implications and recommendations. Recently, it has been suggested that the intervention of the government as a public service provider (infrastructure, education, etc.) is one of the major determinants of other sectors’ as well agricultural growth and is a significant source of productivity gains (see Mundlak and others, 2002). Often, the analysis of this phenomenon requires the fusion of economy-wide/macroeconomic and sector-specific policy tools. Such questions are more appropriately dealt with using general equilibrium analysis in which all the sectors in the economy are considered as one linked system where changes in any part affect prices and output economy-wide.

First, this paper begins with an Introduction that includes the significance, and an Overview of the Thai Economy, and objectives of this study. Then, second, a Brief Review of Related Literature and Theoretical Framework with Model Specification and Results. Conclusion and Bibliography are last.

2. Review of Literature

In Romer’s model, the source of technological change is explained endogenously. Within this approach, Hirschman(1958), Baldwin(1966) , and Lewis(1954) were the first modern economists to emphasize the importance of the agricultural sector. W. Arthur Lewis was a pioneer of the modern version of the two-sector labor-surplus model. Like Ricardo before him, Lewis concentrated on the implication of surplus labor for the distribution of income. Echevarria (1995, 1997, 2000) and Roe et. al (2003) studied a three-sector economy where the agricultural, primary goods, and industrial sector each employs a sector-specific factor: land, capital, and labor. In Echivarria, the preference of the consumer is a non-homothetic preference. She concluded that sector composition might account for the difference in growth rates among countries. Irz and Roe (2000) analyzed the role of agriculture in the process of economic growth in Sub-Saharan Africa, using the Ramsey model with a two-sector economy. They imposed agricultural production on a fixed but degrading land and characterized non-homothetic preferences to apply Engel’s law. Then, with the closed economic environment, they concluded that high agricultural productivity is conducive to a fast transition to a regime of modern economic growth due to the linkage between relatively cheap food and savings. Their analysis, however, did not consider the changing of factors over time or any policy interventions and relied heavily on Engel’s Law. Li(2002) documented the features of a 1998 social accounting matrix (SAM) for Thailand. Recently, studies of the agricultural sector have also included natural resource considerations. Sachs and Warner (1995) studied why economies with abundant natural resources have tended to grow less rapidly than resource-scarce economies. They concluded that economies with a high ratio of natural resource exports to GDP in 1971 (the base year) tended to have low growth rates during the subsequent period 1971-89. Finally, Mundlak, Y., Larson, D.F. and Butzer, R. (2003) concluded that accumulation from policy driven investments in human capital and public infrastructure was the key factor across countries. Policies that ease constraints on factor markets and promote public investment in people and infrastructure provide the best opportunities for agricultural growth.

This paper studies the linkages to economic sectors of the economy, applying a four-sector model with government intervention in terms of public good and output taxes. After developing an overall picture of the Thai economy by national account, a SAM is developed as an analysis tool. Next, the importance of agriculture in economic growth is analyzed theoretically, placing it among other sectors in the economy. The steady-state solution is obtained by the method developed in Mulligan and Sala-i-Martin (1991). Furthermore, to round out the overall economic picture, the total factor productivity (TFP) between agriculture and overall growth is presented. Pursuant to this, an analysis of governmental policy is developed.

3. Social Accounting Matrix (SAM)

To form a CGE model, the first step is organizing the data into a social accounting matrix (SAM), and this should conform to the national account. Here, the analysis uses SAM 1990, pre-devaluation, the fixed exchange rate SAM is developed specifically and is unlike ordinary SAMs where trade is always balanced and the exchange rate system is always flexible. This innovation allows for the nation's status in exchange-rate intervention and the status of over- or under-supply of production in the economy to be reflected in the model. All coefficients are from the real data. There are 29 agricultural sectors classified into two subcategories, by the high/low proportion to produce intermediate for manufacture: (a)Agriculture1 (high manufacture-intermediate proportion) [12]: Paddy, Cassava, Sugar Cane, Palm Nut and Oil Palm, Kenaf and Jute, Crops for Textile and Matting, Tobacco, Cattle and Buffalo, Swine, Poultry, Logging, and Other Forestry Products. (b)Agriculture 2 (low manufacture-intermediate proportion) [17]:Maize, Other Cereals, Other Root Crops, Beans and Nuts, Vegetables, Fruits, Coconut, Coffee and Tea, Rubber, Other Agriculture Products, Other Livestock, Poultry Products, Silk Farming, Agricultural Services, Charcoal and Firewood, Ocean and Coastal Fishing, and In-land Water Fishing. Manufacturing sectors [93 sub-sectors] and Services and others [58 sub-sectors].

