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THE EFFECT OF ENERGY TAX ON TAIWAN'S SERVICE SECTOR AND THE POSSIBLE ENERGY-SAVING STRATEGIES

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Abstract: *The main objective of the paper is to present an estimation of the impact of an energy tax and energy price increase on Taiwan's Service sector. The paper applies the producer's model of a dynamic general equilibrium model of Taiwan (DGEMT) to estimate the energy price elasticity of demand in the service sector for measuring the potential effect of energy-saving with respect to energy price changes. We also analysis the impact of energy tax on service sector and provide energy saving strategies.*

The major findings are 1) The energy elasticity of the whole service sector is -0.988. It means that the potential energy consumption will decrease -0.988% when the energy price increases 1%. 2) Energy price rising can elevate incentive of energy-saving and accelerating industrial structure change. 3) The energy tax levied, with 2016 tax calculation, will cause oil, natural gas and electricity consumption of the whole service sector decrease 1.21%, 1.31% and 3.14%, respectively. 4) With 2025 tax calculation, the whole service sector's industrial prices increased 0.141% and the employment decrease about 3,389 people due to the energy tax.

Keywords: *Elasticity of Demand, Energy Tax, Service Sector, Dynamic General Equilibrium Model of Taiwan*

JEL Classification: *Q01, Q43, Q48*

1. INTRODUCTION

According to statistics of the Bureau of Energy of Ministry of Economic Affairs, in 2000-2014, energy consumption of the service sector with an average annual growth rate of 1.76%, it is higher than the industrial sector (1.66%), the residential sector

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(1.05%) and the transport sector (0.48%). In recent years, in order to rationalize the energy prices, the government of Taiwan announced that increasing the oil price of 10.7% in 2012. At the same time, the government also announced a tariff rationalization scheme to adjust the electricity price at three steps. Energy price adjustments will inevitably affect industrial costs, resulting in rising products price and slowing growth. Because electricity is the main energy consumption in the service sector, the electricity price changes will significantly affect the GDP growth rate in service sector. Besides, one popular measures that elevate the incentive of energy-saving for industries is energy tax. However, energy tax will also rise the operating cost in whole industries. In order to reduce the shock by energy price surge or energy tax, it's necessary to implement the energy conservation measures and policies.

The rest of the paper is organized as follows. Section 2 presents the theoretical model. A brief description of the data is given in the section 3. The empirical results are reported and discussed in section 4. Finally, section 5 summarizes the study and offers some suggestions.

2. THEORETICAL MODEL

2.1. Producer's Model of DGEMT

We assume that the sectoral cost function is translog form with homothetic weak separability of energy and material inputs. The model actually consists of four sub-models (for each sector): an aggregate sub-model, an energy sub-model, a non-energy intermediate input sub-model, and an oil product sub-model. The aggregate sub-model includes one output price equation and five equations relating to the cost shares of capital, labor, energy, non-energy intermediate inputs and the rate of technological change. The energy sub-model has one price (energy price) equation and four share equations explaining the cost shares of coal, oil products, natural gas, and electricity, respectively. The non-energy intermediate sub-model is composed of one price (material price) equation and five equations for the cost shares of agricultural intermediate inputs, industrial intermediate inputs, transportation's intermediate inputs, service intermediate inputs, and imported intermediate inputs, respectively. Similarly, the oil product sub-model has one price (oil price) equation and four share equations explaining the cost shares of gasoline, diesel, fuel oil and other oil products. Figure 1 presents the tier structure of the sub-models in the producer's model. With the sole exception of the oil sub-model, the explanatory variables consist of input prices and time as an index of the level of technology. As for the oil sub-model, the explanatory variable consists of input prices only.

With the aggregate input sub-model as an example, the output price (P) equation is

$$\ln P = \alpha_0 + \alpha_T T + \sum_i \alpha_i \ln P_i + \frac{1}{2}\sum_i \sum_j \beta_{ij} \ln P_i \ln P_j + \sum_i \beta_{iT} \ln P_i T + \frac{1}{2}\beta_{TT} T^2, i, j = K, L, E, M \quad , \tag{1}$$

where i, j = K, L, E, M, C, O, N, e denotes capital, labor, energy, intermediate inputs, coal, oil, natural gas, and electric, respectively. T denotes time as an index of the level of technology.

