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## Article

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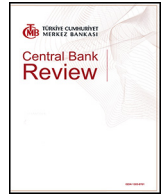
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# Market concentration and producer prices

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## ABSTRACT

This study investigates the role of sectoral market structure in the inflationary dynamics of the domestic producer prices (D-PPI) in Türkiye. We start by reporting the fact that industries with intense competition had lower producer price inflation compared to industries with low-competition in the past few years. Further investigation shows that this differentiation across industries corresponds to the years with higher exchange rate volatility. The industries characterized with low-competition have higher annual producer price inflation on average than those that are characterized with high-competition especially during the periods of high exchange rate volatility. Results are robust to a wide set of additional specifications and cast light on the role of market structure on firms' pricing behavior in Türkiye. © 2023 The Authors. Published by Elsevier B.V. on behalf of Central Bank of The Republic of Turkey. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

Competition is one of the structural determinants of the pricing behavior. Classical price competition theory predicts that intense competition environment within the industry directly leads to downward pressure on prices by restraining excess profits of firms. In a competitive environment where the rival firms compete in prices, firms are prone to undercutting their prices by shrinking their mark-ups in order to capture the market, and equilibrium prices in the product market eventually converge to marginal costs of competing firms (Bertrand, 1883; Tirole, 1994).

Although there are many aspects to criticize on these preliminary theories, the premise that firms are competing in prices still constitutes an important part of pricing behavior of the firms in real world. Many previous studies have uncovered that greater part of companies pay regard to competitors' prices when they set their own pricing strategy (Hall et al., 1996; Fabiani et al., 2006; Alvarez et al., 2005; Hinterhuber, 2008; Sahinoz and Saracoglu, 2008; European Central Bank, 2019). Compared to low-competition

environment, the adjustment of prices is more prompt in the competitive environment (Leith and Malley, 2007; Geroski, 1992; Martin, 1993; Rotemberg and Woodford, 1999) and the firms operating in competitive environment can increase prices only to a certain extent due to higher opportunity costs of mispricing such as potential loss in market share, consumer switching expenditures, and damages in customer loyalty.

Compatible with this economic rationale, dynamic inconsistency theory emphasizes the lack of competition among firms as a driver of cross-country inflation rate differentials in the long run. In an economy where sticky prices and rigidities exist, monetary authority can use unexpected inflation shocks to raise competition and increase output level above full-employment level of output. Hence, under the assumption that the low competition is related with lower full-employment level of output, monetary authority has larger incentive to increase output by using inflation if there is low competition among firms and the countries with lower competition are exposed to higher inflation in the long run (Kydland and Prescott, 1977; Barro and Gordon, 1983; Neiss, 2001). Among many, an important concern with the abovementioned framework is that such an approach would distort the allocative

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role of the price system (Nakamura et al., 2018). In an inflationary environment, relative prices fluctuate more and inefficiently, and as a consequence, they no longer reflect the relative costs of production, leading to lower production efficiency (Nakamura et al., 2018). Global competition hypothesis, on the other hand, has linked decreasing global inflation with the trade openness through productivity and competition channels. Intense foreign competition induces lower inflation through decline in market power of the firms and rise in productivity (Rogoff, 2003; Melitz and Ottaviano, 2008). Recently in a related paper, Autor et al. (2017) argue that if globalization pushes sales toward the most productive firms, the industries will be dominated by superstar firms and the product market concentration will rise. This may in turn lead to higher markups and a low labor share of value added.

Nevertheless, increasing competition does not necessarily lead to lower inflation in theory; there are some arguments that attempt to underpin price-increasing nature of competition in contrast to conventional wisdom. Stiglitz (1987) argues that increasing number of firms implies higher search costs for the consumers and lower search incentives, which leads to higher equilibrium price. Rosenthal (1980) drew attention to the role of different reactions between loyal customer group and switching group. When the seller cannot impose different prices on loyal customers and switchers, increased competition among sellers leads to higher prices. Chen and Riordan (2008) examine the assumptions necessary for duopoly prices to be higher than monopoly prices. Compared to monopoly firm, duopoly firms have incentive to decrease prices since they are able to sell to fewer consumers at the monopoly price (market share effect) and incentive to increase prices since they have steeper demand curve (price sensitivity effect). Duopoly prices can be higher than monopoly prices when price sensitivity effect exceeds the market share effect, potentially more with higher product differentiation.

Despite the prevalence of theoretical discussion on how competition affects pricing, the accumulation of empirical evidence is relatively slow to date, particularly for the case of Türkiye. From an empirical perspective, Neiss (2001) points out that mark-ups are important in explaining inflation rate differences between OECD countries, and Przybyla and Roma (2005) verify positive relationship between those two for the long-run at the both cross-country/cross-industry level data in Europe. On a specific sectoral basis, Pauly and Satterthwaite (1981) and Bresnahan and Reiss (1990) examined physician and auto market industries respectively, and argued that prices are higher in less concentrated market structures. Regarding the link between international trade openness and inflation, Chen et al. (2009) reported that rising trade openness increased productivity, reduced mark-ups and inflation in EU countries during 1988–2000. Andrews et al. (2018) reported that global value chain integration is associated with lower inflation by inducing productivity and decreasing wages. De Loecker et al. (2016) investigate the link between trade openness and markups in the aggregate economy using India's trade liberalization episode, and find that trade openness reduced the factory-gate prices. However, they find that the price declines are smaller than the declines in marginal costs since the firms extract more rents from the consumer side by raising markups.

In the literature, it has already been shown that exchange rates and prices of imported inputs such as commodity, oil, food have been prominent determinants of the producer prices both in

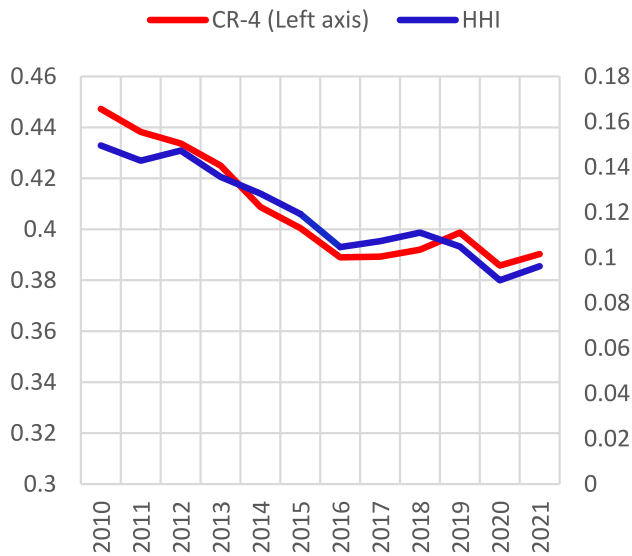
Türkiye and around the world (Central Bank of the Republic of Türkiye, 2021; McCarthy, 2007; Ahn et al., 2016). The literature on Turkish economy also finds that exchange rate pass-through to producer prices is higher than pass-through to consumer prices, and the exchange rate pass-through to domestic producer prices vary substantially across sectors (Yüncüler, 2011; Ertug et al., 2019). Fendoğlu et al. (2020) report that industries with higher foreign currency liabilities raise their producer prices more after a decline in the value of the domestic currency. Regarding the concentration at the supplier network, Akgündüz and Fendoğlu (2022) find that exporters which rely on fewer firms in their domestic supply networks raise their export prices more after a decline in the value of domestic currency.