To form a CGE model, the first step is organizing the data into a social accounting matrix (SAM), and this should conform to the national account as the balance sheet showed in table 1.

Table 1: Thailand National Accounts Balance Sheet

Thailand National Accounts Balance Sheet for 1990 (current billion baht)

(real data for the social accounting matrix with the baseline conceptual framework)

	Income		*Expenditure*
GDP			
GDP at factor cost	1891.2	Government consumption	205.4
Indirect taxes less subsidies	292.3	Private consumption	1235
(Business Tax)		Gross capital formation	903
Indirect taxes	312.7	Export	745.3
Subsidies	*20.4*	*Less import*	*909.5*
		Statiscal discrepancy	*4.3*
Total GDP	**2183.5**		**2183.5**
GNP			
Total GDP	2183.5	Final consumption	1440.4
		Private consumption expenditure	1235
		Government	205.4
Net factor income payment/transfer	-27.4		
(Net from abroad)		Gross saving	903
		Current transfers to	-186.3
		the rest of the world	
		Statiscal discrepancy	*-1*
Total GNP	**2156.1**		**2156.1**
Capital Accounts			
Domestic saving	716.7	Gross capital formation	903
Net foreign saving	186.3		
Total	**903**		**903**
External Transactions			
Exports of goods and services	745.3	Imports of goods and services	909.5
Net factor income/current transfer payment	164.2		
from the rest of the world			
(not including explicit in the SAM here)			
Total	**909.5**		

Source: - Various National Income and Account Tables and Data, NESDB
- Various Economic and Financial Statistics Data, Bank of Thailand

3.1 Cell Entries

Macro SAM cell entries are in the format (Row, Column), where the industry pays to the commodity account for intermediate input. All money is provided in the 1990 1,000 million Thai baht unit of currency.

1. Intermediate input, (Commodity, Industry), refers to the total intermediate input demanded. In this model, only agriculture-intermediate input to manufacture is considered.
2. Returns to primary factors (Value-added), refers to the total value of the primary factors of production labor, capital, and land.
3. Indirect taxes, shows the total indirect taxes, including domestic taxes on goods and services production.
4. Domestic production indicates the domestic marketed product in the economy.
5. Imports, (Trade, Commodities), refers to total imports of goods and services.
6. Household income, (Institutions: Households, Factors), includes wages, salaries, and compensation paid to households.
7. Private consumption, (Commodities, Institution: Households), refers to households' consumption of marketed commodities, including imports.
8. Households' savings, (Capital, Households), shows the total savings by household, which is the remainder from consumption of income households receive at factor cost.
9. Government transfers to productions, (Industry, Government), indicates public services that the government provides and that industries absorb. The model assumes that each industry pays indirect taxes keyed to the amount of the benefit it absorbs.
10. Government consumption, (Commodities, Government), shows total government expenditures on goods and services (including imports).
11. Investment expenditures, (Commodities, Capital), indicates the sum of gross fixed capital formation and change in stocks.
12. Net investment to the rest of the world, (Rest of the World, Capital), is the difference between foreign saving/investment at home and domestic saving/investment abroad.
13. Exports, (Commodities, ROW: Exports), refers to total exports of goods and services.
14. Balance of payment deficit, (Foreign exchange credits to consume, ROW: Exports).
15. Foreign exchange funds from monetary authority, (Capital, Foreign exchange: investment).

4. Economic Model of Thailand (General Equilibrium Model)

4.1 Base Model Assumptions

The model begins with a base model comprised of four sectors: (a) manufacturing sector, (b) first agricultural sector (as an intermediate to manufacture), (c) second agricultural sector (produces its own final good), and (d) service sector (home good). The purpose is to compare and evaluate the difference, if any, between the two agricultural sectors. In addition, the model includes government intervention as output taxes are levied on every sector to constitute productive public good. This pubic good also enters into each sector's production function. Government taxes a portion of the private output and then uses these purchases to provide public goods (G) to private producers. The government production function, thus, does not differ in form from each firm's production function (Barro and Sala-I-Martin, 1995, p. 153). The government is assumed to utilize all the taxes towards the public good, with no wasteful exploitation along the way. The characteristics of public good, according to Samuelson (1954), are as follows: G is non-rival and non-excludable and each firm makes use of all of G, where one firm's use of the public good does not diminish the quantity available to others.