The input cost share equations are[1]

$$S_i = \alpha_i + \sum_i \beta_{ij} \ln P_i + \beta_{iT} T, \quad i, j = K, L, E, M, C, O, N, e \; 0 \tag{2}$$

According to Berndt and Wood (1975), we can calculate the elasticity of translog cost function as follows

$$E_{ii} = \frac{\beta_{ii} + S_i^2 - S_i}{S_i}, i{=}K, L, E, M, C, O, N, e, \tag{3a}$$

S_i is the cost share of i factor, hence E_{ii} will change following. Besides, the AES (Allen Partial Elasticity of Substitution) is

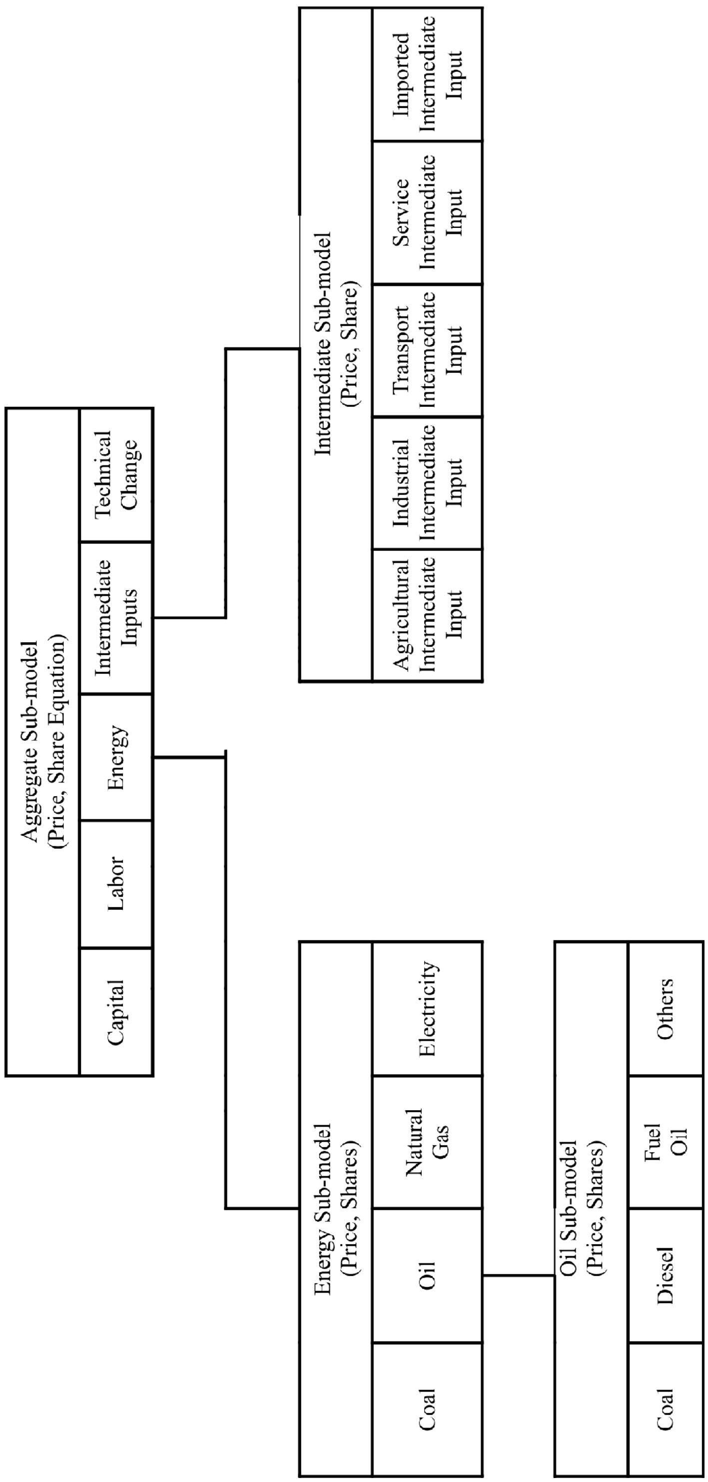
$$\sigma_{ii} = \frac{\beta_{ii} + (S_i)^2 - S_i}{(S_i)^2}, i = K, L, E, M, C, O, N, e \tag{3b}$$

$$\sigma_{ij} = \frac{\beta_{ij} + S_i . S_j}{S_i S_j}, i, j = K, L, E, M, C, O, N, e \tag{3c}$$

We know that $\sigma_{ij} = \sigma_{ji}$ but the value isn't constant. They will change following cost share. The traditional cross- elasticity is defined $E_{ij} = \partial \ln Q_i / \partial \ln P_j$ and the relation between AES and as follows

$$E_{ij} = S_j \, , \sigma_{ij}$$
$$E_{ji} = S_i \, , \sigma_{ji}$$

Figure 1: Tier Structure of the Producer's Sub-model in the DGEMT Model



2.2. The Impact of Energy Tax or Energy Price Change on Service Sector

In this paper, we apply the dynamic general equilibrium model of Taiwan (DGEMT) and the reference of Liang (2009)'s findings, to assess the impact of energy price change or energy tax on the service sector. The estimation process is divided into three steps as: 1) obtain the quantity of energy demand and product price in the benchmark scenario, these values are called baseline values; 2) Imposing taxes on all energy products and obtain another set of quantity of energy demand and product price, we call this scenario for alternative scenarios; 3) comparing 1) and 2) results, we can find out the difference between benchmark scenario and alternative scenarios. Estimating process is described as follows:

2.2.1. Estimate the Baseline Value

Energy consumption and economic growth of the baseline value is derived by the following steps:

(1) The price capital (P_K), wages (P_L) of each sector and time variable (T) data are taken from DGBAS's overall econometric model. [2]And the future growth rate of P_K, P_L are estimated by the average rate of P_K , P_L's previous data, respectively.

