Chapter 4
A Regional Econometric Study of the Interactions among Climate Changes, Agricultural Supply & Demand, and Agri-environmental Policy
—— An approach by the Input-Output analysis ——

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1. Research objectives

The purpose of this study is to conduct a research on the relation between the agricultural activities and climate factors such as the change in temperature and precipitation caused by global warming, etc. Among those, socio-economic impacts of climatic factors are especially focused on. The territory of Turkey consists of several regions or districts whose soil fertility and climate conditions are quite different from each other. Preferably, it would be more precise to analyze each region or district separately. However so far the Input-Output tables in Turkey have been published only for the national level and not for the regional or district levels and the regional level Input-Output tables are not available. Therefore, in this paper as the first approach, the national level Input-Output table is used. By deriving the several indicators based on the national level inter-industry transaction tables, the characteristics of agricultural sectors and the interrelations between the agricultural sectors and the other industrial sectors are first discussed. Then, the input output coefficients of the agricultural sectors in several years which are derived by RAS method are regressed on the climate variables such as temperature, precipitation and the other environmental factors with regional dummy variables. By doing so, it can be discussed how the climate changes affect on the agricultural productivity and inter industry activities in each district or region in Turkey. Following these, we can discuss on how these climate changes affect the job opportunities in each sectors. And also inter temporal effects of the climate changes in each region on Turkish agricultural sector and whole economy can be analyzed in the next step of the project. First of all, methodologies for climate change effects analysis are explained in the next section before actual relations between the climate change and agricultural sectors are discussed.

2. Research methodologies

The basic structure of the Input-Output tables consists of the endogenous area and the exogenous area. The endogenous area is the rectangular part which consists of the intermediate demand sectors and the intermediate input sectors. The exogenous area consists of the final demand sector and the value added sectors. Each horizontal relation of the IO table indicates the balance of demand and supply in each sector, which also show the allocation of the products to the demand sectors. The vertical relations indicate the balance of input and output which also show the cost allocation and income distribution.

(1) treatments of the imported goods

There are several types for the description mode of the Input Output tables depending on the economic concepts and treatment of the original statistical data. The most important classification of these different types of the Input Output tables is related to how to deal with the import sectors. In these aspects, there are three different types of IO tables. These are the competing import type, the non-competing import type and the composite type (i.e. competing & non-competing types). Those are illustrated as follows.

In the case of the competing import type IO tables, the import sectors are arranged in the last column of the final demand sectors (Table 1). The imported amounts of each commodities are written at the corresponding row of this column as the negative values. On the other hand, in the demand side, the

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imported commodities are not classified from the domestically produced commodities of the same kind and they are written in the corresponding cells as the aggregated values of both.

Table 1 The competing import type IO table (illustrated figures)

Demand / Supply	agriculture	manufacture	Consum -ption	Invest-ment	export	import	total production
agriculture	10	20	80	0	20	-30	100
manufacture	20	100	30	70	10	-30	200
value added	70	80					
Ttotal production	100	200					

(source: Miyazawa[6])

In the case of the non-competing import type IO table, the imported commodities are classified from the domestically produced commodities and written in the corresponding cells of each sector as the separated values from the domestically produced ones. So, in this case, the number of rows becomes larger than the number of columns for the endogenous part (the intermediate sectors) of the IO tables (Table 2).

Generally speaking, the competing IO table is suitable for the economic prediction and planning because the demand coefficients are more stable. But this type of IO tables are depending on the assumption that there are no difference in the consumption rate of the imported goods among demand sectors. On the other hand, the non- competing IO table is suitable for the analysis of the current economic structure because the consumption structure of the imported goods are specified clearly and need not to depend on the above mentioned assumptions.

Table 2 The non-competing import type IO table (illustrated figures)

Demand / Supply		agriculture	manufacture	Consum -ption	Invest-ment	export	import	total production
domestic production	agriculture	6	14	60	0	20	0	100
	manufacture	15	85	30	60	10	0	200
import	agriculture	4	6	20	0	0	-20	
	manufacture	5	15	0	10	0	-30	
value added		70	80					
Ttotal production		100	200					

(source: Miyazawa[6])

In the case of the competing/non-competing import mixed type, the non-competing import type is applied partly for the major imported goods and at the same time, the competing import type is applied for the remaining imported goods (Table 3). The merits of this type are that differences of import coefficients by commodities within sector can be eliminated and that the methodological errors due to the difference in consumption rate of imported goods among sectors under the competing import type can be avoided.

Table 3 The competing / non-competing import mixed type IO table (illustrated figures)

Supply \ Demand	agriculture	manufacture	Consum-ption	Invest-ment	export	import	total production
agriculture	8	16	80	0	20	-24	100
manufacture	19	100	30	70	10	-29	200
Non-competing import	3	4	0	0	0	-7	
value added	70	80					
total production	100	200					

(source: Miyazawa[6])

(2) treatment of sectors --- the commodity based or the industry based ---

In addition to the different treatments of imported goods, there are another classifications for the Input-Output tables from the different aspects. The production accounts of the new SNA (Systems of National Account) is divided into two accounts, i.e. the commodity accounts and the activity accounts. The former accounts indicate the balance of the demand and supply by commodities base and the latter accounts indicate the balance of input and output of the industrial activities by sector base.. Reflecting these situations, there are two tables. One of these tables is called the U table, which indicate what commodities are consumed intermediately by what industries (the commodities in rows to the industries in column) . The other table is called the V tables, which indicate what industries use what commodities as their inputs (the industries in rows to the commodities in columns). These situation can be illustrated in the following table (Table 4).

Table 4 The relation of the U table and the V table

input \ output	commodities	industries	final demand	total production
commodities		U	f	q
industries	V			g
Value added		y		
total production	q	g		

(source: Miyazawa[6])

Here, the notations indicate the following.