In this study, we investigate the relationship between market concentration and the producer price inflation in Türkiye using data at the industry level. Thus, the paper builds upon the literature above, and provides additional empirical evidence on the relation between market structure and pricing behavior. Yet, the evidence of the paper is crucial from a policy making perspective as well. Understanding and quantifying the relationship between market structure and pricing behavior is crucial for central banks since monetary policy decisions hinge on the causes of inflation.

For this study, we combine several datasets. First, we use the balance sheet and income statement of all legal and real entities that keep accounting records on a balance sheet basis in Revenue Administration dataset to calculate the sector level concentration ratios. Second, we exploit the domestic producer price index (D-PPI) and import unit value index from Turkstat in monthly frequencies to analyze the price dynamics in the corresponding industries. Finally, we extend this dataset with FX indebtedness of sectors calculated from Credit Registry dataset and imported input intensities calculated by exploiting firm level imports from customs dataset. In this way, we obtain a final dataset on producer price dynamics, imported input prices and product market competition for the 84 industry over the 2010–2021 period.

The first set of our results show that producer price dynamics have differentiated between high-competition and low-competition industries in past few years. The main results from the analysis imply that annual domestic producer price (D-PPI) inflation is approximately 2.3 percentage points lower for the high-competition industries in the 2017–2021 period. A more detailed analysis shows that the divergence between low-competition industries and high-competition industries in the price dynamics is more evident at times of strong exchange rate movements. More specifically, a 10 percent depreciation in local currency is associated with 1.57 percentage points additional increase in annual producer price inflation in the low-competition industries on average. The degree of relationship is robust to alternative definitions of producer price inflation, market competition and exchange rate. Results are also valid for both short-term and long-term relationships, while it is statistically more significant for the long-term relationship. Results highlight the cruciality of creating competitive environment in curbing the reaction of producer prices to the exchange rate depreciation and volatility.

The rest of the paper is structured as follows. Section 2 summarizes competition, price and exchange rate dynamics in Türkiye. Section 3 describes the data, construction of competition variables, and empirical methodology. Section 4 summarizes methodology. Section 5 presents the estimation results of the baseline model.



**Fig. 1.** Market Concentration. Source: Authors' calculations from Revenue Administration dataset. The HHI and CR-4 is constructed by weighting NACE 4-digit levels of industrial competition indicators with their share of net sales in the overall economy (See section 3 for definition of HHI and CR-4).

Section 6 discuss further robustness estimations, and finally section 7 concludes.

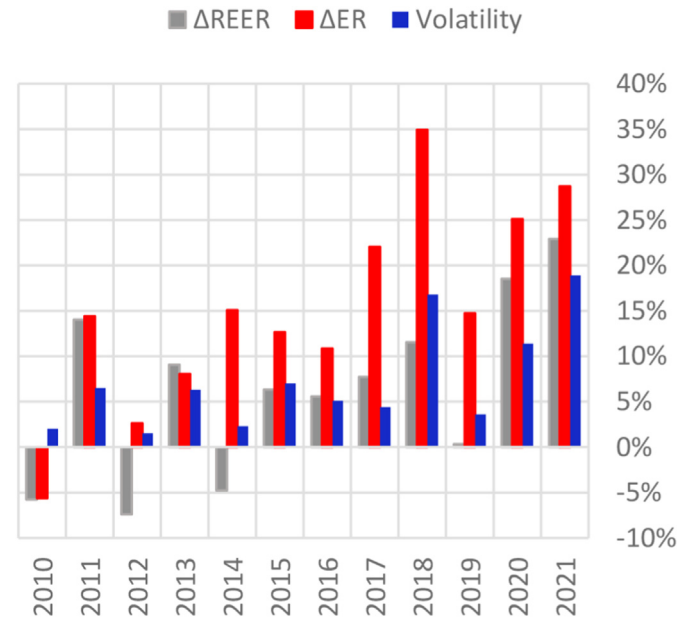
## 2. Competition, exchange rate and price dynamics in Türkiye

Recent studies point to declining product market competition in recent years in United States (Gutiérrez and Philippon, 2017; Covarrubias et al., 2020), in European countries (Van Reenen, 2018; Koltay et al., 2020; Bighelli et al., 2021) and in the other advanced economies (Bajgar et al., 2019).<sup>1</sup> The declining trend has taken place through market concentration (Freund and Sidhu, 2017), mark-ups and the profitabilities (Diez et al., 2018; De Loecker et al., 2020). The decline in competition and its macroeconomic consequences were investigated from different point of views so far and associated with decreasing labor share (Autor et al., 2017), investments (Gutiérrez and Philippon, 2017) and productivity (Covarrubias et al., 2020).

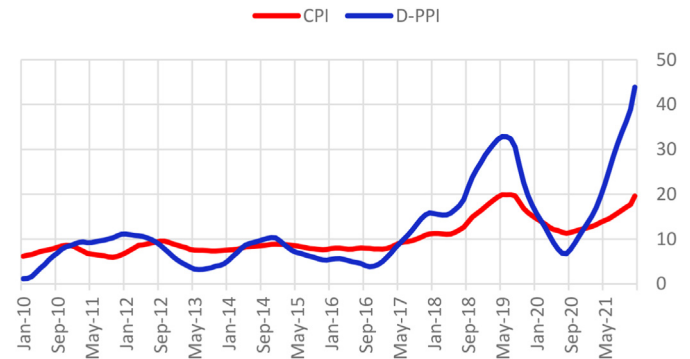
In the meantime, the product market concentration in Türkiye has shown a decreasing pattern in contrast to global trend. As Fig. 1 suggests, the concentration level in terms of both HHI and CR-4 has decreased over the years, leveling off in past few years.<sup>2</sup> Türkiye's evolving market concentration trend includes main sector-level granularity (Figure A1 in appendix). While there is a common decreasing pattern in energy, agriculture and mining, manufacturing and services industries in the before, divergence between main industries become evident in the following period. Markets become more concentrated in agriculture and mining, construction and trade industries, whereas the concentration in the energy continue to decrease. This heterogeneity among main industries is in contrast with US where the decline in competition is observed in broad range of industries (Grullon et al., 2017; De Loecker et al., 2020).

<sup>1</sup> Although there are studies suggest that competition in European countries is stable in the last years (Gutiérrez and Philippon, 2018; Cavalleri et al., 2019), the majority of the very recent literature emphasize declining competition in European countries. Varying results can be attributed to different time spans and databases.

