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Cost-Price Relationships in a Concentrated Economy

Falk Bräuning, José L. Fillat, and Gustavo Joaquim

The US economy is at least 50 percent more concentrated today than it was in 2005. In this paper, we estimate the effect of this increase on the pass-through of cost shocks into prices. Our estimates imply that the pass-through becomes about 25 percentage points greater when there is an increase in concentration similar to the one observed since the beginning of this century. The resulting above-trend price growth lasts for about four quarters. Our findings suggest that the increase in industry concentration over the past two decades could be amplifying the inflationary pressure from current supply-chain disruptions and a tight labor market.

Falk Bräuning (Falk.Braeuning@bos.frb.org) and José L. Fillat (Jose.Fillat@bos.frb.org) are senior economists and policy advisors in the Research Department at the Federal Reserve Bank of Boston. Gustavo Joaquim (Gustavo.Joaquim@bos.frb.org) is an economist in the Boston Fed's Research Department.

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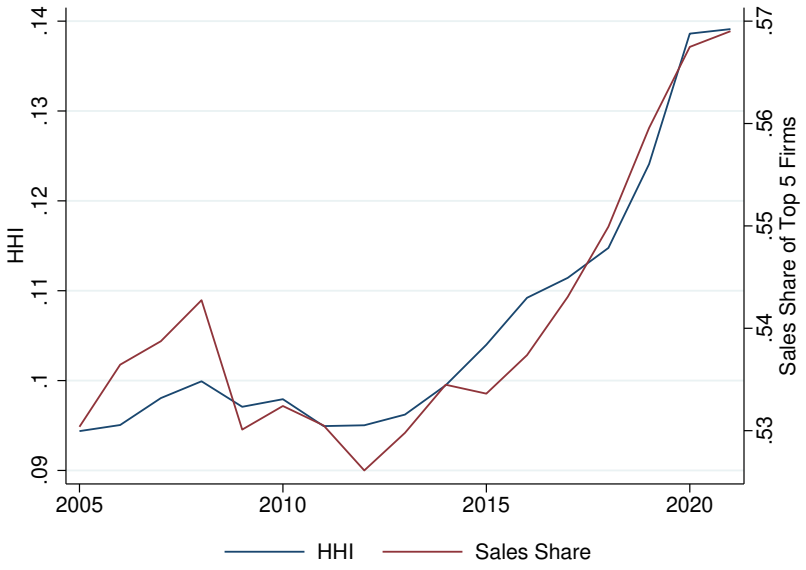
1 Introduction

Recent research and public discussions have highlighted the increase in market concentration during the last two decades and its macroeconomic implications for productivity, economic growth, and price setting.[1] Figure 1 shows the longer-term trend in industry concentration and its acceleration during recent years based on the data used in this study. From 2005 through 2020, industry concentration increased about 50 percent, and several studies project concentration to increase further due to structural changes related to the COVID-19 pandemic (Diez et al., 2021). Does this increase in industry concentration change inflationary dynamics? Specifically, how does the pass-through of cost shocks into prices depend on industry concentration? In our analysis, we reveal a 25 percentage point larger pass-through of costs into producer prices when industries become more concentrated at the rate they have in the United States during our estimation sample of 2005 through 2018.

Figure 1: Trend in Industry Concentration



Note: Sales-weighted average industry concentration measured by HHI or the sales share of industry leaders (top five firms in terms of sales). Firms related to the utilities, financial services, public administration, gasoline stations, and postal service industries, as well as industries with only one firm at any point in our sample, are dropped. Sources: SP Global Market Intelligence, Compustat via Wharton Research Data Services (WRDS); authors' calculations.

In this environment of historically high industry concentration, the US economy experi-

[1]Markups and concentration have been widely used as a measure of market power (see Syverson (2019)) and De Loecker et al. (2020). In this study, we use the Herfindahl-Hirschman Index (HHI) of sales and, for robustness, the combined market share of the largest five firms (leaders) in each industry.

enced a severe but short-lived economic crisis induced by the COVID-19 pandemic. GDP fell at an annual rate of 5.0 percent in the first quarter of 2020 and 32.9 percent in the second quarter. After the second quarter of 2020, the US economy experienced a rapid recovery with a buildup of inflationary pressures that have persisted longer than many projected they would in 2021. For example, as of December 2021, unemployment reached 3.9 percent and Consumer Price Index (CPI) annual inflation climbed to a 7 percent increase. However, these inflationary pressures were not an isolated effect of a rapid US recovery. The recovery itself was uneven across the globe, and many regions experienced longer-lasting containment measures that caused disruptions in global supply chains and associated increases in input prices.

