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The Impact of Trade Openness on Regional Agricultural Productivity in Türkiye

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Introduction

- As a developing country Türkiye relies on agriculture for food security and GDP.
- Agriculture made up 55% of Türkiye's GDP in 1962. Only 5.5% remained by 2021 given industrial boon.
- As Türkiye continues its journey to industrialize and optimize its agricultural production, understanding regional productivity and efficiency become more vital.
- However, studies of TFP at the national level do not provide information on regional economies since productivity growth varies regionally.

Objectives

- Analyze the agricultural TFP growth of 26 regions in Türkiye from 2013 to 2020.
- Investigate the impact of agricultural exports and imports on TFP growth.

Methods

- First, we characterize agricultural technology by translog production function and derive estimates utilizing maximum likelihood SFA.
- However, we get negative elasticities for many observations, which is not anticipated. Therefore, we impose monotonicity restriction utilizing quadratic programming problem on translog SFA.
- Then we feed resulting frontier outputs into new frontier function as an input and estimate its parameters.
- Finally, we use resulting parameters to adjust restricted parameters obtained by quadratic programming problem and use them to calculate the partial production elasticities of inputs and productivity growth consistent with the regularity conditions of the technology.
- Given TC and calculated EC, we provide a TFP growth index in Türkiye at the regional level from 2013 to 2020 and interpret the effect of in(efficiency) driver variables obtained from our model.

Data

Table 1. Summary Statistics

Variable	N	Mean	Std Dev.	Min	Max
Output (1000 TL)	208	6964570	4795318	477812	24168435
Land (Ha)	208	904626	542245	70898	2297510
Labor (1000 Persons)	208	188	98	25	482
Machinery (Number of Tractors)	208	50132	34273	4483	155369
Livestock (Cattle Equivalents)	208	854010	386385	87111	2082967
Fertilizer (Metric Tons)	208	93836	68596	5496	305907
Export (1000 USD)	208	216352	332062	7	1508948
Import (1000 USD)	208	336621	528053	752	2515268