U: the U table,
V: the V table
f: final demand
y: value added
q: the total production of all commodities
g: the total production of all industries

In the new SNA, these tables are converted into one of the two table, i.e the commodity to commodity table (the IO table in terms of commodities) or the industry to industry table (the IO table in terms of industries) by applying the technical assumptions through mathematical method.

If each sector produces only one commodity respectively, the difference between the U table and the V tables disappears and the two tables become the same one. The above table became the same as the typical and orthodox Input-Output tables. In this study, the commodity to commodity table (the IO table in terms of commodities) is applied.

(3) treatment of the byproducts or waste

The other classification is related to how to deal with by-products or wastes which are created through the production process of each sectors. In these aspects, there are several types of the Input-Output tables such as the Stone type, the Transfer type, the Lump-sum type and Separate type. But in this paper, this issues are not focused on. And it is assumed that each sector produces only one commodity without creating any byproducts and wastes.

Here, the Input-Output model of the competing import type and the commodity based type is used for this research. In Turkey, the latest version of published Input- Output table is the IO table of 1996, which contains 98 industry sectors, 7 final demand sectors and 7 value added sectors. By aggregating the non-agricultural sectors, I converted this 98 sector IO tables into agriculture based IO tables and compressed it into the IO tables of 34 industry sectors, 7 final demand sectors and 4 value added sectors .

This table is shown in Table 5 as the agriculture based Input-Output table. In this Table 5, because of the space limitation of the page, only the rural sectors (i.e. 7 sectors from the cereal sector to fisheries sector) are indicated explicitly and the non-rural sectors (i.e. 27 sectors from the coal/oil sector to the administration sector) are not indicated and they are indicated implicitly by the marks of **** in the corresponding rows and columns although all of these aggregated 34 sectors are used for the calculation itself. The unit of the amounts in the table are billion Turkish Lira.

(4) the equilibrium output analysis framework

Applying the typical Inter-Industry analysis i.e. Input-Output Analysis on this table, the following formula are derived,

$$A \cdot X + F = X \quad \cdots\cdots ①$$

$$X = (I - A)^{-1} \cdot F \quad \cdots\cdots ②$$

Here, A: input-output coefficient matrix
F: final demand sector matrix
X: output column vector
I : unit matrix

The matrix $(I - A)^{-1}$ is known as the Leontief's Inverse matrix, which indicates the production inducing multiplier matrix. From these formula, the following 2 coefficients can be calculated,

<influence degree coefficient>

$$E_j = \Sigma_i b_{ij} / (\Sigma_j \Sigma_i b_{ij} / n), \quad (i,j=1,2,\cdots,n) \quad \cdots\cdots ③$$

<responsive degree coefficient>

$$K_i = \Sigma_j b_{ij} / (\Sigma_i \Sigma_j b_{ij} / n), \quad (i,j=1,2,\cdots,n) \quad \cdots\cdots ④$$

Table 5 Agriculture Based Input Output Table (unit: billion Turkish Lira, 1996)

		Intermediate Demand Sector									Final Demand Sector							Total Production
		Cereal	Vegetable	Fruits	Livestock	Animal Process	Forestry	Fisheries	****	Intermediate Demand Total	Private Consumption	Public Consumption	Private Investment	****	Export	Final Demand Total	(−)Import	
Intermediate Input Sector	Cereal	97251	0	0	289980	205000	472	0	****	886723	231000	25410	0	****	73441	418655	−128576	1176803
	Vegetable	0	2171	0	0	0	0	143	****	34256	318000	6590	0	****	8141	334304	−3245	365314
	Fruits	0	0	25127	0	0	0	46	****	93278	554000	12883	0	****	73118	673231	−9661	756848
	Livestock	470	15609	5071	41118	2625	22	0	****	235783	478000	504	5569	****	8455	640598	−17866	858515
	Animal Process	36620	5417	6270	188	17617	0	0	****	195010	62404	0	0	****	0	300172	0	495183
	Forestry	0	1300	0	0	1	1481	22	****	85686	18845	1306	0	****	350	20503	−11819	94370
	Fisheries	0	265	0	0	0	0	672	****	9418	89888	22	0	****	1972	92494	−135	101777
	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****	****
	Intermediate Input Total	444000	102000	93655	448245	336000	12956	23924	****	11752352	9840000	1711286	3130000	****	3650000	19966954	−4133894	27585412
Value Added	Tax	−97000	−5615	13866	8583	2958	2477	900	****	586262								
	Depreciation	25767	9034	22136	13764	36957	401	690	****	837440								
	Wage	104000	32059	22514	41927	47756	24943	8018	****	3234567								
	Profits	701000	228000	604674	345994	71887	53590	68242	****	11174788								
	Value added Total	733000	263000	663192	410269	160000	81413	77852	****	15833059								
Total Products		1176803	365314	756848	858515	495183	94370	101777	****	27585412								

("****" indicates sectors omitted to show due to space limitation)

Here, the influence coefficient of the j^{th} industry (Ej) shows how many times larger than the average the effects of the unit increase of the j^{th} industry output on the whole economy are. If this coefficient is larger than one, the unit increase of the j^{th} industry output causes more serious effects on whole economy than the average of all industries. If this coefficient is less than one, the unit increase of the j^{th} industry output causes less serious effects on whole economy than the average of all industries. If this coefficient is equal to one, the unit increase of the j^{th} industry output causes exactly same effects on whole economy as the average of all industries.

And the responsive coefficient of the i^{th} industry (Ki) shows how many times larger than the average the effects of the unit increase of the activities in whole economy on the derived demand for the i^{th} industry are. If this coefficient is larger than one, the unit increase of the activities of whole economy causes more serious effects on the derived demand for the i^{th} industry than the average of all industries. If this coefficient is less than one, the unit increase of the activities of whole economy causes less serious effects on the derived demand for the i^{th} industry than the average of all industries. If this coefficient is equal to one, the unit increase of the activities of whole economy causes exactly same effects on the derived demand for the i^{th} industry as the average of all industries.