<sup>2</sup> See section 3 for details of market concentration indicators.



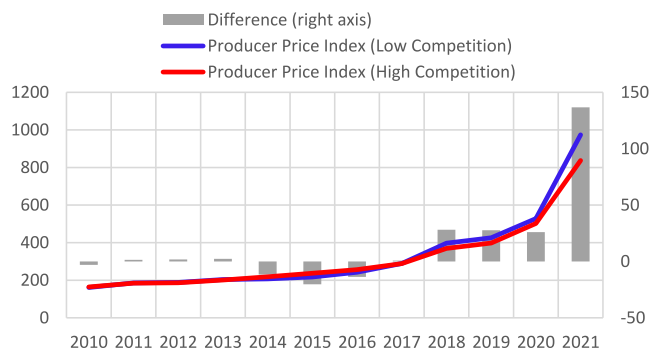
**Fig. 2.** Exchange Rate Dynamics. Source: CBRT. ΔREER is yearly percentage depreciation in real effective exchange rate deflated by consumer price index. ΔER is yearly percentage increase in equal basket exchange rate between EUR and USD. Volatility is coefficient of variation of daily nominal basket currency for each year.



**Fig. 3.** Domestic Producer Price Inflation (D-PPI) and Consumer Price Inflation (CPI) (12 Month Moving Average, %). Source: Turkstat. CPI is rate of consumer price index change in twelve months moving averages. D-PPI is rate of domestic producer price index change in twelve months moving averages.

On the other hand, the exchange rates and import prices have shown volatility in recent years. Figure A1 in the appendix-A shows the increase in import prices and Fig. 2 shows the exchange rates dynamics in past few years. In the same vein, Türkiye experienced large movements in consumer and producer prices in the past few years (Fig. 3). Average annual producer price inflation is 7.15 percentage points in 2010–2016 period, it escalates into %23.32 in 2017–2021 periods.

The significant part of the producer price inflation in this period is attributed to soaring exchange rate and import prices (Central Bank of the Republic of Türkiye, 2021). On the other hand, the market structure that a firm operates in can be a determinant of the pricing behavior. Fig. 4 separates producer price index between low and high-competition industries over the period between 2010 and



**Fig. 4.** D-PPI: High and Low-competition Industries. Source: Authors' calculations from Revenue Administration dataset and Turkstat.

2021. We calculate the long-term average concentration measures for all 84 industries, and call those above the median as the low-competition and below the median as high-competition industries. Although the producer price index followed similar path until 2017 in both groups, low-competition industries significantly deviated from high-competition industries thereafter.

### 3. Data

In this study, we employed a wide range of data sources for investigation. We describe the data sources and the calculation of the variables in the following subsections. Then, we present descriptive statistics.

#### 3.1. Market concentration

We utilize Revenue Administration dataset to calculate sector-level concentration measures.<sup>3</sup> The dataset is provided by Revenue Administration of Turkey and includes balance sheet and income statement of all legal and real entities that keep accounting records on a balance sheet basis for the period between 2010 and 2021. The dataset contains almost all firm-year observations in the population excluding financial and public sector. Starting with the full sample, we exclude mining and quarrying sectors (two-digit NACE codes are from 5 to 9) from the dataset. To calculate the market concentration levels, we use three indicators. First, we calculate Herfindahl-Hirschman Index for all industries under investigation (Hirschman, 1945). HHI is defined as the sum of the squares of the all firms' market share  $MS$  in terms of net sales in the industry  $j$  in year  $t$ , where  $N$  is the number of total firms in the industry. HHI takes the values between 0 and 1, with higher values indicating more concentration and less competition.

$$HHI_t^j = \sum_{i=1}^N (MS_{i,t}^2)^j$$

In addition to HHI, an alternative measure of market concentration,  $CR_4$  is calculated using the firms' net sales data at each

industry.  $CR_4$  is basically sum of the market share of 4 largest firms' in terms of net sales in the industry  $j$ , in year  $t$ .  $CR_4$  also takes values between 0 and 1. Similar to HHI measure, higher values of  $CR_4$  implies higher concentration and lower competition.

$$CR_{4,t}^j = \sum_{i=1}^4 MS_{i,t}^j$$

We also employed number of firms within industry in order to capture the competitive pressures of the firms.

#### 3.2. Domestic producer prices

We obtained Domestic Producer Price Index (D-PPI) from Turkstat in monthly frequencies. D-PPI compiles domestic producers' prices, excluding all taxes at the 3-digit NACE Rev.2 sector-level. We measured yearly inflation in D-PPI in two different ways. First, we take the year-end annual inflation in domestic producer prices for each industry. This basically reflects the December annual inflation levels. Second, we take the average of annual producer price inflation levels over twelve months of the corresponding year. The first indicator differs from the second one in the sense that the former may have very low or very high levels depending on extreme values in December. The second indicator curbs the outliers through the end of year.

#### 3.3. Imported input prices

Import unit value index data is obtained from Turkstat at 2-digit NACE industry level for the 2013–2021 period. The index is equal to 100 in 2015 and an increase in the index means higher import prices. Dataset includes manufacturing industries USD denominated. We use import price data at sectoral level rather than overall import price index due to heterogeneity in the content of imported inputs between sectors. For instance, while oil is the significantly important input for chemical products, rubber and plastic sectors, base metal industries are more sensitive to fluctuations in metal prices. For each 3-digit sector, we calculate the weighted import price inflation  $\Delta WIP_{j,t}$  by weighting 2-digit sectors' yearly import price inflation with their share in total imports of the 3-digit sector in correspondent year.

$$\Delta WIP_{j,t} = \sum_{i=1}^N w_{i,t} * \Delta IP_{v,t}$$

In the formula above,  $v, j, t$  and  $N$  denotes 2-digit main sector, 3-digit subsector, year and total number of 2-digit sectors that 3-digit sector imported in correspondent year, respectively.  $\Delta IP_{v,t}$  refers to 2-digit yearly change of import unit value index obtained from Turkstat.  $w_{i,t}$  is the share of imports from 2-digit NACE sector in all imports by a 3-digit NACE sector.

#### 3.4. Additional control variables

We add several sector-year level control variables such as imported input intensity, gross FX liability, inventory turnover rate and leverage to the model. We defined import input intensity of a sector as total imports divided by cost of goods sold for each year. We obtained imports from firm-level customs dataset provided by the Ministry of Trade. Cost of goods sold is drawn from Revenue Administration dataset. FX indebtedness defined as the share of foreign exchange denominated cash loans in all cash loans at

<sup>3</sup> We adopted market concentration indicators such as HHI,  $CR_4$  and number of firms as the market competition proxy instead of gross profit, which is used as market competition proxy in some studies (Przybyla and Roma, 2005; De Loecker et al., 2020). Even though increasing concentration does not necessarily lead to lower competition due to possibility of 'winner takes most' nature of competition (Autor et al., 2017; Van Reenen, 2018) wide range of literature has employed traditional market concentration variables to capture competition (Gutierrez and Phillippon, 2017; Grullon et al., 2019).



sector-year level. Firm-bank level loan data is obtained from Credit Registry dataset of Turkish banking association. Loan dataset is merged with Revenue Administration dataset, then aggregated for matched sample at 3-digit NACE level for conformability. Inventory turnover and leverage data has been drawn from Revenue Administration dataset that has already outlined in section 3.1. Inventory turnover rate is defined as the cost of goods sold divided by the average of previous year's inventory and current year's inventory, leverage is total debt divided by total assets. We used beginning of the year leverage and FX-indebtedness values.