(2) The total price index (P), energy price (P_E) and price of intermediate input (P_M) of each sector are all endogenous variables generated by the model. This model is a dynamic relational model and contain 28 industries. The intermediate inputs of each industry were divided into four categories after excluding imported goods. Namely: the intermediate inputs of agricultural product, Industrial intermediate inputs, intermediate inputs of transportation service, intermediate inputs of services and labor inputs. Plus the intermediate inputs of coal, petroleum products, natural gas and electricity of the energy sub-models, it is able to constitute 8×28 input-output table instead of 28 × 28 input-output table. The first step is to obtain the above-mentioned eight industries' price equation (every industry has three equations: P, P_E, P_M) by solving simultaneous equations. We can obtain the P_E and P_M estimators by substituting the above price equations into P_E, P_M of each sector. After that, the price index (P) estimator will be obtained by substituting P_E, P_M estimators into the P estimated equation.

(3) Substituting P_E, P_M, P estimators into share equations of each sector, will obtain the estimated value of various energy shares (S_C, So, S_N, S_E), intermediate inputs share (S_{M1}, S_{M2}, S_{M3}, S_{M4}, S_{M5}) and total investment share (S_K, S_L, S_E, S_M) of each sector.

(4) Establish the regression equations of the industrial product price of each sector and the prices of five final goods and services (i.e. Food; clothing; housing; energy; transportation-recreation and other categories), to estimate the future prices of five final goods and services. Then, substitute the above estimated coefficients into the consumer's model of general econometric models, we will obtain the share of the five final goods.

(5) Estimate private consumption growth rate of per capita GDP and the growth rate of the total expenditure based on the economic growth rate predicted by DGBAS's Accounting and Statistics and Global Insight. Substitute (4) and (5) steps into the final consumption equations, to obtain consumers' consumption structure (i.e. The share of five goods and services), and iterates them until convergence.

2.2.2. Estimate The Alternative Scenarios

Calculating the impact of energy tax on energy demand of each industry by the follow steps.

(A) The import price of oil fluctuates: Keeping other conditions remain unchanged, when the oil import price changes, by processing the (1) to (6) steps, we can find a sequence of various industries price, cost share, five kinds of consumer goods and services prices, as well as their shares.

(B) Energy Tax: Other conditions remain unchanged, we took the energy tax into account and based on the above (1) to (6) of the estimated procedure, the product prices, the cost share, the prices of five consumer goods and services, as well as their share can be determined

(C) Electricity price is exogenous changes: By (1) to (6) of the baseline estimated procedure and assumed the growth rate of electricity price vary, we can estimate the future prices of various industries, cost share, price of five consumer goods and services, as well as its share.

Compared with the results of baseline estimation and alternative scenarios estimation, we can calculate the effect of energy taxes or energy price changes on the cost structure of industry, GDP, consumer prices, as well as the effect of the various household consumption structure.

In terms of the output growth, we can obtain through the following steps:

(a) Because of energy price changes will affect the overall price and substitute this effect into the general econometric models, we can obtain the impact of energy tax on private consumption, investment, government spending, net exports and GDP.

(b) By multiplying the above new total private consumption with the new private consumption structure (determined by the consumer model), and deflate it by the consumer price index of all kinds of goods, the amount of all kinds of goods can be calculated at a fixed currency. After that, by applying the latest annual I-O table, to convert the amount of various types of goods into 28 industries' final demand.

(c) By the latest annual domestic transaction table (D), to convert the five categories of consumer goods into industry's final demand (FD). And by the following formula to get in real term output value (Q).

$Q = (1-D)^{-1} \times FD$

(d) Calculate the effect of energy savings of overall economic on the coal industry, petroleum and coal products industry, natural gas and electricity supply industry and the overall economy. Where the energy saving is calculated by the oil and electricity price changes or energy taxes comparison with the basic situation.

Finally, the comparison of different between oil and electricity price changes or energy taxes on the situation of each industry output price, energy demand impact. The basic value estimated steps detailed is shown in Figure 2, while alternative scenarios shown in Figure 3.