By drawing the industries according to the combination of their two coefficients in the x-y coordinate, we can classify the industries into 4 categories.

(5) the equilibrium price analysis framework

The above formula are known as the framework of the equilibrium output analysis in the Input-Output analysis. In addition to these, the following formula are known as the framework of equilibrium price analysis in the Input-Output analysis.

$$P = [(I - A)^{-1}]' V \quad \cdots\cdots ⑤$$

$$\Delta P = [(I - A)^{-1}]' \Delta V \quad \cdots\cdots ⑥$$

Here, V shows the column vector of the value added sector and P shows the column vector of output price of each sector.

In this framework, the effects of the changes of any items in the value added sector on the prices of all commodities can be analyzed. The typical examples of these are the analyses of the effects of increases in wages, tax or subsidies on the prices level of each sector. Also this framework can analyze the effects of changes of specific commodity price on the prices level of the other commodities. This can be done because the price changes of certain commodities indicate the change of input costs for the sectors which are using these commodities as the inputs in their production process. In this sense this framework is corresponding the equilibrium output model and very useful for the policy analysis. However, the purpose of this research is the investigate of the effects of the climate change on the agricultural production efficiency and so, this framework is not applied in this paper.

The climate changes affect on the production of agricultural sectors which are used in the other sectors as the input and also affect on the demand for the commodities which are used as input in the agricultural sectors. In this way, eventually, the climate changes cause substantial impacts on whole economic activities. These economic impacts are not the same in each region and over time depending on the different levels of climate changes in each region and each year. So, by applying the IO analysis explained in the above, the effects of the climate changes in each region and each year on the whole economic activities through the impacts on the agricultural sectors can be analyzed.

3. Estimated results

The calculated results on these are shown in Figure 1. In this figure, each sector is distributed into the 4 regions in the coordinate space which are classified by the intersection of the two lines of unit coefficients of the influence degree and responsive degree.

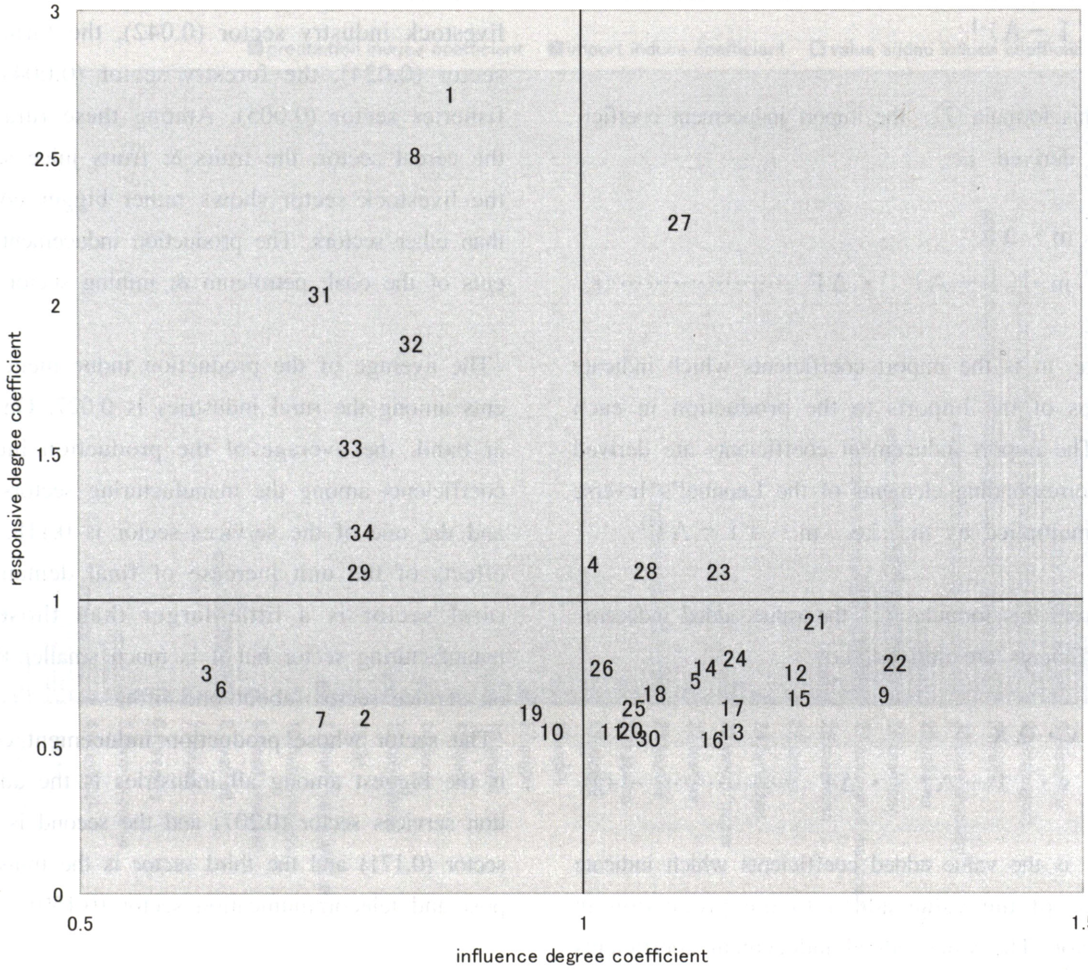
(1) the Influence coefficients and the Responsive coefficients

The region I shows that both the coefficients are larger than 1 and the sectors in this region I indicate that the activities of these sectors affect whole economy stronger than the average and also these sectors tend to be affected by the activity of whole economy more severely than the average. The rural sector in this region is the livestock industry sector only. It can be considered that unlike the other rural sectors the livestock industry is producing the output daily all the year around and the most of their products are used for the processing in the manufacturing sectors. That is why the activities of this sector is related more strongly with the activities of whole economic activities than the other rural sector. However, the location of this sector within the region I is very close to the intersection of the two axis. So, it might be reasonable to consider this sector to be almost same as the average of all sectors.

