

**A Regional Econometric Study of the Interactions Among Climate Changes,
Agricultural Supply & Demand, and AgriEnvironmental policy**

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1. Research objectives

The purpose of this study is to conduct a research on relation between the agricultural activities and climate factors such as the change in temperature and precipitation caused by global warming, etc. Among those, their socio-economic impacts are especially focused on.

2. Research methodologies

The Input-Output model 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 as Table 1. Applying the typical Inter-Industry analysis i.e. Input-Output Analysis on this table, the following formula are derived,

$$A \cdot X + F = X \dots\dots\dots ①$$

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

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

From these formulas, the following 2 coefficients can be calculated,

<influence degree coefficient>

$$E_j = \sum_i b_{ij} / (\sum_j \sum_i b_{ij} / n) \dots\dots ③$$

(i,j=1,2,...,n)

<responsive degree coefficient>

$$K_i = \sum_j b_{ij} / (\sum_i \sum_j b_{ij} / n) \dots\dots ④$$

(i,j=1,2,...,n)

$$P = [(I - A)^{-1}] \cdot V \dots\dots\dots ⑤$$

$$\Delta P = [(I - A)^{-1}] \cdot \Delta V \dots\dots\dots ⑥$$

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 lines of unit coefficients.

The region I where both coefficients are larger than 1 shows that the activities of this sector affect whole economy stronger than the average and the sector tend to be affected by the activity of whole economy more severely than the average. The livestock industry sector is in this region.

The region II where responsive degree coefficient is bigger than 1 but influence degree coefficient is less than 1 shows that these sectors tend to be affected by the whole economy more seriously than average but these sector tend to affect whole economy less than average. It is shown that cereals sector is distributed in this region.

The region III where both coefficients are

less than 1 shows that these sectors are affected less seriously than the average but they give impacts on whole economy more seriously than the average. Most of rural sectors such as vegetable, fruits, forestry and fisheries are distributed in this region.

The region IV where the influence degree coefficient is bigger than 1 but responsive degree coefficient is less than 1 shows that these sectors affects whole economy more seriously than the average but they are affected by whole economy less seriously than the average. Farm processing sector is distributed in this region.

The 3 inducement coefficients are calculated. Those are the production inducement coefficient, the import inducement coefficient and the value added 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 the next, by using the relations that the sum of production + import (i.e. total supply) equals to the sum of domestic demand + export (i.e. total demand), so called “the skyline analysis” can be carried out. The results are shown in Figure 3. According to these results, it is shown that the fruits, livestock products, farm processed commodities and bread are self-sufficient but cereals, vegetables, forest products, fisheries, meat

processing sector are in deficit situation. Also most of manufacturing and service sectors are in deficit situation.

4. The remaining tasks to be tackled

(1).The next stage tasks are to investigate how the above mentioned observations would be affected if climate change occurred.

(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 RAS method on 1990 and 1996 tables.

(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 coefficients and climate variables and then, predict the effects on the inter-industry relations of climate change. In other ward, I try to estimate the following equations.

$$a_{ij} = A_{ij}/Y_j = f (\text{temp, pres, DMreg,}) \quad \text{.....} \textcircled{7}$$

- a_{ij} : input-coefficient
- tem: temperature
- pres: precipitation
- DMreg: Regional dummy- variables