Figure 2: The Estimating Steps of Baseline Value

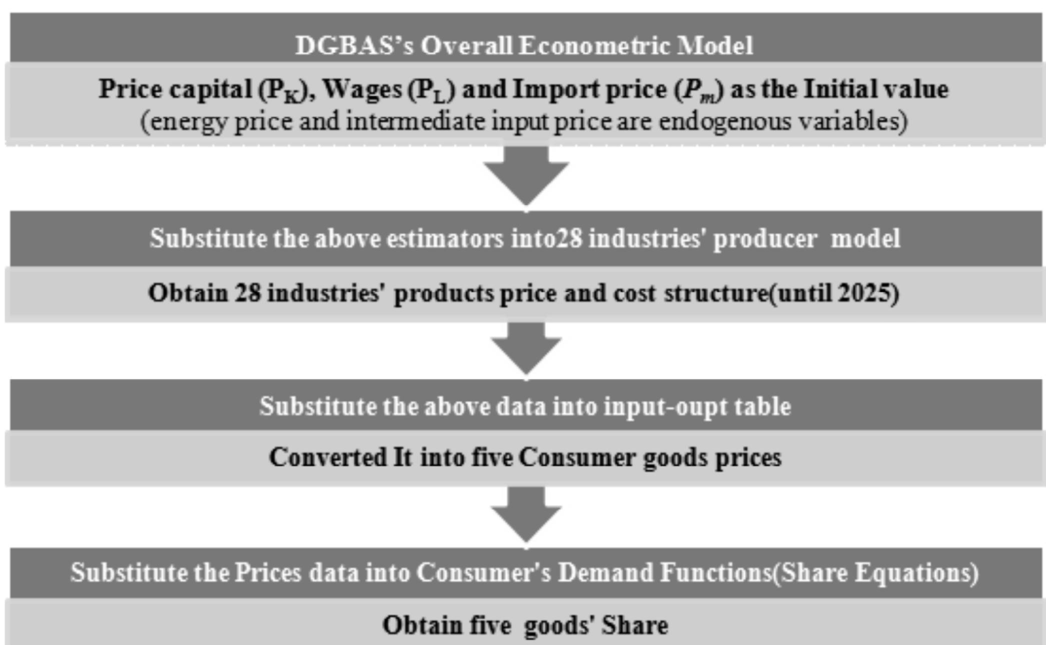
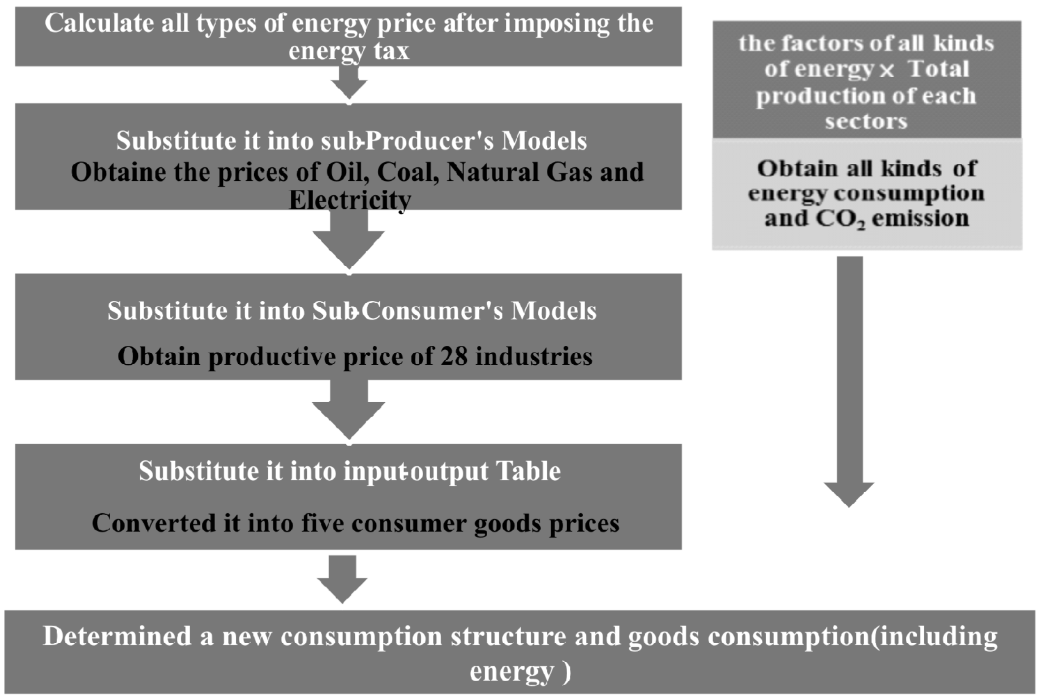


Figure 3: The Estimating Steps of Alternative Scenarios



3. DATA DESCRIPTION

This paper applies the annual data spanning the period from 1951 to 2012. In the producer's model of DGEMT model, we decomposed the whole economy into twenty eight sectors:, including seven main sectors, fifteen manufacturing sectors, and six service sectors. It has to be noted that the government service sector is excluded from the whole economy, because the profit maximizing rule is not applicable to the government service sector. In addition, in the National Income Account, the output of the government service sector is identical with its labor compensation. This is unique.