The region II shows that the responsive degree coefficient is bigger than 1 but the influence degree coefficient is less than 1. And the sectors in this region II indicate that these sectors tend to be affected by the whole economy more seriously than the average but these sector tend to affect whole economy less seriously than the average. The rural sectors in this region is the cereals sector only. As well known, the cereals are typical necessity goods as the staple food. Almost every human activities depend on this commodities to some extent. So, this sector tends to respond to the activities levels of whole economy. But the relative weight of the cereals production in whole economy is not significant. Therefore, the effects of this sector on whole economy tends to be small.

The region III shows that both the coefficients are less than 1. The sectors in this region III shows that these sectors are affected less seriously by the activities of whole economy than the average and also they give impacts on whole economy less seriously than the average. Most of rural sectors such as vegetable, fruits, forestry and fisheries are distributed in this region. This is considered to be typical characteristics of rural sectors not only in Turley but also in most of the countries in the world because the products of the rural industries are necessity goods and so, their price elasticities and income elasticities tend to be very low. These sectors are depending on the natural resources rather than the products of the manufacturing sectors and most of their products is consumed within their own sectors. This situation seems to make these sectors interrelated weekly with the other sector of the economy. But recently they use more and more petroleum or electricals as the form of agricultural machineries and fertilizers or pesticides produced in the other sectors through the economic development process. So, this situation has been changing gradually

Figure1: Influence & Responsive Degree Coefficients



1.cereal	2.vegetable	3.fruits	4.livestock	5.farm process	6.forestry	7.fishery
8.coal/oil	9.meat process	10.fish process	11.fruit/vegetable process	12.fat	13.dairy prod	14.flour
15.feed	16.bread	17.sugar	18.cake	19.alcohl	20.tabaco	21.textile
22.leather	23.wood/paper	24.fertilizer	25.drugs	26.medicine	27.nonmetal materials	28.machine
29.utilities	30.construction	31.retail	32.transport	33.finance	34.administration	

The region Ⅳ shows that the influence degree coefficient is bigger than 1 but the responsive degree coefficient is less than 1. The sectors in this region Ⅳ indicate that these sectors affect whole economy more seriously than the average but they are affected by whole economy less seriously than the average. The rural sectors in this region is the farm processing sector and meat processing sectors. They are kind of agrobusiness industries which are often referred as the downstream industries of agriculture. Within the rural sector, the farm processing and the meat processing are rather exceptional in the sense that they employ more production factors such as labor and capital than the other rural industries. So, they can influence whole economy than the other rural industries. But as long as they are producing the food, both the income elasticity and the price elasticity are small. So, their responsiveness to the activities of whole economy is small.

(2) the Economic Inducement coefficients

From the preceding equation ②, the following formula is derived.

$$\Delta X = (I - A)^{-1} \cdot \Delta F \quad \cdots\cdots⑦$$

The production inducement coefficients are calculated as the corresponding elements of the Leontief's Inverse Matrix $(I - A)^{-1}$

From this formula ⑦, the import inducement coefficients are derived. i.e.

$$\Delta M = m \cdot \Delta X$$
$$= m \cdot (I - A)^{-1} \cdot \Delta F \quad \cdots\cdots⑧$$

Here, m is the import coefficients which indicate the ratios of the imports to the production in each sector. The import inducement coefficients are derived as the corresponding elements of the Leontief's Inverse Matrix multiplied by m, i.e. $m \cdot (I - A)^{-1}$.

Also, from this formula ②, the value added inducement coefficients are derived. i.e.

$$\Delta V = v \cdot \Delta X$$
$$= v \cdot (I - A)^{-1} \cdot \Delta F \quad \cdots\cdots⑨$$

Here, v is the value added coefficients which indicate the ratios of the value added to the production in each sector. The value added inducement coefficients are derived as the corresponding elements of the Leontief's Inverse Matrix multiplied by v, i.e. $v \cdot (I - A)^{-1}$.

The three inducement coefficients are calculated following the above defined formula. Those are the production inducement coefficient, the import inducement coefficient and the value added inducement coefficient. These coefficients show the induced production, import and value added by the unit increase in final demand respectively. The results are shown in Figure 2. According to these results, the production inducement coefficients in rural industries such as cereals, vegetables, fruits and livestock products are rather big in comparison with the downstream agroindustries such as vegetable/fruit processing or dairy sectors although they are much smaller than those of manufacturing or service sectors. Similar tendencies are observed in the other 2 inducement coefficients.

In Figure 2, the production inducement coefficients of the rural sectors are shown. Those are the cereal sector (0.058), the vegetable & horticulture sector (0. 018), the fruit & fruit juice sector (0.037) , the livestock industry sector (0.042), the farm services sector (0.024), the forestry sector (0.004) and the fisheries sector (0.005). Among these rural sectors, the cereal sector, the fruits & fruits juice sector and the livestock sector shows rather bigger coefficients than other sectors. The production inducement coefficients of the coal, petroleum & mining sector is 0.052.

The average of the production inducement coefficients among the rural industries is 0.027. On the other hand, the average of the production inducement coefficients among the manufacturing sectors is 0.021 and the one of the services sector is 0.118. So, the effects of the unit increase of final demand on the rural sector is a little larger than those on the manufacturing sector but it is much smaller than those on service sector (about one fifth).