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

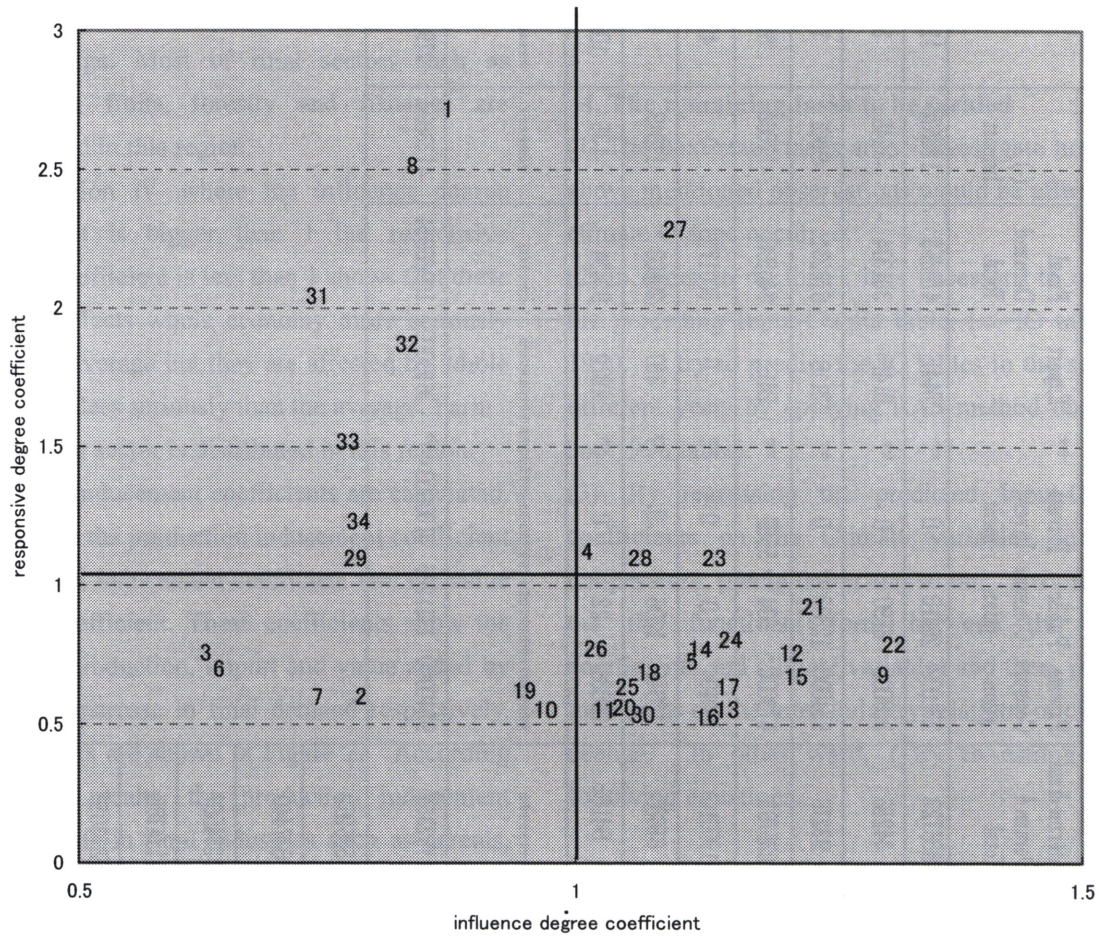
$$L_j = Y_j \times l_{ij} \quad \text{.....} \textcircled{8}$$

- L_j : induced employment in sector j
- Y_j induced production
- l_{ij} : employment coefficient in sector j

Table 1 Agriculture Based Input Output Table

	Intermediate Demand Sector										Final Demand Sector				Total Production			
	Intermediate Demand Total	cereal	vegetable	fruits	livestock	animal process	forestry	fishery	fishery	fishery	Intermediate Demand Total	Private Consumption	Public Consumption	Private Investment		Export	Final Demand Total	(-) Import
		97251	0	0	289980	205000	472	0	*			231000	25410	0	**	73441	-128576	1176803
vegetables		0	2171	0	0	0	0	143	*	34256	318000	6590	0	**	8141	-3245	365314	
fruits		0	0	25127	0	0	0	46	*	93278	554000	12883	0	**	73118	-9661	756848	
livestock		470	15609	5071	41118	2625	22	0	*	235783	478000	504	5569	**	8455	-17886	888515	
ani. proc.		36620	5417	6270	188	17617	0	0	*	195010	62404	0	0	**	0	0	495183	
forestry		0	1300	0	0	1	1481	22	*	85686	18845	1306	0	**	380	-11819	94370	
fisheries		0	265	0	0	0	0	672	*	9418	89888	22	0	**	1972	-135	101777	
*****		*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
Intermediate Input Total		444000	102000	93655	448245	336000	12956	23924		11752352	9840000	1711286	3130000	**	3650000	-4138894	27585412	
Tax		-97000	-5615	13666	8583	2958	2477	900		566262								
Depreciation		25767	9084	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	180000	81413	77852		18933059								
Total Products		1176803	365314	756848	858515	495183	94370	101777		27585412								

Figure1: Influence & Responsive Degree Coefficients



- | | | | | | | |
|--------------|-----------------|-----------------|----------------------------|----------------|-----------------------|------------|
| 1.cerial | 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.alcohol | 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 | |