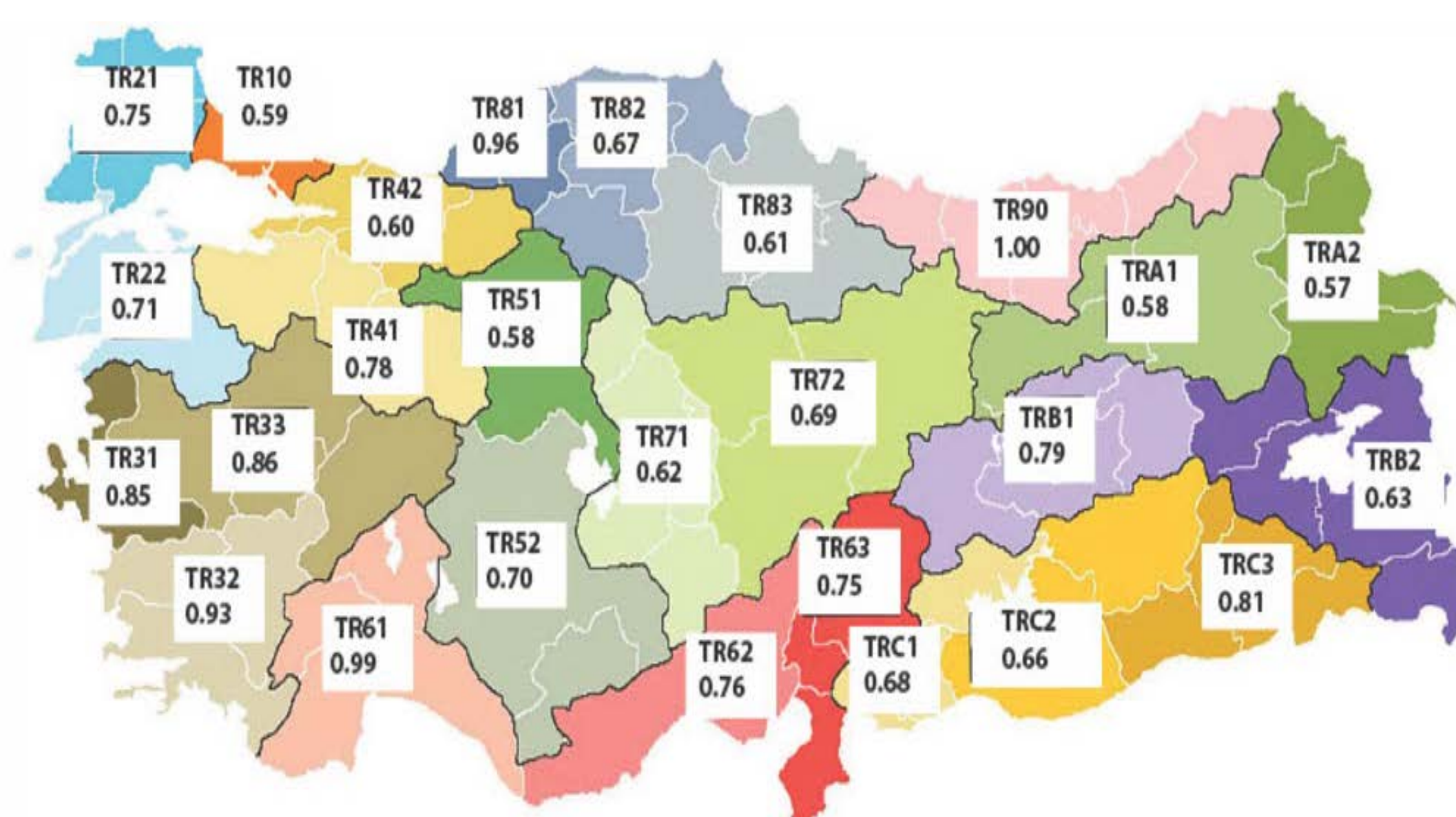
Results and Discussion

- SFA estimation indicates a negative correlation between imports and efficiency, while a positive correlation exists between exports and efficiency.
- 1% rise in imports leads to a 0.15% increase in inefficiency, whereas a 1% increase in exports reduces inefficiency by 0.13%.

Table 2. Restricted SFA Estimation

	Estimate	Std. Error	z value	Pr(> z)
β_0	8.46	0.25	33.81	1.48e-250
β_1	0.06	0.00	35.17	5.02e-271
δ_1	0.15	0.01	12.92	3.45e-38
δ_2	-0.13	0.01	-16.95	1.96e-64
σ^2	0.11	0.01	9.70	2.90e-22
γ	2.89e-08	1.98e-08	1.46	0.15

- Figure below shows the efficiency map of the Türkiye from 2013 to 2020. Annual average efficiency for Türkiye is found to be 0.77 which is weighted by the production of the regions.
- Aegean, Mediterranean and Blacksea regions exhibit high level of efficiency. These regions have favorable climate conditions for agriculture.
- Aegean region is known for olive and tobacco production, Mediterranean region for citrus and vegetables, and Blacksea region for tea and hazelnut.
- Marmara and Anatolian regions exhibits low level of efficiency.
- Marmara region is characterized by strong industrialization and heavy reliance on its resources for the manufacturing industry which limits allocation of resources towards agriculture.
- Anatolian regions have less favorable climate conditions for agriculture and mostly specializes on grain production which requires substantial resources but generates lower returns.



- Table 3 presents average partial production elasticities and return to scale. The average partial production elasticities of land, labor, machinery, livestock, fertilizer, and time were found to be 0.34, 0.17, 0.23, 0.22, 0.18, and 0.5, respectively. All the regions exhibited increasing return to scale, and the average of it was 1.20.

Table 3. Average Partial Production Elasticities and Return to Scale

Region	Land	Labor	Machinery	Livestock	Fertilizer	Time	RTS
Istanbul	0.31	0.15	0.22	0.21	0.13	0.042	1.06
Tekirdağ	0.35	0.19	0.24	0.23	0.17	0.056	1.23
Balıkesir	0.36	0.15	0.23	0.23	0.19	0.054	1.21
Izmir	0.35	0.15	0.23	0.22	0.17	0.050	1.17
Aydın	0.36	0.19	0.24	0.20	0.20	0.058	1.25
Manisa	0.37	0.18	0.24	0.21	0.20	0.061	1.28
Bursa	0.35	0.18	0.24	0.22	0.19	0.056	1.23
Kocaeli	0.36	0.15	0.23	0.22	0.18	0.053	1.20
Ankara	0.33	0.15	0.23	0.26	0.17	0.053	1.20
Konya	0.36	0.19	0.25	0.23	0.18	0.061	1.28
Antalya	0.35	0.19	0.24	0.20	0.19	0.057	1.23
Adana	0.36	0.20	0.25	0.20	0.17	0.058	1.25
Hatay	0.35	0.19	0.25	0.21	0.17	0.056	1.22
Kirikkale	0.35	0.18	0.24	0.24	0.18	0.058	1.25
Kayseri	0.35	0.18	0.24	0.23	0.19	0.060	1.26
Zonguldak	0.31	0.15	0.20	0.20	0.20	0.046	1.10
Kastamonu	0.33	0.15	0.22	0.22	0.19	0.051	1.17
Samsun	0.37	0.20	0.24	0.20	0.20	0.061	1.28
Trabzon	0.35	0.19	0.24	0.18	0.18	0.057	1.20
Erzurum	0.34	0.13	0.22	0.24	0.19	0.051	1.16
Ağrı	0.34	0.12	0.22	0.24	0.20	0.052	1.17
Malatya	0.34	0.15	0.22	0.22	0.19	0.052	1.17
Van	0.34	0.14	0.22	0.22	0.19	0.053	1.18
Gaziantep	0.34	0.17	0.23	0.22	0.18	0.054	1.19
Şanlıurfa	0.37	0.19	0.27	0.21	0.16	0.060	1.26
Mardin	0.34	0.14	0.24	0.26	0.14	0.050	1.16
Average	0.35	0.17	0.23	0.22	0.18	0.05	1.20