### 3.5. Descriptive statistics

We match the D-PPI data with competition variables and obtain final dataset with 84 NACE 3-digit level sub-industries from manufacturing, electricity, gas and water supply sectors for the years between 2010 and 2021. Table 1 presents descriptive statistics of the variables. Over the past 12 years, the average D-PPI end of the year inflation was around 14 percent and there was a 14 percent annual depreciation in Turkish Lira on average. In the sample under investigation, the share of imported goods in the cost of sale is around 20 percent.

The table reports summary statistics of the variables through 2010–2021.  $\Delta D\text{-PPI}$  is log difference in year-end or mean annual producer price index. Herfindahl-Hirschman Index is sum of the squares of the all firms' market share in the 3-digit NACE industry. CR-4 is sum of the market share of 4 largest firms in the 3-digit NACE industry. Imported input is total imports divided by cost of goods sold. FX liability is the total debt outstanding denominated in foreign exchange to all debt outstanding. Inventory turnover rate is defined as the cost of goods sold divided by the average of previous year's inventory and current year's inventory. Leverage is total debt divided by total assets. Import prices are calculated by weighting 2-digit import prices with their share in total imports of correspondent 3-digit sector.  $\Delta REER$  is yearly percentage change in real effective exchange rate deflated by consumer price index.  $\Delta ER$  is yearly percentage change in basket currency exchange rate. Volatility is the coefficient of variation of daily nominal basket currency for each year.

## 4. Methodology

Following the clues on differentiation of prices between high and low-competition industries depicted in Fig. 4, we employ several panel data regressions to develop insights. Using the calculated producer price inflation and concentration measures at the industry level, we estimate the following regression equation.

$$\Delta PPI_{j,t} = \beta_0 + \beta_1 \text{High Competition}_{j,t} \times X_{j,t} + \partial_j + \partial_\nu x \delta_t + \varepsilon_{j,t} \quad (1)$$

The dependent variable  $\Delta PPI$  denotes end of year producer price increase in percentages. *High Competition* takes the value 1 if the long-term average market concentration (CR4 or HHI) indicator of the sector is below the median, 0 otherwise.  $X_{j,t}$  describes variables of interest such as the yearly change in real effective exchange rate, nominal US dollar exchange rate or exchange rate volatility. In each specification, we examine whether high-competition industries behave differently in D-PPI dynamics compared to low-competition industries when there is exchange rate movement.  $\partial_j$  is three-digit NACE industry fixed-effects that capture time-invariant industry specific characteristics that do not change across time. In order to capture unobservable time variant industrial shocks, two-digit sector times year fixed effects  $\partial_\nu x \delta_t$  are included in the model. In the model,  $j$  indexes 3-digit industry,  $t$  indexes year and  $\nu$  indexes 2-digit industry.

Furthermore, high-competition and low-competition industries' pricing behavior can be differentiated with respect to their promptness of response. Geroski (1992) and Martin (1993) suggest that more concentrated industries react more sluggishly to shocks on cost of input prices or demand conditions. In order to eliminate cyclical short-run deviations and to focus on long-term relationship as in Neiss (2001) and Przybyla and Roma (2005), we estimate the model below with the target variables are replaced with 3 year moving-average. Robust standard errors are employed in the estimations.

$$\frac{\sum_{z=0}^2 \Delta PPI_{i,t-z}}{3} = \beta_0 + \beta_1 \text{High Competition}_{i,t} \times \frac{\sum_{z=0}^2 X_{i,t-z}}{3} + \partial_j + \partial_\nu x \mu_t + \varepsilon_{i,t} \quad (2)$$

One potential drawback in our analysis is the potential spurious correlation between competition intensity and producer prices due to other characteristics such as imported input, foreign exchange liability. The industries classified as low-competition can be also industries with imported input intensive or FX-indebted industries and the relationship can be attributed to these characteristics. While 2-digit industry-year fixed effects partially capture all economy-wide variations for the parent sectors and 3-digit industry fixed effects control all characteristics specific to these sub-sectors these characteristics still can play overwhelming role in the 3-digit-year variations. In order to check whether these characteristics are the main driver behind our model instead of

**Table 1**  
Descriptive statistics.

	Nr	Sd	Mean	Min	P25	Median	P75	Max
$\Delta D\text{-PPI}$ (Year-end)	951	0.17	0.14	−0.35	0.05	0.10	0.20	1.02
$\Delta D\text{-PPI}$ (Mean annual)	951	0.11	0.12	−0.33	0.05	0.09	0.17	0.74
Herfindahl-Hirschman Index (HHI)	951	0.16	0.09	0.00	0.01	0.04	0.08	1.00
Concentration Ratio (CR-4)	951	0.25	0.37	0.05	0.16	0.31	0.47	1.00
Imported Input Intensity	951	0.19	0.25	0.00	0.10	0.21	0.36	0.99
FX Liabilities	951	0.22	0.52	0.00	0.37	0.54	0.69	0.99
Inventory Turnover	951	7.16	6.10	0.87	3.94	5.06	6.35	90.96
Leverage	951	0.09	0.25	0.00	0.9	0.25	0.32	0.54
Number of Firms	951	1848.31	1407.70	2	286	773	1692	13950
Import Prices (USD-Based)	646	0.08	0.00	−0.17	−0.04	−0.01	0.03	0.33
$\Delta ER$	12	0.09	0.14	−0.06	0.10	0.14	0.22	0.30
$\Delta REER$	12	0.10	0.07	−0.07	0.00	0.08	0.15	0.26
Volatility	12	0.06	0.07	0.01	0.04	0.06	0.11	0.19

**Table 2**  
Producer prices and competition.

Panel A: All Sample								
	Full Sample							
	Yearly Inflation				3-year MA Inflation			
	Using HHI		Using CR4		Using HHI		Using CR4	
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year end	Year end	Mean Annual	Mean Annual	Year end	Year end	Mean Annual	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High-competition	−0.011*	−0.011**	−0.012*	−0.012**	−0.011***	−0.010***	−0.012***	−0.012***
Nace-2 x Year FE	+	+	+	+	+	+	+	+
Observation	951	951	951	951	784	784	784	784

Panel B: Subsample Analysis								
	2010–2016				2017–2021			
	Using HHI		Using CR4		Using HHI		Using CR4	
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year end	Mean Annual	Year end	Mean Annual	Year end	Mean Annual	Year end	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High-competition	−0.002	−0.002	−0.004	−0.005	−0.023**	−0.022**	−0.021*	−0.021**
Nace-2 x Year FE	+	+	+	+	+	+	+	+
Observation	542	542	542	542	409	409	409	409

High-competition is the binary variable that takes 1 if the long-term average market concentration indicator of the sector is below the median. Other variables are defined in Table 1. Robust standard errors are reported in parentheses. “+” represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively.

competition, we feed the model with several variables that can influence the producer prices such as share of imported input, foreign exchange liability, inventory turnover rate and leverage at 3-digit industry-year level in the regression.