Figure2 : Inducement Coefficients

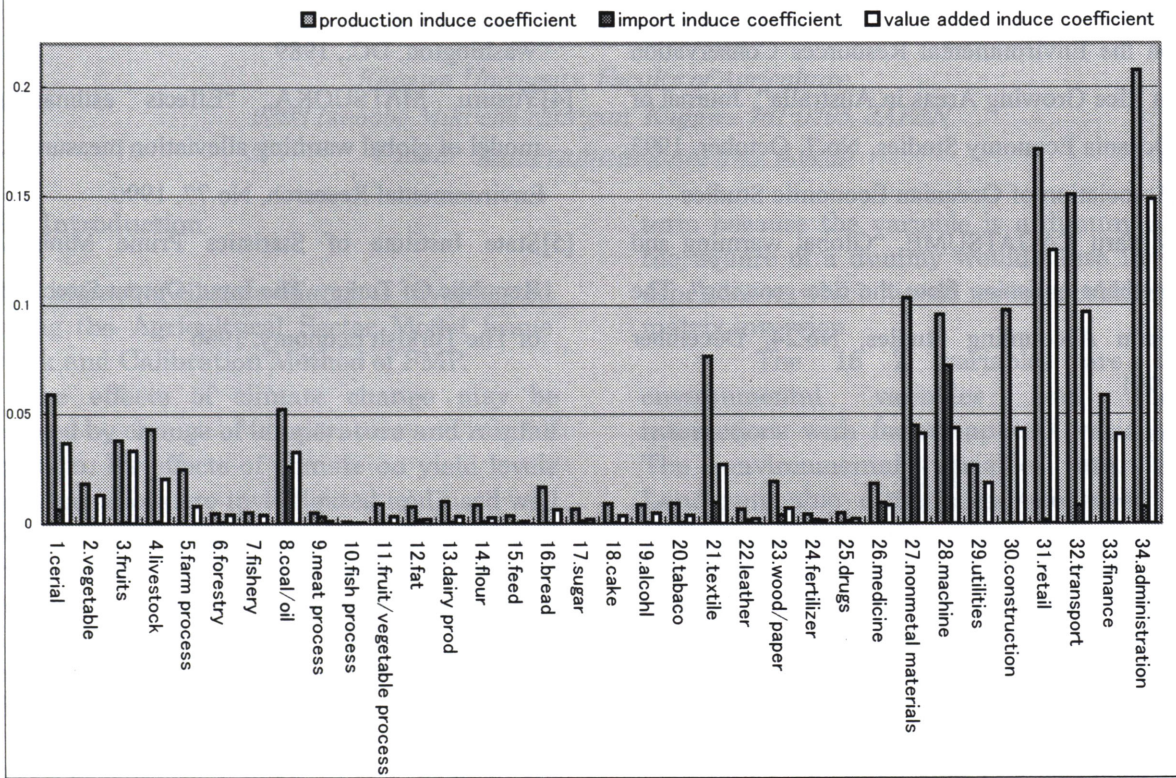
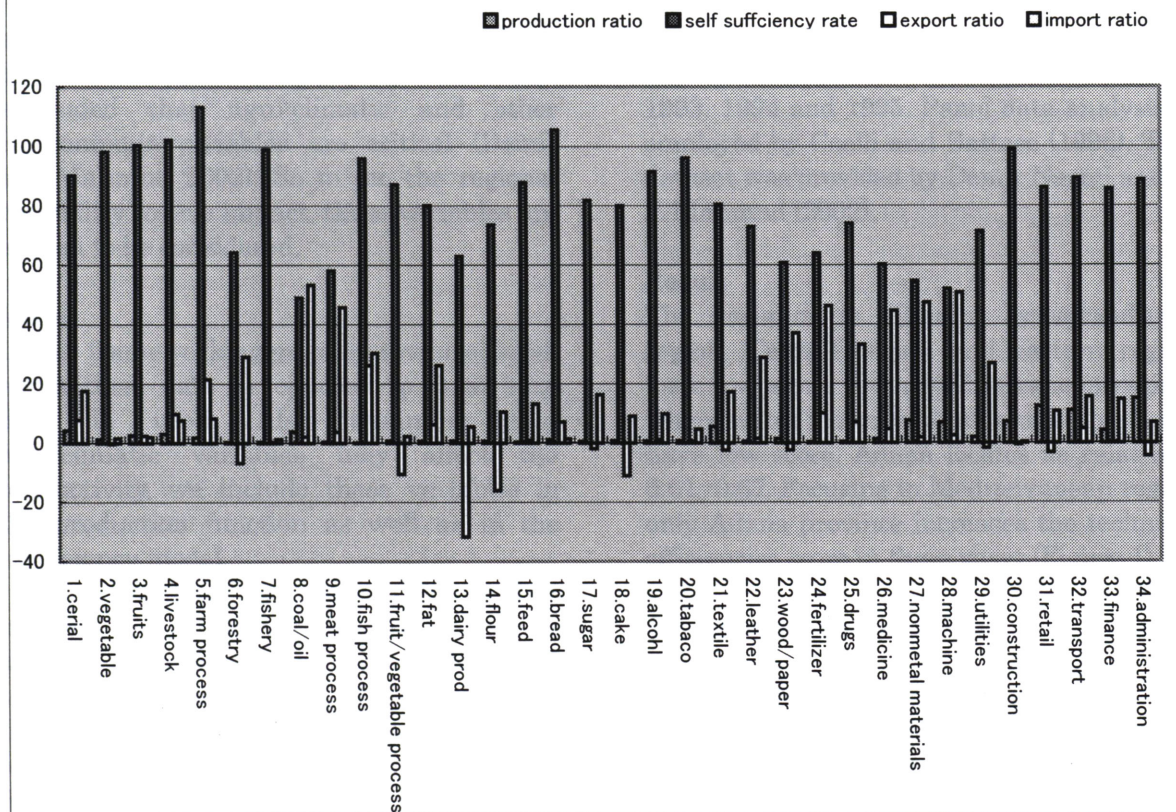


Figure3 : Self-sufficiency & Trade Ratios (%)



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