With no externality, the base model is of a small, open economy constituted by four sectors, producing three final goods and one intermediate good or, from another perspective, three traded goods and one home good: manufacture, agriculture (as final good), agriculture (as some part is a primary to manufacture) and service. These sectors are respectively endowed with three factors: two economy-wide factors (i.e., capital and labor) and one sector-specific factor (i.e., land). The model has the following assumptions:

First, homogeneous product is assumed on each type of goods; so that we can apply the representative case. For the economic agents' side, second, it is assumed that the economy is inhabited by an infinitely-lived representative agent and a government agent. Third, to better represent the real economy, which evolves over time, the model assumes some labor-productivity (population) growth and also technological growth. Fourth, the model presumes full employment, as if every labor represents the total population at each instant of time. For production's side, fifth, sector outputs are produced by capital and labor for every sector, in addition to land specifically for agricultural sector and intermediate agricultural input for manufacturing sector. Here, no depreciation allowance for capital is assumed, for simplicity's sake. Sixth, there is perfect competition. Labor and capital are mobile across sectors within countries, and land is sector-specific. Each sector's capital allocation is fixed at the beginning of each period. Seventh, output is perishable if used for consumption or as an intermediate-input and durable if used for investment.

4.2 Define Functions

In this perfectly competitive decentralized economy where households maximize the discounted value of their dynastic utility over an infinite horizon, the households are identical in tastes and preferences, as well as in terms of initial endowments. Representative households purchase goods j for consumption, save capital stock by accumulating additional assets , and own (a) labor service *(L)*, (b) capital assets (*A*), and (c) land (*T*). These factors yield earnings as wage (*w*), interest income (*r*), and land rent (ζ), respectively. Preferences are time separable and, preliminarily, utility is iso-elastic and leisure is not taken into account. An individual maximizes infinite-time utility subject to a budget constraint such that, in any period, the consumption and investment expenditures do not exceed total income in that period. There are three types of firms (with no hybrids). First, manufacturing firms (*m*) who demand labor and capital for production. Second, agricultural producers (*a*) who demand labor, capital, and land for production, where sub-sector a1 represents agricultural firms whose output is also an intermediate good for manufacturing firms and sub-sector a2 represents agricultural producers who produce output as an agricultural final good. Lastly, there are the service producers (*s)* who demand labor and capital for production. The government levies tax by unit of output on each firm and provides public service, which each firm can use in its production. The ability to utilize this government service depends upon the capability of the firm's labor. The price of traded goods in the world market is fixed and assumes purchasing power parity holds.

Define Functions:
A representative consumer (Ramsey-type) maximizes a weighted sum of all future flows of utility:

$$\int_{t=0}^{t-\infty} \frac{u(\hat{c}_{j,t})^{1-\theta}-1}{1-\theta} e^{(n-\rho)t} dt$$

where goods $\hat{c}_j = \frac{c_j}{a(t)L(t)}$, $_{j=m,a1,a2,s}$

$$L(t) = e^{nt}L(0)\ , \quad a(t) = e^{xt}$$

Subject to $\dot{A} = w_t L_t + r_t A_t + \varsigma_t T_t - E_t$ given A_0, T_0

$E_t = P_{m,t}c_{m,t} + P_{a,t}c_{a,t} + P_{s,t}c_{s,t}$; $c_{j,t} \geq 0,\ j = m,a1,a2,s \quad \forall t$

No-Ponzi: $\lim_{t\to\infty} A_t \left(\frac{1}{1+r}\right)^t \geq 0$ Tranversality condition: $\lim_{t\to\infty} A(t) e^{-\int_0^t r(s)ds} \geq 0$

Define Equilibrium:

Given $\{k_0$, l_0, T_0, x, $n\}$, $\{G_0, \tau_1, \tau_{21}, \tau_{22}, \tau_3\}$, a government-distorted competitive equilibrium allocation comprises of a sequence of quantities:

(a) $\left\{\left\{\hat{c}^*_{j,t}\right\}_{j=m,a2,s}, \hat{l}_t^{s^*}, \hat{k}_t^{s^*}, T_t^{s^*}\right\}_{t=0}^{\infty}$ for household;

(b) $\left\{\left\{\hat{y}^*_{j,t}, \hat{y}^*_{a1m,t} \hat{l}^{d^*}_{j,t}, \hat{k}^{d^*}_{j,t}\right\}_{j\in\{m,a1,a2,s\}}, \left\{T^*_{aj,j\in\{1,2\}}\right\}\right\}_{t=0}^{\infty}$ for firms, with associated explicit price vector $\left\{w_t^*, r_t^*, \left\{P^*_{j,t}\right\}_{j=m,a,s}\right\}_{t=0}^{\infty}$ and implicit price array $\left\{\varsigma_t^*\right\}_{t=0}^{\infty}$ such that $\forall t$,

Given $\left\{w_t^*, r_t^*, \left\{P^*_{j,t}\right\}_{j=m,a,s}, \varsigma_t^*\right\}_{t=0}^{\infty}$; $\left\{\left\{\hat{c}^*_{j,t}\right\}_{j=m,a,s}, l_t^{s^*}, \hat{k}_t^{s^*}, T_t^{s^*}\right\}_{t=0}^{\infty}$ solves

(P1) $$\underset{\{c_{j,\{j=m,a1,a2,s\}}(t),A(t)\}}{Max} \int_{t=0}^{t=\infty} \frac{u(\hat{c}_{j,t})^{1-\theta}-1}{1-\theta} e^{(n-\rho)t} dt \quad ; c_{j,t} \geq 0, \quad j = m,a1,a2,s \quad \forall t$$

Subject to $\dot{\hat{k}} = \hat{w} + \hat{k}(r-x-n) + \zeta T - \hat{E}$ Give $\hat{k}_0, T_0$ …... 1.(a)

$E_t = P_{m,t}c_{m,t} + P_{a,t}(c_{a1,t} + c_{a2,t}) + P_{s,t}c_{s,t}$ …….. 1.(b)

Transversality holds: $\lim_{t\to\infty} A(t)e^{-\int_0^t r(s)ds} \geq 0$ …… 1.(c)

(2) Given $\left\{w_t^*, r_t^*, \{P_{j,t}^*\}_{j=m,a,s}, \zeta_t^*\right\}_{t=0}^{\infty}$; $\left\{\left\{\hat{y}^*_{j,t}, \hat{y}^*_{a1m,t}, l_{j,t}^{d^*}, \hat{k}_{j,t}^{d^*}\right\}_{j\in(m,a,s)}, T_1^*, T_2^*\right\}_{t=0}^{\infty}$; solves (P2) $\underset{\{l_{m,t},k_{m,t}\}}{Max} P_{m,t}\hat{y}_{m,t} - \hat{w}_t l_{m,t} - r_t\hat{k}_{m,t} - P_{a,t}\hat{y}_{a1m,t} - \tau_1\hat{y}_{m,t}$, non-negativity, condition (2.i)

where $\hat{y}_{a1m,t}$ is the agriculture good sub-sector 1 used as intermediate good for manufacturing production

(P3) $$\underset{\{l_{a1,t},k_{a1,t}\}}{Max} P_{a,t}\hat{y}_{a1,t} - \hat{w}_t l_{a1,t} - r_t\hat{k}_{a1,t} - \zeta_t T_1 - \tau_{21}\hat{y}_{a1,t}$$

with $T_1 + T_2 \leq \bar{T}$ and $\frac{T_i}{T}|_{i=1,2}$ fixed, non-negativity (2.ii)

(P4) $$\underset{\{l_{a2,t},k_{a2,t}\}}{Max} P_{a,t}\hat{y}_{a2,t} - \hat{w}_t l_{a2,t} - r_t\hat{k}_{a2,t} - \zeta_t T_2 - \tau_{22}\hat{y}_{a2,t}$$

with $T_1 + T_2 \leq \bar{T}$, and $\frac{T_i}{T}|_{i=1,2}$ fixed, non-negativity (2.iii)

(P5) $\underset{\{l_{s,t},k_{s,t}\}}{Max} P_{s,t}\hat{y}_{s,t} - \hat{w}_t l_{s,t} - r_t\hat{k}_{s,t} - \tau_3\hat{y}_{s,t}$,non-negativity(2.iv)