## 5. Baseline results

### 5.1. Market concentration and producer prices

The results presented at Table 2 gives estimations of general relationship between producer prices and market concentration. Panel-A shows the results for the panel data regressions to estimate the D-PPI inflation distinction between high and low-competition industries for all sample during 2010–2021. The coefficient of *High-Competition* represents the producer price differential on inflation in the high-competition industries compared to low-competition ones. Year-end (column 1) and mean annual (column 2) domestic producer price inflation are 1.2 percentage points and 1.1 percentage points lower for high-competition industries in this period, respectively. Lower PPI inflation is also observed when we use CR-4 ratio as the sector level concentration measure in columns 3–4 in Panel A. In columns 5–8 we repeat the analysis using the 3-year moving average producer price inflation. The results are similar for all specifications. The positive and statistically significant coefficient for  $\beta_1$  suggest that the relationship is not temporary and both statistically and economically significant for a prolonged period of time irrespectively of business cycles.

Panel B shows that the negative relationship is more pronounced for the past few years. Columns 1–4 imply that there is no statistically significant relationship between HHI and producer price inflation for the years 2010–2016. The results are similar when we use CR4 indicator for the market structure. High-competition industries have lower producer price inflation in the

following period (column 5–8). High-competition sectors have 2.3 percentage points lower producer price inflation compared to low-competition industries in this period.

In the following sub-section, we analyze the potential mechanisms through which PPI has proven to be higher in low-competition industries. In other words, we ask the question of what factors lead to higher PPI in low-competition industries in this period of time. Potential explanations revolve around exchange rate dynamics as the domestic currency depreciation was higher in 2016–2021 period compared to the previous period.

### 5.2. Role of exchange rate volatility in the relationship between market structure and producer prices

Considering the differentiation in the degree of the market concentration-producer prices relationship in the past few years, we investigate the role of within-industry competition in exchange rate pass-through. Although Table 2 highlights the differentiation producer price inflation differentiation in low and high-competition industries across time; this is likely to be a result of several economic dynamics other than time itself. In this subsection, we interact the competitiveness of industries with time variant variables related to exchange rate levels and volatility.

Table 3 shows that high-competition industries have lower producer price inflation in years with higher depreciation in domestic currency and higher exchange rate volatility. This can also be expressed as low-competition industries are likely to have higher exchange rate pass-through to producer prices. The empirical specifications in the first and the second columns interact the competitiveness of industries with change in Real Effective Exchange Rate, taking the inverse of REER as the measure. Thus, the interpretation of REER is similar to exchange rate itself. Results in column 1 indicate that when the domestic currency depreciates in

**Table 3**  
Role of Exchange Rate Volatility in the Relationship Between Market Structure and Producer Prices: Y-o-Y changes.

	Real Effective Exchange Rate Depreciation		Nominal Exchange Rate Depreciation		Exchange Rate Volatility	
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year- end	Mean Annual	Year- end	Mean Annual	Year- end	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)
High-competition X $\Delta$ REER	-0.090 (0.071)	-0.044 (0.058)				
High-competition X $\Delta$ ER			-0.157** (0.070)	-0.092 (0.057)		
High-competition X Volatility					-0.276** (0.140)	-0.184* (0.109)
Nace-3 FE	+	+	+	+	+	+
Nace-2 x Year FE	+	+	+	+	+	+
Observation	951	951	951	951	951	951

High-competition is the binary variable that takes 1 if the long-term average HHI of the sector is below the median. Other variables are defined in Table 1. Robust standard errors are reported in parentheses. "+" represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively.

**Table 4**  
Role of exchange rate volatility in the relationship between market structure and producer prices: 3 Year moving average changes.

	Real Effective Exchange Rate Depreciation		Nominal Exchange Rate Depreciation		Exchange Rate Volatility	
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year- end	Mean Annual	Year- end	Mean Annual	Year- end	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)
High-competition X $\Delta$ REER	-0.090 (0.079)	-0.128** (0.057)				
High-competition X $\Delta$ ER			-0.121** (0.048)	-0.130*** (0.043)		
High-competition X Volatility					-0.220* (0.123)	-0.275*** (0.094)
Nace-3 FE	+	+	+	+	+	+
Nace-2 x Year FE	+	+	+	+	+	+
Observation	784	784	784	784	784	784

High-competition is the binary variable that takes 1 if the long-term average HHI of the sector is below the median. Other variables are defined in Table 1, while three-year moving average of the inflation and exchange rate variables are used. Robust standard errors are reported in parentheses. "+" represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively.

real terms, producer prices in high-competition industries increase more than those in low-competition industries. The results are similar when alternative measure of inflation is used as the dependent variable in column 2. In columns 3 and 4 we use nominal increase in the equal basket exchange rate between US Dollar and Euro against domestic currency and interact it with high-competition indicator, and obtain very similar results. Finally, columns 5 and 6 show that low-competition industries increase producer prices more compared to high-competition industries in the presence of exchange rate volatility. Specifically, in reaction to a 10 percent depreciation in domestic currency, high-competition industries have around 1.57 percentage points lower year-end producer price inflation compared to low-competition industries.

Table 4 repeats the analysis in Table 3 for the 3-year moving average inflation using equation (2). The degree of the relationship is qualitatively stronger with respect to yearly inflation results in Table 3. High-competition industries have lower producer prices when exchange rate depreciation or volatility is higher in the long term and this relationship is robust to different inflation definitions. High-competition industries experience 1.21 percentage

point lower year-end inflation and 1.3 percentage point lower mean annual inflation in comparison to high-competition industries following 10% depreciation in local currency. Results suggest that the relationship is significant in the long-run as well, independently from business cycle or sluggish responses of the firms operating in low-competition industries.