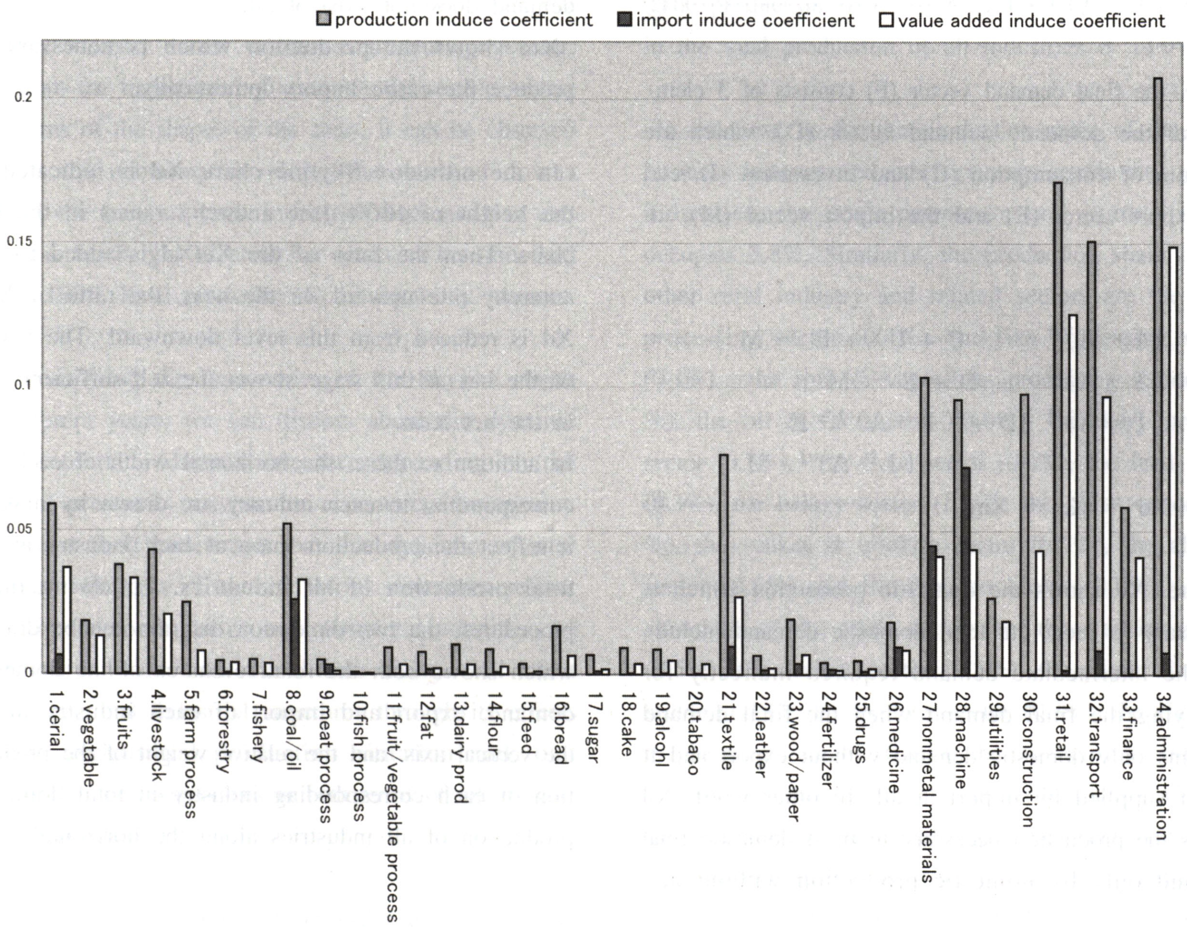
The sector whose production inducement coefficient is the biggest among all industries is the administration services sector (0.207) and the second is the retail sector (0.171) and the third sector is the transportation, post and telecommunication sector (0.150).

Also, in Figure 2, the import inducement coefficient of all industries are shown, Among these, those for the rural sectors are the cereal sector (0.0064), the vegetable & horticulture sector (0.0001), the fruit & fruit juice sector (0.0004), the livestock industry sector (0.0008), the farm services sector (0.0), the forestry sector (0.0005) and the fisheries sector (0.0). Among these rural sectors, the cereal sector shows the biggest coefficient and the farm services sector and the fisheries sector show almost none or negligible coefficients.

The import inducement coefficients of the coal, petroleum & mining sector is 0.0258, which is much bigger than those of these rural sectors.

The average of the import inducement coefficients among the rural industries is 0.0012. On the other hand, the average of the import inducement coefficients among the manufacturing sectors is 0.0077 and those of the services sector is 0.0030. So, the effects of the unit increase of final demand on the rural sector is much smaller than those on the manufacturing sector (about one seventh) and the services sector (about one third).

Figure2 : Inducement Coefficients



The sector whose import inducement coefficient is the biggest among all industries is the machines, fine electrical goods , vehicles, and furniture sector (0.072) and the second is the non-metal materials & metal sectors (0.044) and the third sector is the coal, petroleum & mining sector (0.0258).

Next, in Figure 2, the value added inducement coefficient of all industries are shown. Among these, those for the rural sectors are the cereal sector (0.036), the vegetable & horticulture sector (0.013), the fruit & fruit juice sector (0.033), the livestock industry sector (0.020), the farm services sector (0.007), the forestry sector (0.004) and the fisheries sector (0.003). Among these rural sectors, the cereal sector shows the biggest coefficient. The next is the fruits & fruits juice sector and the third is the livestock sector.

The value added inducement coefficients of the coal, petroleum & mining sector is 0.032.

The average of the value added inducement coefficients among the rural industries is 0.017. On the other hand, the average of the value added inducement coefficients among the manufacturing sectors is 0.008 and the one of the services sector is 0.078. So, the effects of the unit increase of final demand on the rural sector is two times bigger than those on the manufacturing sector but much smaller than the services sector (about one fourth).