(3) Commodities $\forall t$, $\hat{E}_{m,t} = \hat{y}_{m,t} - \hat{c}_{m,t} - \dot{\hat{k}}_t - \hat{k}_t(x+n) \lesseqgtr 0$

$\hat{E}_{a1,t} = \hat{y}_{a1,t} - \hat{c}_{a1,t} - \hat{y}_{a1m,t} \lesseqgtr 0$ $\hat{E}_{a2,t} = \hat{y}_{a2,t} - \hat{c}_{a2,t} \lesseqgtr 0$ $\hat{E}_{s,t} = \hat{y}_{s,t} - \hat{c}_{s,t} = 0$

Factors $\forall t$, $\sum_j^{m,a1,a2,s} L_{j,t} = \bar{L}$ $\sum_j^{m,a1,a2,s} k_{j,t} = \bar{K}$ $\sum_j^{a1,a2} T_{j,t} = \bar{T}$

(4) $\forall t \geq 0$: $P_{m,t}\tau_1\hat{y}_{m,t} + P_{a,t}(\tau_{21}\hat{y}_{a1,t} + \tau_{22}\hat{y}_{a2,t}) + P_{s,t}\tau_3\hat{y}_{s,t} = \underline{P_c}_t G_t$

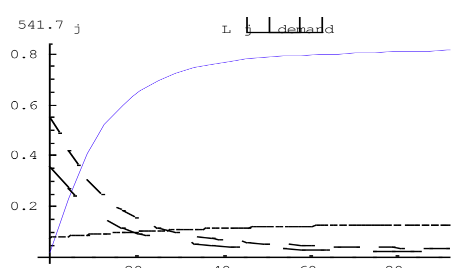
(5) No-arbitrage condition, $\forall t \geq 0$: $r = \frac{\varsigma + \dot{P}_L}{P_L}$

In principle, this system can be solved to express each of the endogenous variables $\{\hat{w}^*, r^*, \hat{y}_m^*, \hat{y}_s^*, \hat{p}_s^*\}$ as a function of the exogenous variables $\{p_m^*, p_a^*, T_1, T_2\}$ and the remaining endogenous variables $\left\{\hat{k}^{*},\hat{E}^{*}\right\}$ at each instant of time $t=0...\infty$. Differential equations are non-autonomous and thus difficult to solve directly. The time-elimination method developed by Mulligan and Sala-i-Martin (1991, 1995) is employed. Since at the steady state, $\dot{p}_{s(t)}$ and $\dot{\hat{k}}(t)$ approach zero, a linearization of the steady-state neighborhood is conducted. The simulations then are confined to macroeconomic variables and the comparisons are between variances and co-variances. Then, all the rest of endogenous variables are obtained.

5. Calibration Result

The calibrated share parameters in the Cobb-Douglas production function for labor are 0.49 in the manufacturing sector, 0.75 in both agriculture 1 and agriculture 2, and 0.22 in the service sector. The agricultural value-added accounted for 12 percent of GDP, manufacturing for 28 percent, and the remaining 60 percent is comprised by the service sector and other sectors. The indirect taxes in agriculture 1, agriculture 2, manufacturing, and services are 0.65, 1.01, 3.61, and 8.01 percent of GDP, respectively. The rate of time preference calculated from the Euler equation is 0.032. Path of the amount of labor in each sector (Lj&t) Figure 1 shows the amount of labor employed in manufacturing (L1), agriculture 1 (L21), agriculture 2 (L22), and services (L3) over time. The paths are represented by solid line, medium-dash line, small-dash line, and large-dash line, respectively.

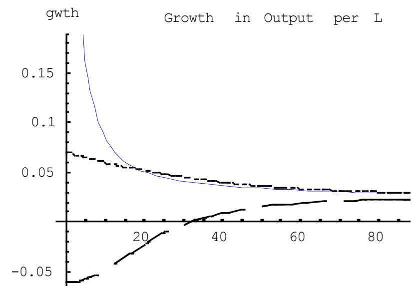
Figure1: Labor force in each sector



As can be seen, the agricultural sector, taken in sum, employs the biggest share of the labor force at the starting point, manufacturing, agriculture 1, agriculture 2, and services employ 1.68, 35.66, 54.94, and 7.73 percent of the total workforce, respectively. Then, as capital accumulates, the economy grows over time, and the amount of labor employed in agriculture 1 and agriculture 2 both decrease. However, labor increases tremendously in manufacturing and to a lesser extent in services. Manufacturing becomes the sector hiring the most labor after approximately 15 years. At the steady state (around 22 years after the starting period), manufacturing, agriculture 1, agriculture 2, and services employ 81.3, 29.3, 11.5, and 17.7 percent of the total labor force, respectively.

