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STRUCTURAL DETERMINANTS OF PRODUCTIVITY: SECTOR-LEVEL EVIDENCE FROM TURKIYE

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ABSTRACT

Purpose- The purpose of this study is to investigate how market concentration, capital intensity, labour share, and macroeconomic conditions shape sectoral productivity in Türkiye. Although substantial research highlights the link between market structure and productivity, empirical evidence from emerging economies, particularly at the sector level, remains limited. Türkiye represents an important case due to its structural heterogeneity, frequent macroeconomic fluctuations, and the coexistence of highly concentrated and highly competitive industries. This study aims to fill this gap by providing sector-level evidence based on the Annual Industry and Service Statistics (AISS) for the period 2009–2022.

Methodology- The analysis employs fixed-effects panel regressions. Labour productivity (lnprod) is modelled as a function of market concentration (HHI), capital–equipment ratio (lncer), employment scale (lnemployment), and the adjusted labour share (adj_ls). Additional models include exchange rate, interest rate, year fixed effects, and a linear time trend. Robust standard errors are clustered at the industry level.

Findings- The results consistently indicate that increases in market concentration are associated with higher sectoral productivity across all model specifications. Although the magnitude of the HHI coefficient declines when macroeconomic controls or time effects are added, the positive and statistically significant relationship remains highly robust. Capital intensity is another strong and stable predictor of productivity, indicating that sectors employing more capital-intensive production technologies tend to achieve higher efficiency levels. In contrast, the effect of employment size becomes statistically insignificant when macroeconomic shocks are controlled for, suggesting that sector size alone does not drive productivity. The adjusted labour share has a persistent adverse impact on productivity, consistent with the idea that higher-productivity sectors allocate a smaller share of value added to labour. Finally, exchange rate and interest rate dynamics affect productivity in expected directions.

Conclusion- The study concludes that productivity differences across sectors in Türkiye are shaped by both structural characteristics, particularly concentration and capital intensity, and macroeconomic conditions. The persistence of the concentration–productivity relationship suggests that market structure plays a significant role in sectoral performance.

Keywords: Market concentration, productivity, capital intensity, labour share, panel data analysis
JEL Codes: L11, O47, C23

1. INTRODUCTION

Labor productivity is a complex phenomenon shaped by numerous macro and micro-level determinants. Explaining the industry-level differences in labor productivity, especially in developing countries undergoing structural transformations, has been a central issue in empirical economics. Sectoral productivity varies widely in Türkiye, a pattern attributable to differences in technological intensity, market structure, input composition, and vulnerability to exogenous shocks. Although productivity in Türkiye has been studied extensively, the role of market concentration, along with structural sectoral characteristics such as labor intensity, labor share, and sector size, particularly at the industry level, has not been examined. This study aims to fill this gap in the literature by employing a fixed-effects estimation framework with industry-level data from 2009 to 2022 to examine the impacts of market concentration, capital intensity, sector size, and macroeconomic variables on productivity across Turkish industries.

2. LITERATURE REVIEW

A vast body of literature examines the mechanisms by which market structure influences productivity. Syverson (2004, 2011) shows that high competitiveness improves sectoral efficiency by increasing the share of productive firms while forcing low-productivity firms to exit the industry. Supporting this finding, Foster et al. (2008) show that increases in sectoral productivity primarily derive from reallocation across firms within industries rather than from within-firm productivity gains. A broader structural trend is demonstrated by De Loecker and

Eeckhout (2017), Calligaris et al. (2018), and Autor et al. (2020). They show the link among rising global markups, increasing productivity, and the declining labor share.

Evidence from developed and developing countries supports the importance of market concentration for productivity. Rodríguez-Castelán, López-Calva, and Barriga Cabanillas (2020) show that a decrease in market concentration amplifies firm-level productivity, while Savagar (2024) also reports a strong link between rising market concentration and rising productivity in the UK. By contrast, Suyanto et al. (2022) demonstrate the negative impact of high market concentration on productivity in Indonesia's manufacturing sector, owing to substantial cross-country heterogeneity in market concentration and its implications for firm behaviour. Another focus of the labor productivity literature is the role of capital intensity, both in capital deepening (Olley & Pakes, 1996; Melitz, 2003) and in the structure and quality of capital equipment (Ahmad & Peters, 2018).