3.1. Capital Input

The capital input is decomposed into six categories. There are construction (K_1), other construction (K_2), transportation equipment (K_3), machineries (K_4), inventory (K_5), and land (K_6).

The time series capital stocks data are compiled by the perpetual inventory approach. Except for the land, the time series capital stock in 1961-2012 is calculated by adding up the net capital formation, which is the difference between the gross capital formation and the depreciation, starting from 1951 - the beginning year of the *National Income Account* in Taiwan.

The gross capital formation during 1951-2012 comes from the DGBAS; the types of depreciation are compiled by employing the constant rate depreciation method and the years of depreciation listed in the *National Wealth Census*. This method implicitly assumes that no net capital stock existed before 1951. The time-series land data come from the *Industrial and Commercial Census* in every five-year by applying interpolation/extrapolation methods.

3.2. Labor Input

72 categories of labor for each industry are classified on the basis of:

a. Gender	(a) Male (b) Female
b. Employment status	(a) Employed
	(b) Self-employed and/or unpaid family worker
c. Ages	(a) 15-24 (b) 25-34 (c) 35-44
	(d) 45-54 (e) 55-64 (f) over 65
d. Educational level	(a) Junior high school graduate or less
	(b) Senior or vocational high school graduate
	(c) College graduate and above

Wages and labor inputs on the basis of 72 categories for each sector during 1982-2012 are compiled from the magnetic tape of the Manpower Utilization Survey, DGBAS.

3.3. Energy Input and Intermediate Input

The energy input data are derived from Energy Statistical Yearbook, Energy Balance Sheet, MOEA, Taipower Statistical Yearbook, and China National Petroleum Corporation (CNPC). Intermediate Input is compiled from Input-Output Table, DGBAS.

3.4. Real Value Added

The constant prices (at 2006 price level) GDP and value-added data were mainly taken from the DGBAS's Domestic Production Index and Price Deflator for the years 1982-2012.

4. EMPIRICAL RESULTS

This section starts with an application of an aggregate sub-model to estimate the price elasticity of demand and cross elasticity of demand of factors. And followed by employing the same model to analysis the impact of energy tax on ths service sector.

4.1. Price Elasticity and Cross Elasticity of Demand

The price and cross-price elasticities are calculated based on the expressions mentioned in the methodology section. The elasticities are calculated for the whole service sector as well as for different sub-sectors. The signs of all the price elasticities are negative, which is satisfying the The law of demand.

4.1.1. Price Elasticity

E_{EE} is the price elasticity of energy demand, represents the percentage change of energy demand with the energy prices change. Column 3 of Table 1 presents the estimated value of each industry, in the case of 2012, the price elasticity of energy demand of Transportation, Warehouse and Communications Sector is -0.827, and the whole service sector is -0.988. Among sub-sectors, besides other service sector (the energy is price elastic with a value of -1.591), the energy is also price elastic for Social and Personal Service Sector (with the value of -1.0564). The rest of the sectors, such as Business Sector (-0.988), Accommodation and Catering Services Sector (-0.980), Wholesale and Retailing (-0.968) and Finance, Insurance and Real Estate sector (-0.729). The energy price elasticity of demand shows that the service sectors have the absolute value of the price elasticity is greater than 0.5, means that when the energy prices increase, which can effectively reduce the amount of energy use in all sectors. And Social and Personal Service Sector and Other Service Sector are more sensitive to the price than other sectors (the absolute value of price elasticity is greater than 1). Therefore, to reduce the quantity of energy consumption in various sectors to achieve energy savings target, through price adjustment is a feasible way.

4.1.2. Cross Price Elastcities

When there is a substitute or complementary relationship between the two elements, that is the price of one element changes would cross-impact of another element's demand. Cross elasticity of demand is used to measure this relationship. When the cross-price elasticity is positive ($|E_{ij}|>0$), it means that two elements *i* and *j* are substitutes, the greater value represents the stronger substitute between two elements. $|E_{ij}|<0$ represents *i* element and *j* element are complementary goods and the greater the value means the stronger the complementary between two elements. To show the cross correlation between energy and other elements, we will analysis how the different elements will respond to the energy price change. The cross-price elasticities are reported in Table 2. The signs of E_{KE} are all positive