Figure 2 shows that manufacturing has the highest growth but decreases over time, while agriculture's growth is the reverse direction. The service sector's growth rate slows over time. In the steady state, the output of all sectors grows at a rate of *x+n*.

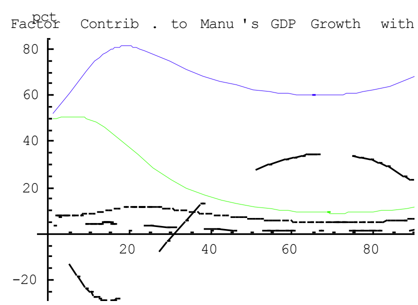
Figure2: Growth in per capita output



A point worth noting from Figures 2 is that, despite being the largest sector and holding the biggest share of production, the growth rate of manufacturing declines over time. While the agricultural sector, the smallest sector, has a growth rate that is higher over time.

Figure 3 shows the contribution to manufacturing's GDP growth by capital, labor, public good, agricultural raw-material (intermediate to manufacturing), and total factor productivity (here, labor-augmenting technology). They are represented by a heavy-solid line, light-solid line, large-dash line, medium-dash line, and small-dash line, respectively.

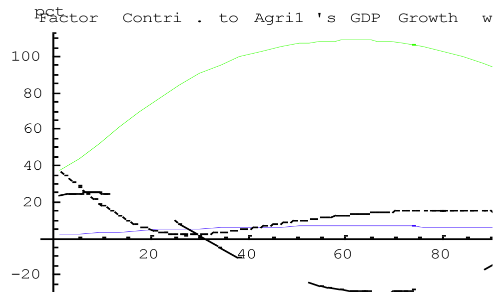
Figure 3: Factor contribution to manufacturing's GDP growth



As can be seen, capital accumulation plays a major role in the contribution to manufacturing's GDP growth, at an increasing rate for about the first 20 years and at a decreasing rate until year 80, where it proceeds to increase again. The total factor productivity (i.e., labor-augmenting technology) is relatively small and has a negative value after about 12-13 years. This implies an ineffectiveness of factor utilization and an ineffectiveness of technology exploitation in the manufacturing sector under the base-line policy environment. Also, notice that government public service does not help this sector much in the first 30 years.

Figure 4 demonstrates the contribution to agriculture 1's GDP growth by capital, labor, public good, and total factor productivity (here, labor-augmenting and land-augmenting technologies). They are shown as a heavy-solid line, light-solid line, large-dash line and small-dash line, respectively. Contrary to Figure 3 (manufacturing), labor input is the main contribution throughout all years.

Figure 4: Factor contribution to agriculture1's GDP growth



P (small dash)”

As shown by Figure 5, the Contribution to agriculture 2 GDP growth from capital, labor, public good, and TFP are represented by a heavy-solid line, light-solid line, large-dash line, and small-dash line, respectively. Like agriculture 1, the labor input is the main contributor in almost all periods, except in the first 15 years where TFP leads. The total factor productivity in agriculture 2 never reaches the first rank as a contributor to this sector's output growth.

Figure 5: Factor contribution to agriculture2's GDP growth

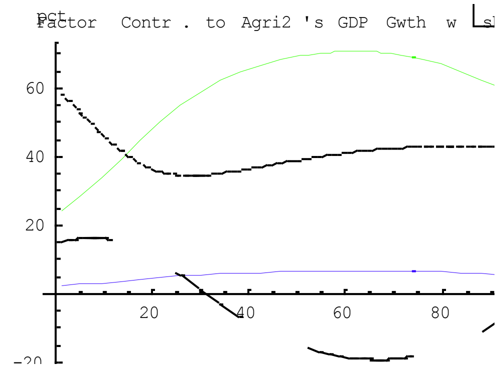
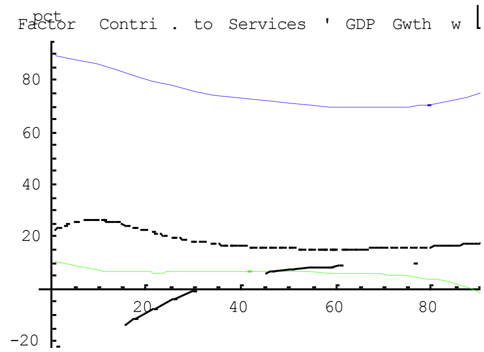