Studies on Türkiye report high heterogeneity in productivity and market structure across industries. Unver & Sunal (2015) show that high price mark-ups explain Turkiye's relatively low labor share rather than low productivity. They also emphasize the role of market concentration in determining the income distribution. The Central Bank of Türkiye (2021) finds that increases in the labor share since the mid-2000s can be explained by both within- and between-industry dynamics, indicating a substantial structural transformation in Türkiye. Sector-level studies exhibit diverse concentration patterns. Sarıdoğan (2021) finds medium market concentration in the information technology sector. Karaçayır (2021) shows that market concentration positively affects export intensity in the manufacturing sector. Polat (2007) and Öngel (2022) report high market concentration in the cement manufacturing industry. Ünsal & Akbıyık (2019) report a decline in market concentration in the beverage industry. These strong heterogeneities in both productivity and concentration levels across industries make Türkiye an important case for examining the dynamics between the two.

3. DATA AND METHODOLOGY

This study employs industry-level panel data from Türkiye's Annual Industry and Service Statistics (AISS), covering the period 2009-2022. The AISS survey, compiled by TURKSTAT, provides firm-level data on turnover, production value, and value added at factor cost, personnel costs, and other demographic variables across NACE Rev. 2 industries. From AISS, sectoral aggregates are calculated on labor productivity (lnprod), market concentration (HHI), capital intensity (lncer), size (lnemployment), and adjusted labor share (adj_ls). Labor productivity is defined as gross value added per employee. The choice of the HHI (Herfindahl–Hirschman Index), based on sectoral turnover shares as the measure of market concentration, is motivated by its ability to yield more reliable results at the NACE2 level. Other concentration measures, such as CR3 and CR4, are better suited to a finer industrial classification (e.g., NACE3, NACE4) because they are more sensitive to missing observations and annual fluctuations. To calculate the capital intensity variable, the ratio of the fixed assets to employment is used. Fixed asset values at the NACE2 level are obtained from the Sector Balance Sheets Statistics (SBSS) compiled by TURKSTAT. The total employment-to-employee ratio adjusts the labor share at the sectoral annual level. To control for time-varying macroeconomic shocks, annual exchange-rate and interest-rate variables are also included in the analysis. The final balanced industrial level panel dataset comprises 16 NACE2 sectors over 14 years.

The appropriate empirical approach for this analysis is fixed-effect panel regression. This framework enables control for unobserved, sector-specific characteristics that may jointly affect productivity and market concentration. The following model is employed as the baseline specification:

$$lnprod_{\{it\}} = \beta_0 + \beta_1 hhi_{\{it\}} + \beta_2 lncer_{\{it\}} + \beta_3 lnemployment_{\{it\}} + \beta_4 adj\_ls_{\{it\}} + \gamma_t + u_i + \varepsilon_{\{it\}} \quad (1)$$

This model estimates the effect of HHI, capital intensity, employment size, and adjusted labor share on productivity, while controlling for unobserved, time-invariant sectoral heterogeneity. The following models include year fixed effects to capture standard macroeconomic shocks, followed by specifications that include explicit macroeconomic controls (exchange and interest rates). A linear time trend is also added to account for gradual structural change. All regression models are estimated using robust, clustered standard errors at the industry level to address serial correlation and heteroskedasticity. This stepwise modelling strategy enables us to see how the concentration–productivity relationship evolves as additional sources of variation are incorporated.

4. FINDINGS

Table 1 shows the high variation across Turkish NACE2 industries in productivity and other structural characteristics. A substantial variation is observed in labor productivity. Descriptive statistics on HHI reveal that a few industries exhibit much higher concentration levels than the average in a competitive environment. These patterns indicate the significant impact of market concentration on labor productivity, which can be modelled using a fixed-effects framework.

Table 1: Summary Statistics of Main Variable

Variable	Mean	SD	Min	Max	P25	P50	P75
lnprod	11.584	1.045	9.687	15.150	10.801	11.461	12.221
hhi	0.034	0.083	0.001	0.633	0.002	0.006	0.027
lncer	4.696	1.373	1.958	8.957	3.801	4.487	5.343
lnemployment	12.441	1.379	9.876	15.254	11.309	12.240	13.527
adj_ls	0.456	0.223	0.041	1.000	0.266	0.451	0.639
exchange_rate	4.495	4.007	1.500	16.564	1.792	2.871	5.671
interest_rate	15.559	4.471	8.908	24.078	12.758	14.093	20.787

Capital intensity and the labour share also differ considerably across sectors, as evident in the regression results. The fluctuations in exchange rates and interest rates during the sample period are substantial, supporting their inclusion in analyses of productivity over time. Therefore, the descriptive patterns and the econometric findings are mutually supportive. Productivity outcomes across sectors are associated with variations in market structure, input composition, and broader macroeconomic conditions.