The sector whose value added inducement coefficient is the biggest among all industries is the administration services sector (0.148) and the second is the retail sector (0.125) and the third sector is the transportation, post and telecommunication sector (0.096).

(3) the Skyline Analysis

Figure 3 is the results of so-called "the Skyline Analysis" of the Input-Output Structures. The orthodox form of the Skyline analysis is a little different from this. In the case of typical Skyline Analysis, the graphs are drawn in the following way.

From the formula ②,

$$X = (I - A)^{-1} \cdot F \quad \cdots\cdots ②$$

Here, the final demand vector (F) consists of 3 elements of the domestic demand vector (D), which are the sum of consumption (C) and Investment (I), etc, the export vector (E) and the import vector (M). i. e.,

$$\begin{aligned} X &= (I - A)^{-1} \cdot [(C + I) + E - M] \\ &= (I - A)^{-1} \cdot [D + E - M] \\ &= (I - A)^{-1} \cdot D + (I - A)^{-1} \cdot E - (I - A)^{-1} \cdot M \\ &= Xd + Xe + Xm \quad \cdots\cdots ⑩ \end{aligned}$$

Here, Xd shows the domestic production which is necessary to meet the total domestic demand including the intermediate demand required indirectly for supplying the final demand when the final demand contains only domestic demand without export and it is not supplied by import at all. In other word, Xd shows the production necessary to meet domestic final demand only by domestic production without any international transaction and is called as the autarchy production.

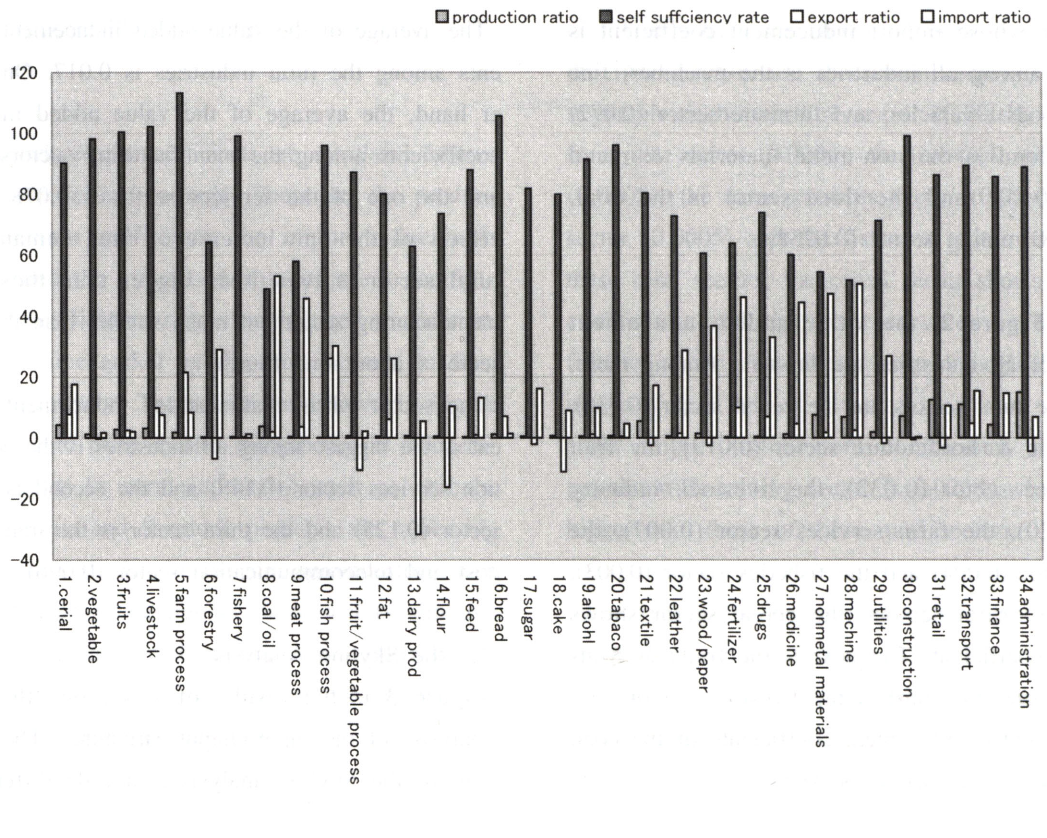
Xe shows production which is necessary to meet only export by domestic production when domestic demand does not exist at all.

Xm shows the production which is necessary to produce the entire import domestically.

In the orthodox Skyline chart, Xd is indicated at the height of 100% (the autarchy rate) in the bar chart. Then the ratio of the Xe/Xd is added to the autarchy rate upward. In the next, the ratio of Xm/Xd is reduced from this level downward. The height of the bar at this stage shows the self-sufficient rare in the net term.

In addition to these, the horizontal width of each bar corresponding to each industry are drawn by making it reflect the production share of each industry in the total production of all industries. Following these procedures, the two dimension diagram can be drawn, which shows both the relative shares of the domestic demand, export and import of each industry along the vertical axis, and the relative weight of the production of each corresponding industry in total domestic production of all industries along the horizontal axis.

Figure3 : Self-sufficiency & Trade Ratios (%)



The merit of the Skyline chart is that it can show the relation of the maturity of the economy and the industrial structure, which had been argued as the law of Pety-Clerk. i.e. the proposition that as the economy develops the gravity of the economy shifts from the primary industry sector to the manufacturing sector, and from the manufacturing sector to the service sector. In terms of the shapes of the chart, it can be observed that as the economy develops, the ups and downs among the bars of each industries become less and less and the height of each bar tends to be smoothed at the 100% level gradually as the economy matures.

By comparing the time series of the Skyline charts in different years, we can discuss about the dynamic change of the industrial structure depending on the level of economic activities or economic development. Of course it is understood that this dynamic or inter temporal changes of the industrial structures reflect the climate condition or environmental condition of each year. In addition, the climate change will affect on the regional industrial structures through its effects on the agricultural production situation and total demand for the commodities in both terms of intermediate and final demands.