While industry concentration is not new, its recent acceleration and the persistently high inflationary pressure in the United States have triggered a renewed interest by academics and policymakers in the role of concentration with respect to price increases. The objective of our analysis is to gain a better understanding of how the pass-through of costs into prices depends on industry concentration. Several recent papers explore theoretical links between concentration and inflation, including Mongey (2021), Wang and Werning (2020), and Baqaee et al. (2021), among others. But the qualitative predictions of these studies are ambiguous and provide little data-based guidance for policymakers. We contribute to this debate by providing empirical evidence that relies on industry-level data on producer prices and the industry concentration of sales, in addition to firm-level data.

Estimating the effect of concentration on the pass-through of costs into producer prices is challenging because costs and prices respond simultaneously to supply and demand shocks; that is, both variables are endogenous. As a consequence, an analysis of the empirical relationship between costs and prices cannot directly identify the pass-through of costs into prices.[2] To identify exogenous cost shocks in the data, we leverage the granular instrumental variables (GIV) method recently developed by Gabaix and Koijen (2020).[3] The GIV approach combines two key insights. First, granular firm-level data enable identification of idiosyncratic cost shocks, that is, changes in cost that are exogenous to the overall evolution of the economy (or industry) and specific to a given firm. Second, due to the granularity of the firm-size distribution, that is, the fact that a few large firms account for a large

[2]For instance, suppose that a given industry faces a positive demand shock. It is likely that prices and costs will rise simultaneously—but the increase in prices will not be a result of the increase in costs. When costs and prices are considered together, given that each industry faces several positive and negative demand and supply shocks, one would expect the relationship between the two to be muted. This is exactly what we find empirically in our sample, where observed cost changes are not associated with statistically or economically significant price changes.

[3]For applications of the GIV, see, for instance, Galaasen et al. (2020), Adrian et al. (2020), and Gabaix and Koijen (2021).

share of the economic activity in a given industry, these arguably exogenous idiosyncratic cost changes identify exogenous variation of the aggregate cost measure changes in a given industry.

We follow a GIV approach to construct a measure of industry-specific cost shocks and estimate how concentration affects the pass-through of these cost shocks into producer prices. We find that cost shocks cause an economically and statistically significant increase in prices. Importantly, this pass-through is 25 percentage points larger in an economy that has seen an HHI increase of 0.02, which roughly corresponds to the increase in concentration in our estimation sample from 2005 through 2018. This calculation is conservative, because the concentration continued a sharp increase after 2018, as shown in Figure 1. Our findings suggest that the recent increase in industry concentration has contributed to the accelerating inflationary pressure resulting from supply shortages and tight labor market conditions.

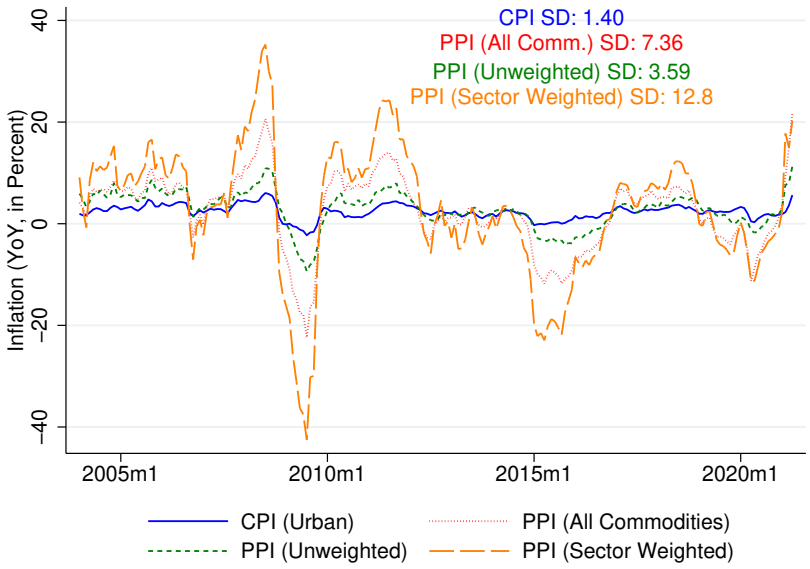
2 Data

Our main analysis uses data at the industry-quarter level and builds on two main data sources. We define industries based on their three-digit NAICS code. First, we collect balance sheet and income statement data from Compustat, which covers the universe of all publicly traded firms in the United States. We focus on operating expenses as our main cost measure. In addition to costs of goods sold, operating expenses include other costs of operating a business that are not directly tied to production, such as those related to non-production employee salaries, sales, and marketing. We also use the Compustat data to measure industry sales concentration by the Herfindahl–Hirschman Index (HHI) at the industry level. That is, we compute, for each industry, the sum of the squared sales share of each firm. To guarantee that our data are representative of the underlying market structure in a given industry, we exclude from our regression analysis industries that have fewer than two firms in Compustat at any moment in our sample and retail industries (NAICS 44/45).[4]