Table 1
Own-Price Elasticities

Sectors	E_{KK}			E_{LL}			E_{EE}			E_{MM}		
	% change of capital demand /% change of the capital price			*% change of labor demand /% change of the labor price*			*% change of energy demand/% change of the energy price*			*% change of intermediate demand /% change of the intermediate price*		
	2002	*2007*	*2012*	*2002*	*2007*	*2012*	*2002*	*2007*	*2012*	*2002*	*2007*	*2012*
Transportation ,Warehouse and Communications Sector	-0.846	-0.872	-0.898	-0.693	-0.672	-0.651	-0.831	-0.829	-0.827	-0.630	-0.625	-0.628
Whole Service Sector	-0.681	-0.668	-0.654	-0.614	-0.621	-0.628	-0.985	-0.987	-0.988	-0.720	-0.729	-0.725
Wholesale and Retailing	-0.719	-0.711	-0.703	-0.601	-0.614	-0.628	-0.969	-0.967	-0.968	-0.712	-0.707	-0.702
Accommodation and Catering	-0.862	-0.876	-0.891	-0.565	-0.573	-0.582	-0.962	-0.971	-0.980	-0.611	-0.580	-0.548
Business Sector	-0.812	-0.814	-0.817	-0.619	-0.604	-0.593	-0.988	-0.988	-0.988	-0.815	-0.830	-0.840
Finance, Insurance and Real Estate	-0.449	-0.453	-0.457	-0.834	-0.841	-0.849	-0.762	-0.736	-0.729	-0.717	-0.706	-0.695
Social and Personal Service	-0.926	-0.913	-0.904	-0.445	-0.462	-0.478	-1.052	-1.056	-1.056	-0.733	-0.724	-0.715
Other Service	-1.155	-1.241	-1.319	-0.483	-0.439	-0.395	-1.699	-1.574	-1.591	-0.908	-0.971	-0.934

Source: Authors' estimations.

Table 2
Cross-Price Elasticities

Sectors	E_{KE} *% change of capital demand /% change of the energy price*			E_{LE} *% change of labor demand/ % change of the energy price*			E_{ME} *% change of intermediate demand/% change of the energy price*		
	2002	*2007*	*2012*	*2002*	*2007*	*2012*	*2002*	*2007*	*2012*
Transportation, Warehouse and Communications Sector	0.169	0.171	0.173	0.169	0.171	0.173	0.169	0.171	0.173
Whole Service Sector	0.015	0.013	0.012	0.015	0.013	0.012	0.015	0.013	0.012
Wholesale and Retailing	0.031	0.032	0.033	0.031	0.032	0.033	0.031	0.032	0.033
Accommodation and Catering	0.038	0.029	0.020	0.038	0.029	0.020	0.020	0.029	0.038
Business Sector	0.018	0.019	0.019	0.014	0.014	0.014	0.026	0.026	0.026
Finance, Insurance and Real Estate	0.003	0.002	0.002	0.002	0.002	0.002	0.001	0.000	0.000
Social and Personal Service	0.045	0.042	0.041	0.014	0.013	0.013	0.018	0.018	0.017
Other Service	0.095	0.109	0.121	0.001	0.003	0.003	-0.047	-0.049	-0.055

Source: Authors' estimations.

in 2002-2012, indicating that the energy price increases will result in a reduction of energy consumption and increase the capital instead for each sector. Moreover, the signs of E_{LE} are all positive from 2002 to 2012, indicating for each sector, when the energy prices increase the industries will replace energy by labor and the energy consumption will decrease. Because the relationship between energy and labor, energy and capital are substitutes, keeping the total output level unchanged, the energy price increase will give the industries incentives to invest in energy-saving equipment or hiring professional workers to assist industries to save energy, reduce energy consumption cost.

4.2. The Impact of Energy Tax on Service Sector

Over the past years in Taiwan, there are a lot of varied versions of the energy tax draft. However, Energy Tax Regulations has not yet been finalized, and only the Executive Yuan's version (2006) and The Tax Reform Committee's version (2009) have more explicit tax, the rest versions are not. The introduction of evolution of Energy Tax Regulations in Taiwan is in the next section.

4.2.1. The Draft of Taiwan's Energy Tax Content

Since 1987, Tax Reform Committee has been planning to discuss energy tax. This article organized the previous evolution of energy tax in Figure 4. Among the energy tax plans, we can see the aim of imposing an energy tax is to promote the energy use, protect the environment and internalize the external costs of energy use. Taxable items were expanded from crude oil, natural gas to coal and various types of oil products with the specific tax and the progressive way to mitigate the impact._It recommended that the tax revenue will be used to cancel the excise tax, cut income taxes, provide subsidies to low-income families, and encourage manufacturers to improve energy efficiency as supporting measures. Currently, the idea of energy tax of the Ministry of Finance integrated the current gasoline fuel fees, water pollution fees, air pollution fees into a single tax. However, due to the consideration of economic growth, CPI increasing and other factors, the government announced the suspension of an energy tax in May 2013.