However, in this figure 3, in order to simplify the chart, the relative share of the production of each industry is shown as the height of the bar chart of each industry instead of reflecting it to the width of the each bar and so, each bar has same width in figure 3. Similarly, for the same reason, the ratios of the productions necessary for domestic demand (Xd), export (Xe) and import (Xm) respectively are also not accumulated among them vertically in each bar chart but shown separately as the heights of the independent bar charts. So, in Figure 3, for each industry, four bar charts corresponding to the three ratios of the productions necessary for domestic demand (Xd), export (Xe) and import (Xm), respectively and the relative share of the production of each industry in total production of all industries (Xi), are indicated.

In Figure 3, as for the production share of rural industries sectors, the cereal sector occupies 4.3% of the total production of all industries and similarly the vegetables and horticulture sector occupies 1.3%. The production shares of the other rural industry sectors are the fruit & beverage sector (2.7%), the livestock industry (3.1%), the farm services sector (1.8%), the forestry sector (0.3%) and the fisheries sector (0.4%). The production share of the rural sector as a whole in the total production of all industries is 13.9%.

In the next, as for the production share of the agro-business industry and other primary commodity related industries, the coal, petroleum and mining sector occupies 3.8%. Similarly, the production share of the other rural industry and related sectors are the meat processing sector (0.4%), the fish processing sector (0.1%), the fruit & vegetables processing sector (0.7 %), the oil & fat sectors (0.6%), the dairy product sector (0.7%), the flour sector (0.6%), the feed sector (0.3%), the bakery sector (1.2%), the sugar sector (0.5 %), the cakes & cookies sector (0.7%), the alcohol sector (0.6%) and the tobacco sector (0.7%). The situations of the other sectors are the weaving sector (5.5%), the leather sector (0.5%), the paper & wood sector (1.4%), the fertilizer sector (0.3%), the chemistry, paintings sector (0.4%), the medicine sector (1.3 %), the nonmetal & metal materials sector (7.5%), the machines & electrical appliances sectors (6.9%), the public utilities sector (1.9%), the construction sector (7.1%), the retail sector (12.4%), the transportation & postal services (10.9%), the financial & monetary sector (4.2%) and the administration services sector (15%).

Summing up theses situations, the production share of the primary or rural sectors is 17.7%. On the other hand, the production share of the manufacturing or industrial sectors is 30.9% and the production share of the third industries or services sectors is 51.4. Judging from the relative shares of these three aggregated sectors, the stage of the economic development of Turkey is not considered to be highly advanced countries in terms of the industrial structures in comparison with the other advanced countries.

As for the self-sufficiency rate of each sector, among the rural and mining industry sectors, the self-sufficiency rate of the cereal sector (90.2%) and the vegetable & horticulture sector (98.1%) are a little lower than 100%. On the other hand, the self sufficiency rate of the fruit & fruits juice sectors (100.4%), the livestock industry sector (102.2%) and the farm services sector (113.2%) are larger than 100%. The self sufficiency rate of the forestry sector is as low as 64.2% although those of fisheries sector is as high as 99.0%. The average rate of self sufficiency for the rural sectors is as high as 95.3% while the one of the coal, petroleum & mining sector is as low as 48.9% . In comparison to these, the average rate of self-sufficiency for the manufacturing sector is 75.8 % and the one of the service sector is 86.6%.

As for the export rate among rural industry sectors, the farm services sector shows high export rate (21.5 %) and two sectors of fruits & horticulture sector (-0.3 %) and the forestry sector (-6.8%) show negative export rate.

The average of the export rate for the rural sector is 4.95%. In comparison to this, the average of export rate of the manufacturing sector is -0.16% while the one of the services sectors is -0.85%

The sector whose export rate is the biggest among all industries is the fish processing sector (26.2%) and the lowest sector is the dairy product sector (-31.7 %).

As for the import rate among the rural industry sector, two sectors of the cereal sector (17.6%) and the forestry sector (29.1%) show relatively larger import rate. The other rural industry sectors shows rather small import rate.

The average of the import rate for the rural sector is 9.64%. In comparison to this, the average of import rate of the manufacturing sector is 23.9% while the one of the services sectors is 12.4%

The sector whose import rate is the biggest among all industries is the coal, petroleum & mining sector (53.2%) and the lowest sector is the construction sector (0.3%).

4. The remaining tasks to be tackled

(1) The next stage tasks are to investigate how the above mentioned observations would be affected if the climate change occurred in the regional level, especially in Adana district or Chukuloba region in Turkey. In other word, it is necessary to find out the relationship between the intertemporal change of the economic structure and the regional climate change. So, there should be two stages. First stage should be the clarification of the intertemporal relationship at the national level. And the second stage should be investigation of the causal relation between the two phenomenon at the regional level. In this interim report, research works has been focused on this first stage of the research purpose

(2) In order to do this, it is necessary to collect the preceding Input-Output table, i.e. IO table of 1990. I try to predict the IO tables in the several different years by applying the RAS method on 1990 and 1996 tables.

As the predicting methodologies of the input-output coefficients, there are several algorithms such as (i) the RAS method, (ii) the average increase rate method and (iii) the Lagrange variables multiplier method. Among these, here the RAS method will be adopted because of the simplicity and flexibility of application.

(a) The RAS method is explained as follows. The RAS method is the method to predict the input-output coefficients at the predicted time point as the multiplication of the three matrix R·A·S. Here, the matrix R is the row-wise revising matrix of the original input-output matrix A in the base time point and the matrix S is the collumn-wise revising matrix of the original matrix A. The matrix R shows substitutional change among raw materials and the matrix S show the change among the raw materials input rate i.e. the change of the processing degree. These revising coefficients matrix R and S are solved by revising alternately so that the row-wise sum and the column-wise sum of the endogenous sectors which can be obtained by multiplying the input-output coefficients to the tentative production amounts should be equal to the tentative intermediate demands and intermediate inputs respectively.