As a second data source, we use producer price data from the Bureau of Labor Statistics (BLS) at the three-digit NAICS level. Producer prices are available at the industry level, which allows us to exploit variation in industry concentration, both across industries and within industries across time, to understand its effect on prices. A firm-level analysis of the

[4]We exclude retail industries because they have a small number of firms in Compustat and because regional concentration is more important than total industry-level concentration (see, for instance, Rossi-Hansberg et al. (2018)). Our results are robust to changing these filters to simply exclude industries with fewer than 20 firms at any moment in our sample. As is standard in the literature, we also exclude the postal service (NAICS 491), utilities (NAICS 22), finance and insurance (NAICS 52), and public administration (NAICS 91/92) industries.

Figure 2: Comparison of CPI and PPI Inflation



Note: The figure shows different year-over-year (YoY) inflation measures, in percentages, during our main sample period. Standard deviations of the different inflation measures are reported in the figure. PPI (sector weighted) is the sales-weighted average PPI inflation among industries classified at the NAICS three-digit level. Sales weights are computed based on Compustat sales. Sources: BEA/BLS, authors' calculations.

cost-price relationship is not feasible given the lack of broadly available firm-level price data for firms in the United States. To measure the effect of concentration on real outcomes, we also collect data on industry employment and output from the BLS at the three-digit NAICS level. Our sample for the regression analysis comprises 35 industries. The sample period used in our main analysis runs from 2005Q1 through 2018Q4 and is constrained overall by the availability of Producer Price Index (PPI) data, in particular from the period before 2004. In 2017, total sales in our sample corresponded to roughly 53 percent of the aggregate final sales of US domestic product.

Figure 2 shows the annual inflation rate in our data set (industry-sales weighted or unweighted) measured as the growth rate in prices since the same quarter in the previous year, which we refer to as year-over-year henceforth. For comparison, we measure inflation using the CPI and PPI (all commodities) indexes. While the overall pattern is very similar across inflation measures, producer price inflation is much more volatile than consumer price inflation, with the PPI having a standard deviation 8 times larger than that of the CPI. The magnitude of our estimated effects must thus be interpreted accordingly, as they refer to the more volatile producer prices.

Because cost and prices are endogenous—higher product demand can lead to an increase

in output and associated higher production costs as well as upward pressure on prices—we use the cost data to extract exogenous (supply-driven) industry-level cost shocks based on the GIV strategy of Gabaix and Koijen (2020). Specifically, we recover firm-level idiosyncratic cost shocks as the residuals from a regression of firm-level cost changes on industry-time fixed effects, firm fixed effects, firm-specific trends, and time-specific changes in sales controls (to adjust for firm-specific demand). We then aggregate these residuals using within-industry sales shares as weights to construct our instrument for cost changes at the industry level. More details on the shock construction will be included in this note's forthcoming companion working paper. Throughout this note, we use *costs* to refer to the endogenous cost measures observed in financial statements (for instance, operating expenses) and *cost shocks* to refer to our constructed measure of exogenous industry-level cost shocks.

3 Cost Pass-Through and Concentration

In this section, we investigate the pass-through of cost shocks into prices and how this pass-through changes with industry concentration. We first focus on the relationship between costs (or cost shocks) and prices independently of concentration to set a benchmark. We run local projections (as in Jordà, 2005) to understand how price changes respond to cost changes (or cost shocks) at the industry-quarter level. Our specifications include quarter-of-year fixed effects, industry fixed effects, and an industry-specific linear trend. Our results should be interpreted as being within industry and as deviations relative to the pre-shock local trend growth in prices. To interpret our results as the aggregate effect of concentration, we weight our regressions by lagged industry sales unless otherwise noted.[5]