Due to the planned tax rates of the Tax Reform Committee's versions (2009) is high, this article reference of the simulation scenarios of Liang (2007) and Liang (2009), as well as complementary measures with energy tax proposed by Executive Yuan, this simulation scenario hereinafter referred to the Executive Yuan's version. The main content of this version is that the energy tax levied on all kinds of energy in a progressive way and will increase from 2009 gradually, and will abolish the oil excise tax simultaneously. For example, the current excise tax on gasoline is

Figure 4: The Evolution of Energy Tax in Taiwan

Source: Taiwan's Economic Sustainable Growth Conference (2006), Ministry of Finance (2006), Bureau of Energy, Ministry of Economic Affairs (2009), Shaw (2007), Shaw (2009) and Authors' Organization.

6.83 NT / liter, the tax rate will increase 1 NT / liter per year since 2009, the tax rate will be 16.83 NT /liter in 2018.

However, this article assumed that the energy tax will be imposed gradually in ten years beginning in 2016 and the tax rate will be lower than Executive Yuan's version (2006). For example, the energy tax rate of gasoline and diesel are expected to be 3.333 NT / liter and 2.667 NT / liter, as shown in Table 3.

According to the tax rate should be imposed, we project that the energy tax revenue is roughly 8.646 billion NT dollars in 2016, 43.232 billion NT dollars in 2020 and 86.463 billion NT dollars in 2025. And the tax revenue will be used to mitigate the impact of energy tax on each industry, as shown in Table 4.

Table 3
The Amount of Energy Tax

Categories	*Price units*	*Unit price (Average price of 2012)*	*Annual increment*	*2016*	*2020*	*2025*
Gasoline	NT/ liter	34.13	0.333	0.333	1.667	3.333
Diesel fuel	NT/ liter	31.36	0.267	0.267	1.333	2.667
Kerosene	NT/ liter	41.87	0.8	0.800	4.000	8.000
Aviation fuel	NT/ liter	27.95	0.1	0.100	0.500	1.000
LPG	NT/ kg	31.58	ÿ	0.000	0.000	0.000
Fuel Oil	NT/ liter	22.01	0.05	0.050	0.250	0.500
Coal	NT/ kg	3.58	0.04	0.040	0.200	0.400
Natural gas	NT/m^3	18.72	0.07	0.070	0.350	0.700

Source: Authors' collection.

Table 4
The Energy Tax Revenue

Unit: 100 million NT

Taxable items	*2016*	*2020*	*2025*
Gasoline	34.76	173.82	347.65
Diesel fuel	11.78	58.92	117.84
Kerosene	0.12	0.60	1.20
Aviation fuel	0.32	1.59	3.18
Fuel Oil	4.54	22.70	45.41
Solvent naphtha	No tax	No tax	No tax
LPG	0.00	0.00	0.00
Natural gas	7.05	35.23	70.46
Coal	27.89	139.45	278.89
Total	86.46	432.32	864.63

Sources: Liang (2007), Authors' estimation.
Note: The annual tax revenue= the amount of energy consumption × the amount of tax levied.

All energy price of products will rise while imposing energy taxes and increase the production cost of each industry. The results of energy tax in the service sector are as follows:

4.2.2. Effects of Energy Taxes on the Energy Consumption of Sevice Sector

Energy taxes will cause the oil, coal, natural gas and other energy products (including electricity) prices increase. The Electricity price is expected to increase 0.1266NT /kWh in 2025 due to the energy tax. Mainly, consumption of primary energy products for the service sector are oil and electricity, so energy tax will increase energy price and reduce the energy usage of the service sector.

In Table 5, estimation results for service sector natural gas and electricity demand caused by the energy tax are presented. With 2016 tax calculation, the percentage change of oil and electricity use by the Transportation, Warehouse and Communications will reduce about 0.80% and 0.81%, while in 2025 tax calculation, expected to change about -6.96% and -5.14%, respectively. In terms of the whole service sector, with 2025 tax calculation, the percentage change of oil, natural gas and electricity consumption are -1.21% - 1.31% and -3.14%, respectively.

Table 5
Effects of Energy Taxes on the Energy Consumption of Sevice Sector

Unit: %

	Calculated by 2016 tax rate			*Calculated by 2025 tax rate*		
Sectors \ Items	*Oil*	*Natural gas*	*Electricity*	*Oil*	*Natural gas*	*Electricity*
Transportation, Warehouse and Communications	-0.803	-	-0.810	-6.958	-	-5.135
Whole Service Sector	-0.172	-0.122	-0.645	-1.205	-1.311	-3.138
Wholesale and Retailing	-0.109	-0.077	-0.408	-0.761	-0.889	-2.128
Accommodation and Catering	-0.219	-0.155	-0.822	-1.535	-1.717	-4.110
Business Sector	-0.079	-0.056	-0.297	-0.555	-0.570	-1.364
Finance, Insurance and Real Estate	-0.026	-0.018	-0.098	-0.182	-0.199	-0.475
Social and Personal Service	-0.426	-0.301	-1.600	-2.987	-3.177	-7.602
Other Service	-0.599	-0.424	-2.250	-4.200	-4.567	-10.928

Source: Authors' estimation.