## 6. Further discussion and robustness analysis

### 6.1. Number of firms as alternative measurement of competition

In addition to market concentration measurements such as Herfindahl-Hirschman Index (HHI) and Concentration Ratio (CR), wide range of theoretical literature has been employed number of firms operating in industry in order to proxy competition intensity in the industry (Stiglitz, 1987; Rosenthal, 1980; Chen and Riordan, 2008; Grullon et al., 2017). To simply put, higher number of competitive firms represents number of the rivals of the firm. In the classical textbook theories such as perfect competition or Cournot-type competition, competitive price is occurred as the number of



**Table 5**  
Number of firms as competition indicator and producer prices.

	Full-Sample		2010–2016		2017–2021	
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year- end	Mean Annual	Year- end	Mean Annual	Year- end	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)
High-competition	–0.011 (0.007)	–0.010* (0.005)	0.001 (0.007)	0.000 (0.006)	–0.026** (0.012)	–0.024** (0.009)
Nace-2 x Year FE	+	+	+	+	+	+
Observation	951	951	542	542	409	409

High-competition is the binary variable that takes 1 if the long-term average number of firms in the sector is above the median. Other variables are defined in Table 1. Robust standard errors are reported in parentheses. “+” represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively.

**Table 6**  
Number of Firms as Competition Indicator: Y-o-Y changes.

	Real Effective Exchange Rate Depreciation		Nominal Exchange Rate Depreciation		Exchange Rate Volatility	
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year- end	Mean Annual	Year- end	Mean Annual	Year- end	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)
High-competition X $\Delta$ REER	–0.159** (0.076)	–0.091 (0.063)				
High-competition X $\Delta$ ER			–0.164** (0.072)	–0.124** (0.063)		
High-competition X Volatility					–0.325** (0.147)	–0.283** (0.114)
Nace-3 FE	+	+	+	+	+	+
Nace-2 x Year FE	+	+	+	+	+	+
Observation	951	951	951	951	951	951

High-competition is the binary variable that takes 1 if the long-term average number of firms in the sector is above the median. Other variables are defined in Table 1. Robust standard errors are reported in parentheses. “+” represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively.

**Table 7**  
Number of firms as competition indicator: 3 Year moving average changes.

	Real Effective Exchange Rate Depreciation		Nominal Exchange Rate Depreciation		Exchange Rate Volatility	
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year- end	Mean Annual	Year- end	Mean Annual	Year- end	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)
High-competition X $\Delta$ REER	–0.210** (0.083)	–0.172*** (0.061)				
High-competition X $\Delta$ ER			–0.168*** (0.051)	–0.145*** (0.047)		
High-competition X Volatility					–0.391*** (0.128)	–0.343*** (0.103)
Nace-3 FE	+	+	+	+	+	+
Nace-2 x Year FE	+	+	+	+	+	+
Observation	784	784	784	784	784	784

High-competition is the binary variable that takes 1 if the long-term average number of firms in the sector is above the median. Other variables are defined in Table 1, while three-year moving average of the inflation and exchange rate variables are used.. Robust standard errors are reported in parentheses. “+” represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively.

firms goes to infinity (Stiglitz,1987; [Tirole, 1994](#)). Differently from HHI and CR, higher number of firms per industry means higher competition level within the industry. Thus, in the following empirical specifications expect negative coefficient estimate if firms in industries with high-competition environment have lower producer price inflation.

Results of the regressions in which number of firms is employed as competition proxy are reported in [Tables 5–7](#). Negative and statistically significant coefficients for the interaction terms through column 1 and column 4 in [Table 5](#) confirm the findings in the baseline results. The industries with high number of firms within industry have 1 percentage point lower mean annual

**Table 8**  
Competition and exchange rate pass-through: Additional controls with 3 Year moving average changes.

	Macro: Nominal Exchange Rate Depreciation			Macro: Exchange Rate Volatility		
	HHI	CR-4	Nr of Firms	HHI	CR-4	Nr of Firms
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	(1)	(2)	(3)	(4)	(5)	(6)
High Competition X Macro	−0.116** (0.055)	−0.093* (0.054)	−0.162*** (0.049)	−0.215* (0.120)	−0.163 (0.121)	−0.358*** (0.113)
Imported Input Intensity X Macro	0.471** (0.237)	0.451* (0.252)	0.482** (0.229)	1.009* (0.547)	0.993* (0.574)	0.970* (0.532)
FX Liability X Macro	0.107 (0.211)	0.140 (0.209)	0.231 (0.207)	0.347 (0.445)	0.399 (0.438)	0.619 (0.432)
Inventory X Macro	−0.010** (0.004)	−0.009** (0.004)	−0.011*** (0.004)	−0.017 (0.012)	−0.014 (0.011)	−0.022* (0.011)
Leverage X Macro	−0.810* (0.469)	−0.835* (0.474)	−1.088** (0.458)	−1.141 (1.118)	−1.166 (1.131)	−1.670 (1.131)
Nace 3 FE	+	+	+	+	+	+
Nace-2 x Year FE	+	+	+	+	+	+
Observations	781	781	781	781	781	781

High-competition is the binary variable that takes 1 if the long-term average HHI or CR4 (Nr of firms) of the sector is below (above) the median. Dependent variable is mean annual percentage increase in domestic producer prices. Other variables are defined in Table 1, while three-year moving average of the inflation and exchange rate variables are used. Robust standard errors are reported in parentheses. “+” represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively. The variables in levels not reported in table.

producer price inflation than the industries with low number of firms in whole sample (column 1–2). This relationship is concentrated in the 2017–2021 period (column 5–6) rather than 2010–2016 period (column 3–4). High-competition industries determined by number of firms in the industry have 2.6 percentage points lower year-end producer price inflation.

Tables 6 and 7 summarizes the role of number of firms for the sensitivity of producer prices to exchange rates movements. The signs of the coefficients are still compatible with baseline results, and the statistical significance has increased in short term (Table 6). Results are still strongly significant in the long-run relationship (Table 7).

## 6.2. Additional controls

We test the robustness of the results in several estimations presented by Table 8. First, we enrich the empirical specification with further control variables. When the regression equations control for imported inputs, FX liability, inventory turnover rate and leverage competition characteristics of industries still partially explain the variation in the producer price inflation. In the case of

nominal exchange rate depreciation and volatility, there are significant differentiations between high and low competition industries in the long run. This relationship is robust to different competition proxies.

The other control variables provide insights. Imported input intensity is significant determinant in exchange-rate pass-through as previously emphasized in the literature (Ahn et al., 2016; Ertug et al., 2019). Inventory turnover rate is significant in some cases, implying that industries with higher inventory turnover rate increase prices less.