(b) The average increase rate method is the method that adjusts the row-wise and column-wise revisions not alternately but simultaneously by the simple average of their revising coefficients. In comparison with the RAS method, the number of revision in this method is reduced but the final revising coefficients R and

S can not be specified unlike the RAS method..

(c) The Lagrange variables multiplier method is the least squares methods that minimize the squared sum of errors between the input-output coefficients in the base time point and the prediction time point under the assumption that when the input-output coefficients in the prediction time point are multiplied to the tentative production amounts, the row-wise sum and column-wise sum equal to the tentative intermediate demands and intermediate inputs respectively. In this method the input-output coefficients which are the least different than the input-output coefficients in base time point are adopted.

These methods have the merits that give the totally consistent input-output coefficients automatically but at the same time it has the demerits that the input-output coefficients obtained by these methods can not be independent from the production or final demands, which is not consistent to the basic assumption of the Input-Output analysis.

The algorithm of the RAS method is as follows
Through the iterative calculation on the following equations, the diagonal matrix R' and S' ,which has the substitution change coefficients and the processing degree change coefficients in their diagonal elements and zero in other elements, can be solved.

$A^*(t) = R' \cdot A(0) \cdot S'$

$C_t = i \cdot A^*(t) \cdot X'(t)$

$D_t = A^*(t) \cdot X'(t) \cdot j$

Once these coefficients matrixes R' and S' are solved, the input-output coefficients at prediction time point can be derived by the following formula of the iteration process.

Making the ratio of $A^*(t) \cdot X'(t) \cdot j$ to D_t equal R_1, then $R_1' \cdot A(0) = A_1$

Making the ratio of $i \cdot A_1^*(t) \cdot X'(t)$ to C_t equal S_1, then $A_1 \cdot S_1' = A_2$

Making the ratio of $A_2^* \cdot X'(t) \cdot j$ to D_t equal R_2, then $R_2' \cdot A_2 = A_3$

Making the ratio of $i \cdot A_3^*(t) \cdot X'(t)$ to C_t equal S_2, then $A_3 \cdot S_2' = A_4$

↓

(the several stage of the iteration process)

↓

when the situation of $S_n = R_n = 1$ is realized at last, then $A(t) = R'^{n/t} \cdot A(0) \cdot S'^{n/t}$

where t is the time difference from the base time point to the comparison time point.

Here,

- A(0) : the input-output coefficient matrix in base time point
- A*(t) : the estimated input-output coefficient matrix in base time point
- X(t) : the row vector of production amount in comparison time point
- Ct : the row vector of the intermediate input in comparison time point
- Dt : the column vector of the intermediate demand in comparison time point
- R' : the column vector of substitution change
- S' : the row vector of the processing degree change
- i : the row vector whose elements are one.
- j : the column vector whose elements are one.

(3) By regressing the predicted Input-Output coefficients on the Climate variables such as temperature, precipitation and so on, I try to find out the functional form between the input-output coefficients and the climate variables and then, predict the effects of the climate change on the inter-industry relations. In other word, I try to estimate the following equations.

$a_{ij} = A_{ij}/X_j = f$ (temp, pres, DMreg, ...) ··················⑪

Here,
- a_{ij} : input-coefficient
- temp: temperature
- pres: precipitation
- DMreg: Regional dummy- variables

As mentioned in the preceding sections of this paper, this is only the first approach to the original research purpose. In order to get the precise and meaningful implications, it is desirable to use the Input Output tables at the regional level and the regression analysis should be carried out region by region. But there are no regional Input-Output tables in Turkey. So, what can be done at this stage is to clarify the relationship between the input output coefficient in the national level and the climate environmental conditions at regional level. To offset the mismatching between the dependent variables and explanatory variables, several regional dummy variables have to be used. It would be necessary to repeat a lots of trial and errors to get the statistically significant results from this estimation work.

(4) In addition, I try to predict the effects of the climate changes on job opportunities in each sector by multiplying the employment coefficients to the induced production in each sector..

$$L_j = X_j \times l_j \quad \cdots\cdots ⑫$$

Here, L_j : induced employment in sector j
X_j : induced production in sector j
l_j : employment coefficient in sector j

From the results of this calculation process, we can argue that the climate changes in which districts are most influential to the economic activities in Turkey as a whole. At the moment, the complete statistics of the number of workers or annual working hours in each sectors has not been announced in the detailed form which can be applied to this research in Turkey. So, we have to estimate by statistically processing the original data under the certain assumption. Here, we have to take into account the three dimensions of labor measurement. i.e. in terms of the annual working hours, the number of person employed in each sector and the working efficiency, which reflects the educational background and age structure of the workers.

<Reference>

[1] Masaru KAGATSUME, "Input Output Analysis on the Environmental Resources Conservation in Rice Growing Areas in Australia", Journal of Oceania Economy Studies, No.7, October, 1993, Association of Oceanian Economic Studies

[2] Masaru KAGATSUME, "Global warming and methane emission from the rice growing", The Farm Accounting Studies, No.24, December 1991

[3] Lashof, D & Tirpak, D., "Policy options for stabilizing global climate" (draft), US. EPA, Washington, DC., 1989

[4] Yuzuru MATSUOKA, "Effects estimation model of global warming alleviation measures", Environmental Research, No.77, 1990

[5] State Institute of Statistics Prime Ministry Republic Of Turkey, The Input-Output Structure of The Turkish Economy, 1996

[6] Kenichi Miyazawa, "The introduction of the Input Output Analysis", Japan Economic Press. 1980