4.2.3. Effects of Energy Tax on WPI and GDP Growth of Service Sector

The impact of energy tax on WPI and GDP growth of each service sector as shown in Table 6. With 2025 tax calculation, for example, transportation, warehouse and communications sector and the whole service sector's industrial prices increased 0.959%, 0.141%, respectively. In terms of Industrial output, the output of transportation, warehouse and communications sector and the whole service sector is expected to reduce 1.475% and 0.033%, respectively. Because energy taxes so that the oil price rises higher than the electricity price, and oil is the main energy consumed by transportation industry, the fluctuation of industry prices and industrial output's is relatively high.

By observation of sub-service sectors, except for the other service sector, the rest of sectors such as: accommodation and catering sector, social and personal services sector, the magnitude of fluctuation of industry prices and industrial output are higher than the whole service's. Similarly, with 2025 tax calculation, the fluctuation rate of Accommodation and Catering sector's industry price and output are about 0.184% and - 0.044%, respectively. And the changing rate of industry price and output of social and personal service sector are 0.341% and - 0.081%, respectively.

Table 6
Effects of Energy Tax on WPI and GDP Growth of Service Sector

Unit: %

Years / *Sectors*	*Industry prices (WPI)* Calculated by 2016 tax rate	*Industry prices (WPI)* Calculated by 2025 tax rate	*Industrial output (GDP)* Calculated by 2016 tax rate	*Industrial output (GDP)* Calculated by 2025 tax rate
Transportation, Warehouse and Communications	0.121	0.959	-0.151	-1.475
Whole Service Sector	0.035	0.141	-0.002	-0.033
Wholesale and Retailing	0.027	0.095	-0.002	-0.023
Accommodation and Catering	0.047	0.184	-0.003	-0.044
Business Sector	0.013	0.061	-0.001	-0.015
Finance, Insurance and Real Estate	0.006	0.021	-0.000	-0.005
Social and Personal Service	0.078	0.341	-0.005	-0.081
Other Service	0.116	0.490	-0.008	-0.116

Source: Authors' estimation.

4.2.4. Effects of Energy Tax on Employment of Service Sector

In terms of employment, calculating by 2025 tax rate, the number of employees in transportation, warehouse and communications sector and the whole service sector will decrease about 1,314 people and 3,389 people, respectively (See Table 7).

5. CONCLUSIONS AND SUGGESTIONS

The objectives of this paper are (1) To estimate the price elasticity of demand in Taiwan's service sector for evaluating the potential effect of energy conservation through energy pricing policy on the service sector. (2) Measuring the impact of energy tax on service sector. The major findings are 1) The energy elasticity of the whole service sector is -0.988. It means that the potential energy consumption will

Table 7
Effects of Energy Tax on Employment of Service Sector

Unit: People

	Calculated by 2016 tax rate	*Calculated by 2025 tax rate*
Transportation, Warehouse and Communications	-159	-1,314
Whole Service Sector	-395	-3,389
Wholesale and Retailing	-102	-768
Accommodation and Catering	-12	-102
Business Sector	-42	-331
Finance, Insurance and Real Estate	-97	-934
Social and Personal Service	-21	-192
Other Service	-121	-1,062

Source: Authors' estimation.

decrease 0.988% if the energy price increases 1%. It can be said that increasing the energy price is a useful tool to induce energy-saving. 2) Energy price rising can stimulate the incentive of energy-saving and accelerating industrial structure change. 3) The energy tax levied, with 2016 tax calculation, the percentage change of oil, natural gas and electricity demand of the whole service sector are -1.21% -1.31% and -3.14%, respectively. 4) With 2025 tax calculation, the whole service sector's industrial prices increased 0.141% because of the energy tax. 5) The employment of the whole service sector will decrease about 3,389 people.

According to the results, we make some suggestion as: 1) energy price rationalization and energy tax are helpful for energy-using structure adjustment and reallocation of production inputs. It's also helpful to adjust the structure of energy inputs and makes the relationship of substitution or complement between energy inputs more flexible, then enhance the response ability of energy price fluctuation. 2) Implementing the energy saving measures, such as the tax credit, can reduce the input price of energy-saving capital or labor. Thereby, inducing industry to increase energy-saving investment and hire more employees instead of energy consumption. 3) By providing energy-saving information, technology assisting and energy auditing to relieve the fluctuation of energy price and the shock of energy cost surge the industry faced with.

Notes

1. Based on Shephard's lemma, the input cost share equation (S_i) can be derived by differentiating Equation (1) with the logarithmic form of the price of input (P_i).
2. DBGAS is acronym of Directorate-General of Budget, Accounting and Statistics, Executive Yuan, Taiwan.

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