Table 2: Sector Level Summary Statistics

Sector Name	lnprod	HHI	lncer	lnemployment	adj_ls
Mining and Quarrying	12.050	0.022	5.533	11.466	0.286
Manufacturing	11.451	0.003	4.728	14.948	0.427
Electricity, Gas, Steam and Air Conditioning Supply	13.083	0.032	7.651	11.249	0.142
Water Supply; Sewerage, Waste Management and Remediation	11.801	0.055	3.790	11.027	0.401
Construction	11.652	0.002	4.821	13.820	0.227
Wholesale and Retail Trade	11.256	0.001	4.227	14.584	0.457
Transportation and Storage	11.419	0.035	5.035	13.418	0.494
Accommodation and Food Service Activities	10.725	0.002	4.701	13.344	0.631
Information and Communication	12.276	0.051	5.218	11.893	0.389
Real Estate Activities	12.130	0.010	7.136	10.628	0.259
Professional, Scientific and Technical Activities	11.258	0.001	3.973	12.913	0.527
Administrative and Support Service Activities	10.569	0.003	3.486	13.577	0.776
Education	10.871	0.006	3.824	12.072	0.734
Human Health and Social Work Activities	11.011	0.009	3.949	12.384	0.631
Arts, Entertainment and Recreation	13.416	0.308	4.430	10.374	0.083
Other Service Activities	10.371	0.002	2.633	11.361	0.832

The sector-level statistics in Table 2 reveal the clear variation in the structures of Turkish industries. While we observe higher productivity in energy related industries and in art and entertainment, service activities such as water services and other service activities categories exhibit a low level of productivity. Arts and entertainment sector also stands out with its high concentration level relative to the other industries with lower concentration degrees. Capital intensity and employment size exhibit high variation across industries while labor share seems higher in service related sectors and lower in capital intensive ones. Overall, these descriptive statistics show that industries in Turkish economy have different technological and market conditions.

Table 3 presents four fixed-effects models in a stepwise framework. Across all four fixed-effects models, the coefficient on HHI remains positive and statistically significant, indicating that productivity tends to rise in years when a sector becomes more concentrated. The effect is most pronounced in the simplest specification and diminishes as year effects, macroeconomic variables, and a linear trend are added. This pattern suggests that the link between concentration and productivity is explained by shifts within sectors, as well as by long-run movements. Capital intensity shows a similarly stable and positive relationship with productivity. In contrast, the employment size effect becomes insignificant when aggregate shocks are included, suggesting that sector size does not play a central role once macroeconomic conditions are accounted for. The adjusted labour share consistently harms productivity, indicating that higher productivity is associated with less labour-intensive value added. The exchange rate and interest rate are also significant, capturing movements that appear to influence measured productivity through price and cost channels rather than through structural change.

Table 3: Fixed-Effects Estimates of the Determinants of Sectoral Productivity

Variable	(1)	(2)	(3)	(4)
hhi	2.717***	1.789***	2.282***	1.795***
	(0.226)	(0.127)	(0.180)	(0.121)
lncer	0.760***	0.144**	0.484***	0.141***
	(0.044)	(0.060)	(0.042)	(0.046)
lnemployment	0.746***	0.025	0.524***	0.003
	(0.118)	(0.152)	(0.064)	(0.090)
adj_ls	-2.696***	-2.116***	-1.822***	-2.073***
	(0.570)	(0.457)	(0.503)	(0.419)
exchange_rate			0.0497***	0.0539***
			(0.0065)	(0.0056)
interest_rate			0.0100***	0.00529***
			(0.0021)	(0.00173)
trend (t)				0.0699***
				(0.0082)
_cons	-0.129	10.883***	3.165***	10.919***
	(1.601)	(2.149)	(0.842)	(1.310)
Year FE	No	Yes	No	No
Industry FE	Yes	Yes	Yes	Yes
Observations	224	224	224	224
R2_within	0.9490	0.9816	0.9696	0.9797

Clustered standard errors are in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

5. CONCLUSION

This study analyzes sectoral productivity dynamics in Türkiye using a panel of 16 industries from 2009 to 2022, employing fixed-effects estimation. The descriptive analysis exhibits substantial structural variation across sectors in productivity, concentration, capital intensity, and labour share. The econometric results show that higher market concentration is consistently associated with higher labour productivity, even after controlling for sector-specific characteristics, macroeconomic shocks, and long-term trends. Capital intensity also plays a positive and robust role, whereas the adjusted labour share is negatively associated with productivity. Overall, the findings suggest that both market structure and input composition are central to explaining productivity differences across Turkish industries.

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