Figure 6 shows the factor contribution to the service sector from capital, labor, public good, and total factor productivity (labor-augmenting technology) by a heavy-solid line, light-solid line, large-dash line, and small-dash line, accordingly. Capital accumulation dominates other factors in the contribution to service's GDP growth. TFP in service, however, is never a negative contribution, unlike manufacturing's TFP contribution.

Figure 6: Factor contribution to service's GDP growth



Lastly, the public good is consumed as a non-rival good; that is, its consumption by one sector does not prevent its use by another. However, sectors benefit differently from the public good since each sector is assumed to absorb the benefit respective to its elasticity of labor. While each economic sector has its own marginal value, in reality, when the government needs to pass a law or a concession to have a public good, the budget must be set ahead of implementation. Hence, the sectors, which are to bear the cost of this public good, need to be set beforehand at the efficient level. The sensitivity analysis, with six scenarios, is designed to answer this question. Possible criteria are by the measurement of utility level, GDP growth, the change in wage/ capital rental/ land rental rates, and so on. As the analysis reported, the output GDP at half-time to steady state level is the highest in the case where there is no intermediate in the economy. The second highest is the case where there is no government in the economy. If the government enters into the economy and intermediate is present, where the tax on the agricultural sectors is equal to their labor elasticity, is the best scenario, and utility level is at a maximum as well. Therefore, this method of levying tax is a sound policy and one that allows the economy to reach the next highest GDP level at the steady state half-life. All in all, given government intervention and intermediate, to earn a maximum GDP level, maximum utility, maximized wage rate, and capital rental rate, with the least trade deficit at the steady state, the most promising policy is the one where the tax on agricultural sectors is set equal to their labor elasticity. With this policy, the government will affect the best outcome from among the six analyzed cases. Otherwise, no government intervention at all would be the best policy. It should be noted that ignoring intermediate can produce misleading results. It may appear to produce a higher GDP level, a higher wage rate, and a capital rental rate, but when intermediate is ignored it creates a lower land rent and lower price of land than would ever practically occur.

6. Conclusion and Policy Implications

This paper studied the development of the Thai economy, with the government providing productive public goods and levying taxes on each production sector differently. The national accounts balance sheet and a social accounting matrix were used to estimate the parameters of the model. The basic model is a dynamic general equilibrium model (four sectors: manufacture, agriculture 1 and agriculture 2, and services) with government intervention. This basic model and variations of the model were used to examine the main stylized features of macroeconomic fluctuations. Noting that agriculture (along with the balanced-growth path) yields a higher growth in the long-run and represents the majority of the people in the Thai economy, higher tax distortions in this sector than on other sectors (e.g., doubling the tax on agriculture) has negative consequences on economy-wide national growth. Indeed, excessive exploitation of agriculture is not a first-best policy, i.e., it does not transfer resources from agriculture in a way that benefits the overall economy's long-run growth prospects. According to a real data analysis, the agricultural sector probably helps maintain economic stability and balance the other sectors in the economy, in part because it is a supplier of primary resources, such as labor, a supplier of intermediate factors of production to the non-farm sector, and through intermediate factor and final demand, a source of demand growth for the entire economy. As for policy recommendations, it is a good chance for government to more promote the agricultural sector, particularly if revenue from this sector is needed. One way is by increasing the labor productivity, e.g. more investment in human capital, or research and development. Evidence gathered in this study showed that capital accumulation overall, especially in manufacturing, may be too crowded. The growth of the economy, given this, may not be sustainable, as the economy may easily become over-heated. At the same time, however, effects on agriculture from natural incidents and geo-political factors affecting the markets, we often cannot prepare for ahead of time. All are for trading off for the first best policy in each situation.

7. Limitations and Scope for Further Research

It will be interesting to have some statistical tests to cross check the pattern of economic sectors development and might include some economic fluctuations. Sudden shocks to incorporate in the model further at some points will be interesting as well.

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