- Table 4 shows, average EC, TC and TFP growth for the regions in Türkiye. Annual average of national TFP growth in agriculture were 5%. TFP growth in regions were mostly driven by TC.

Table 4. Average EC, TC, TFP Growth

Region	EC	TC	TFP Growth
Istanbul	0.004	0.042	0.046
Tekirdağ	-0.002	0.056	0.054
Balıkesir	-0.004	0.054	0.050
Izmir	-0.013	0.050	0.037
Aydın	0.005	0.058	0.063
Manisa	0.004	0.061	0.064
Bursa	0.008	0.056	0.064
Kocaeli	0.018	0.053	0.071
Ankara	-0.039	0.053	0.015
Konya	0.003	0.061	0.064
Antalya	0.000	0.057	0.057
Adana	0.003	0.058	0.061
Hatay	0.001	0.056	0.057
Kirikkale	-0.013	0.058	0.045
Kayseri	-0.016	0.060	0.043
Zonguldak	0.014	0.046	0.060
Kastamonu	-0.024	0.051	0.027
Samsun	-0.001	0.061	0.060
Trabzon	0.000	0.057	0.057
Erzurum	0.098	0.051	0.149
Ağrı	0.007	0.052	0.059
Malatya	-0.017	0.052	0.036
Van	0.149	0.053	0.202
Gaziantep	0.003	0.054	0.057
Şanlıurfa	-0.020	0.060	0.040
Mardin	-0.002	0.050	0.048

- The relationships between agricultural TFP growth and exports-imports growths are demonstrated by the cumulative growth indexes observed from 2013 to 2020 in Table 5.
- According to the results for most regions, higher TFP growth mostly results in greater export growth. Similarly, there is a clear disproportional relationship between TFP growth and import growth.

Table 5. TFP, Output, Export and Import Growth Indexes and Output Shares

Region	Share	Output	TFP	Export	Import
Van	0.02	3.08	2.60	1473.76	10.10
Erzurum	0.02	2.56	2.44	62.29	0.82
Kocaeli	0.03	2.52	1.61	1.64	0.69
Konya	0.07	2.88	1.55	0.72	0.65
Bursa	0.04	2.72	1.54	1.55	1.04
Manisa	0.06	2.78	1.54	0.49	0.47
Aydın	0.06	2.27	1.53	1.67	1.29
Adana	0.08	2.90	1.51	1.22	1.06
Samsun	0.06	2.60	1.51	1.14	1.20
Zonguldak	0.01	2.39	1.49	3.49	0.40
Ağrı	0.02	3.05	1.48	1.06	0.83
Hatay	0.04	2.39	1.48	1.04	1.01
Antalya	0.08	2.31	1.48	1.32	0.93
Trabzon	0.05	2.84	1.47	0.70	0.86
Gaziantep	0.03	4.01	1.47	1.55	1.32
Tekirdağ	0.03	2.76	1.44	1.16	1.33
Balıkesir	0.04	2.69	1.41	0.68	0.88
Istanbul	0.004	2.33	1.37	1.40	1.11
Mardin	0.03	2.87	1.37	1.95	2.18
Kirikkale	0.04	2.94	1.36	0.90	1.79
Kayseri	0.04	2.52	1.34	0.46	1.16
Şanlıurfa	0.06	3.28	1.30	0.67	2.09
Izmir	0.04	2.31	1.29	0.87	1.69
Malatya	0.02	2.88	1.28	0.53	1.29
Kastamonu	0.01	2.63	1.19	0.47	1.84
Ankara	0.03	2.59	1.06	0.37	3.71
Average		2.73	1.48		

Conclusions

- Trade openness significantly affects agricultural TFP growth and efficiency in Türkiye from 2013 to 2020.
- Increased imports are associated with reduced agricultural efficiency, potentially due to displacement of domestic crops and output devaluation.
- Conversely, increased exports are associated with improved efficiency, driven by competitive pressure from the rest of the world.
- Regional variations in productivity underscore the importance of tailored agricultural policies considering regional characteristics and resources.
- Technical change emerges as a primary driver of TFP growth, highlighting the necessity of prioritizing R&D initiatives.
- Policymakers should balance trade policies to maximize the gains from trade openness while mitigating adverse effects on productivity.

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