## 6.3. Role of imported input prices

Another crucial determinant of the producer prices in Türkiye is the imported input prices. Recent studies have reported that a rise in prices of main inputs in manufacturing industries such as base metal, energy and agricultural commodities induce upward pressures on domestic producer prices. The impact of the import prices on the producer prices is not negligible, hence whether the competition dampens pass-through from import prices to producer price inflation is a notable question. Table 9 replicates the baseline

**Table 9**  
Role of imported input price changes in the relationship between market structure and producer prices.

	HHI				Nr of Firm			
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year end	Mean Annual	Year end	Mean Annual	Year end	Mean Annual	Year end	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High Competition X Import Price	−0.087 (0.085)	−0.046 (0.068)	−0.205 (0.146)	−0.227** (0.112)	−0.118 (0.099)	−0.127* (0.076)	−0.231 (0.168)	−0.300** (0.132)
Nace-3 FE	+	+	+	+	+	+	+	+
Nace-2 x Year FE	+	+	+	+	+	+	+	+
Control Variables	−	−	+	+	−	−	+	+
Observation	646	646	646	646	646	646	646	646

High-competition is the binary variable that takes 1 if the long-term average HHI (Nr of firms) of the sector is below (above) the median. Other variables are defined in Table 1. Robust standard errors are reported in parentheses. “+” represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively.

regression including imported input prices. Results indicate that high-competition industries have lower producer price inflation compared to high-competition industries in some specifications. The degree of the relationship is ranging from 1.27 to 3 percentage point following %10 percentage point increase in import prices. Similar to the rise in the exchange rate, when there is a rise in the import prices firms in the low-competition industries reflect the rise in costs more easily to their prices compared to the firms in high-competition industries.

To further investigate the robustness of findings, we employ wide set of additional checks. First, in order to control the sensitivity of our results to outliers in the dataset, we replicate all regressions with winsorized exchange rate and producer price inflation variables in 1 percent. Results are broadly similar but there is partial loss in statistical significance (Appendix A1-A3.). Hence, results are not driven by sharp exchange rate or producer price inflation movements. We replicate regressions by excluding energy sectors. Energy sectors had decreasing market concentration trend in recent years due to some regulations (Figure A1). Results for the sample excluding energy sector are the same both qualitatively and quantitatively (Appendix A4-A6). We include the interaction term between one-year lag of exchange rate and high competition variable in order to capture the delayed impacts of the exchange rate depreciation on the prices. Results corroborate our baseline estimations.

We also employed different competition indicators. We used concentration ratios directly instead of binary competition variables. Results are consistent with the baseline results despite weaker significance in short term (Appendix A7-A8). We also calculated time-varying high-competition binary variable that takes the value 1 if concentration measure of industry is above the median in the corresponding year, 0 otherwise. We obtained similar results with our baseline estimations.

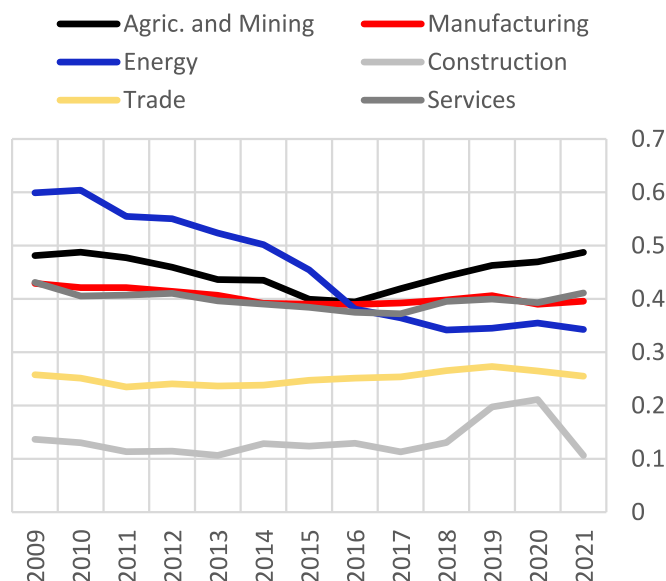
## 7. Conclusion

The declining competition trend in the world has drawn attention in the recent literature and it is associated with macroeconomic implications such as labor share, investments and productivities. However, the relationship between market structure and prices is not sufficiently examined and this relationship has become more important considering recent surge on global inflation in the world.

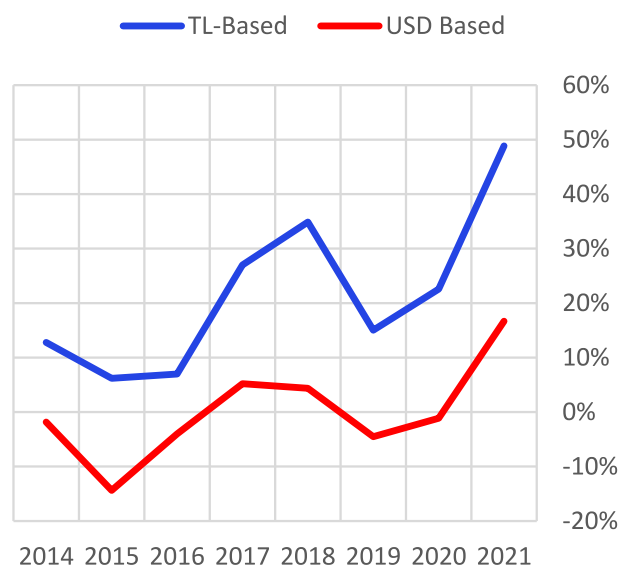
In this paper, we investigate the relationship between sectoral market structure and the domestic produce price inflation in Türkiye in the presence of exchange rate fluctuations. We first document that firms operating in a sector with low-competition environment increase prices more than the firms in high-competition sectors. With the close relationship between producer prices and exchange rates fluctuations in mind, our further analyses show that high-competition industries increase prices less than low-competition industries in the presence of exchange rate depreciation. Industries with low-competition have around 1.57 points additional annual year-end producer price inflation following %10 depreciation in nominal exchange rate.

Findings of the study are confirmed by broad range of robustness tests including alternative definitions and measures of producer price inflation, exchange rate and sectoral competition. Overall, results suggest that increasing exposure to market competition limit the scope for firms to raise producer prices during the periods of high exchange rate volatility.

## Appendix-A. Robustness Results



**Fig. A1.** Market Concentration in Main Sectors. Source: Authors' calculations from Revenue Administration dataset. CR-4 is constructed by weighting NACE 4-digit levels of industrial competition indicators with their share in the main sector. (See section 3 for definition of CR-4).



**Fig. A2.** Annual Percentage Increase in Import Unit Value Index. Source: Turkstat. Yearly percentage differences of import unit value index (2015 = 100).

**Table A1**  
Competition and Producer Prices (Winsorized Sample)

	All Sample				2017–2021			
	(HHI)		(CR-4)		(HHI)		(CR-4)	
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year end	Mean Annual	Year end	Mean Annual	Year end	Mean Annual	Year end	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High-competition	−0.009 (0.006)	−0.009* (0.005)	−0.009 (0.006)	−0.011** (0.005)	−0.017 (0.011)	−0.017** (0.008)	−0.016 (0.011)	−0.017** (0.008)
Nace-2 x Year FE	+	+	+	+	+	+	+	+
Observation	951	951	951	951	409	409	409	409

High-competition is the binary variable that takes 1 if the long-term average market concentration indicator of the sector is below the median. Other variables are defined in Table 1. Robust standard errors are reported in parentheses. “+” represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively.

**Table A2**  
Competition and Exchange Rate Pass-through: Y-o-Y changes (Winsorized Sample)

	Real Effective Exchange Rate Depreciation		Nominal Exchange Rate Depreciation		Exchange Rate Volatility	
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year- end	Mean Annual	Year- end	Mean Annual	Year- end	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)
High-competition X $\Delta$ REER	−0.043 (0.062)	−0.000 (0.048)				
High-competition X $\Delta$ ER			−0.125* (0.064)	−0.061 (0.052)		
High-competition X Volatility					−0.179 (0.121)	−0.095 (0.091)
Nace-3 FE	+	+	+	+	+	+
Nace-2 x Year FE	+	+	+	+	+	+
Observation	870	870	870	870	870	870

High-competition is the binary variable that takes 1 if the long-term average HHI of the sector is below the median. Other variables are defined in Table 1. Robust standard errors are reported in parentheses. “+” represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively.

**Table A3**  
Competition and Exchange Rate Pass-through: 3 Year Moving Average Changes (Winsorized Sample).

	Real Effective Exchange Rate Depreciation		Nominal Exchange Rate Depreciation		Exchange Rate Volatility	
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year- end	Mean Annual	Year- end	Mean Annual	Year- end	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)
High-competition X $\Delta$ REER	−0.062 (0.069)	−0.120** (0.054)				
High-competition X $\Delta$ ER			−0.109** (0.044)	−0.126*** (0.041)		
High-competition X Volatility					−0.175 (0.109)	−0.261*** (0.089)
Nace-3 FE	+	+	+	+	+	+
Nace-2 x Year FE	+	+	+	+	+	+
Observation	715	715	715	715	715	715

High-competition is the binary variable that takes 1 if the long-term average HHI of the sector is below the median. Other variables are defined in Table 1, while three-year moving average of the inflation and exchange rate variables are used. Robust standard errors are reported in parentheses. + represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively.

**Table A4**  
Competition and Producer Prices: Post-2017 (Excluding Energy Sectors)

	All Sample				2017–2021			
	(HHI)		(CR-4)		(HHI)		(CR-4)	
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year end	Mean Annual	Year end	Mean Annual	Year end	Mean Annual	Year end	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High-competition	−0.011* (0.006)	−0.011** (0.005)	−0.011* (0.006)	−0.012** (0.005)	−0.023** (0.011)	−0.022** (0.009)	−0.021* (0.012)	−0.021** (0.009)
Nace-2 x Year FE	+	+	+	+	+	+	+	+
Observation	0.840	0.769	0.841	0.770	0.841	0.717	0.840	0.717

High-competition is the binary variable that takes 1 if the long-term average market concentration indicator of the sector is below the median. Other variables are defined in Table 1. Robust standard errors are reported in parentheses. “+” represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively.

**Table A5**  
Competition and Exchange Rate Pass-through: Y-o-Y changes (Excluding Energy Sectors)

	Real Effective Exchange Rate Depreciation		Nominal Exchange Rate Depreciation		Exchange Rate Volatility	
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year- end	Mean Annual	Year- end	Mean Annual	Year- end	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)
High-competition X $\Delta$ REER	−0.095 (0.073)	−0.057 (0.059)				
High-competition X $\Delta$ ER			−0.151** (0.071)	−0.097* (0.058)		
High-competition X Volatility					−0.261* (0.142)	−0.215* (0.111)
Nace-3 FE	+	+	+	+	+	+
Nace-2 x Year FE	+	+	+	+	+	+
Observation	0.868	0.809	0.868	0.810	0.868	0.810

High-competition is the binary variable that takes 1 if the long-term average HHI of the sector is below the median. Other variables are defined in Table 1. Robust standard errors are reported in parentheses. “+” represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively.

**Table A6**  
Competition and Exchange Rate Pass-through: 3 Year MA Changes (Excluding Energy Sectors)

	Real Effective Exchange Rate Depreciation		Nominal Exchange Rate Depreciation		Exchange Rate Volatility	
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year- end	Mean Annual	Year- end	Mean Annual	Year- end	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)
High-competition X $\Delta$ REER	−0.114 (0.081)	−0.144** (0.059)				
High-competition X $\Delta$ ER			−0.140*** (0.049)	−0.151*** (0.043)		
High-competition X Volatility					−0.250** (0.126)	−0.305*** (0.096)
Nace-3 FE	+	+	+	+	+	+
Nace-2 x Year FE	+	+	+	+	+	+
Observation	0.894	0.883	0.895	0.884	0.895	0.884

High-competition is the binary variable that takes 1 if the long-term average HHI of the sector is below the median. Other variables are defined in Table 1, while three-year moving average of the inflation and exchange rate variables are used. Robust standard errors are reported in parentheses. “+” represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively.



**Table A7**  
Competition and Exchange Rate Pass-through: Y-o-Y changes (Concentration Ratios Instead of Binary Competition Variable)

	HHI		CR4		Nr. of Firm	
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year- end	Mean Annual	Year- end	Mean Annual	Year- end	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)
HHI X $\Delta$ ER	-0.063 (0.400)	0.307 (0.391)				
CR4 X $\Delta$ ER			0.265 (0.233)	0.195 (0.210)		
Nr. of Firm X $\Delta$ ER					-0.070* (0.037)	-0.055 (0.034)
Nace-3 FE	+	+	+	+	+	+
Nace-2 x Year FE	+	+	+	+	+	+
Observation	0.873	0.813	0.874	0.813	0.875	0.815

High-competition is the binary variable that takes 1 if the long-term average HHI or CR4 (log of nr of firms) of the sector is below (above) the median. Other variables are defined in Table 1. Robust standard errors are reported in parentheses. "+" represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively.

**Table A8**  
Competition and Exchange Rate Pass-through: 3 Year Moving Average Changes (Concentration Ratios Instead of Binary Competition Variable)

	HHI		CR4		Nr. of Firm	
	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI	$\Delta$ PPI
	Year- end	Mean Annual	Year- end	Mean Annual	Year- end	Mean Annual
	(1)	(2)	(3)	(4)	(5)	(6)
HHI X $\Delta$ ER	0.465 (0.299)	0.405 (0.305)				
CR4 X $\Delta$ ER			0.370*** (0.133)	0.330** (0.143)		
Nr. of Firm X $\Delta$ ER					-0.047** (0.022)	-0.052** (0.024)
Nace-3 FE	+	+	+	+	+	+
Nace-2 x Year FE	+	+	+	+	+	+
Observation	0.898	0.886	0.899	0.887	0.899	0.887

High-competition is the binary variable that takes 1 if the long-term average HHI or CR4 (log of nr of firms) of the sector is below (above) the median. Other variables are defined in Table 1, while three-year moving average of the inflation and exchange rate variables are used. Robust standard errors are reported in parentheses. + represents that fixed effect is included in the model. Statistical significance at the 1%, 5%, and 10% levels is indicated by \*\*\*, \*\*, and \*, respectively.

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