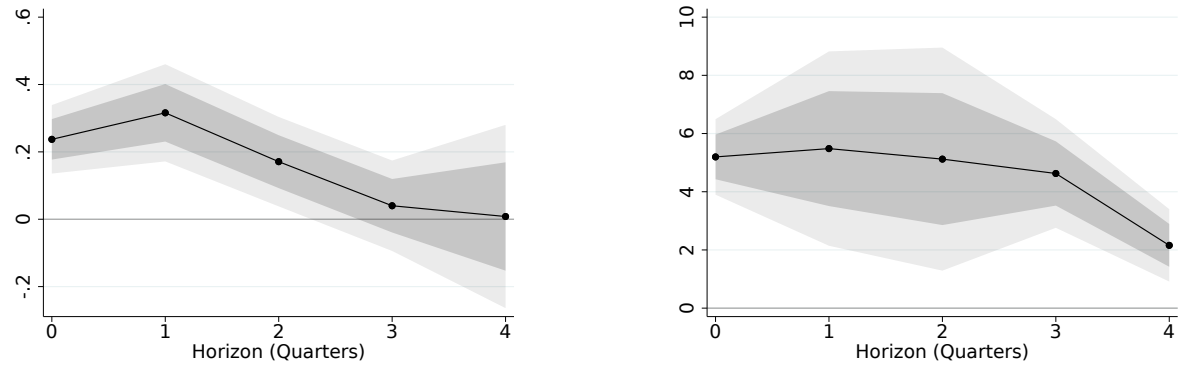
As shown in Panel (a) of Figure 3, an increase in cost shocks leads to a significant short-run increase in prices relative to the trend, consistent with a supply shock.[6] The estimate suggests that a 1 percent cost shock increases prices by about 0.3 percent one quarter after the shock. For a different interpretation of the magnitude of the estimated coefficients, we can scale the response by the effect of the cost shocks on cost (operational expenses). In our sample, a 1 percent cost shock implies a 0.4 percent increase in observed operational expenses on impact. Therefore, the elasticity of industry prices to industry operational expenses is approximately 0.72 on impact of the shock and 0.95 one quarter after it.

Now we focus on the central question that motivates our analysis: How does this elasticity depend on concentration? To understand the differential effect of concentration on the pass-through, we augment our previous specification to account for differences in in-

[5]Also the BLS's producer prices are sales weighted within industry.

[6]Consistent with this interpretation, we also find a significant negative effect of real output on cost shocks.

Figure 3: Pass-Through of Cost Shock into Prices



(a) Prices on Cost Shock

(b) Differential HHI Effect

Note: Panel (a) shows the estimated response of price changes at the zero through four-quarters horizons in response to cost shocks. Panel (b) shows the estimated differential pass-through of cost shocks into prices based on industry concentration (HHI) at the zero through four-quarters horizons. Darker shades correspond to estimates ± one standard error, and lighter shades represent 90 percent confidence intervals. Regressions are weighted by lagged industry sales. Sources: BEA/BLS, CRSP/Compustat, and authors' calculations.

dustry concentration, while holding constant other industry-specific characteristics, such as production-specific factors or other factors. Specifically, we include two important additions. First, we add the lags of HHI at the industry level and the lags of the interaction between HHI and the cost shocks. Second, we include industry-specific coefficients for the baseline effect of cost shocks by industry. As a result, the variation in concentration that we use to estimate our coefficients of interest is within industry. Therefore, the analysis is not subject to concerns that our estimation is simply picking up that more concentrated industries have a higher pass-through in the cross section.

We report our OLS estimates in Panel (b) of Figure 3. We interpret our results considering an HHI that has grown by 0.02, which corresponds to the increase in HHI that occurred from 2005 to 2018 (shown in Figure 1), the sample period we use in our estimation. We find that a cost shock of 1 percent causes a differential increase in prices above trend of approximately 0.10 percentage point for three quarters after the shock. Rescaling the differential effect of prices on cost changes for interpretation, as shown earlier, we find that the pass-through is 25 percentage points larger for three quarters following a 0.02 increase in the HHI.

3.1 Extensions and Robustness

We extend the analysis in various dimensions. For each extension, we provide only a brief description of the analysis and results here. More details are available upon request and will be included in the forthcoming companion paper.

Asymmetric Effects. It is possible that prices react differently to positive and negative cost changes. To understand if the pass-through of costs into prices is asymmetric, we separate positive cost shocks from negative cost shocks in our baseline specification. We find that, on average across industries, there is no differential pass-through of positive versus negative cost shocks. However, in terms of the differential effect of concentration, we find that in more concentrated industries positive cost shocks are more strongly passed through into prices relative to negative cost shocks, for which we do not find a significant differential effect of concentration.

Real Output. We extend our analysis of the level effect of cost shocks and the differential effect of industry concentration to industry output (deflated by industry specific prices). We find that a cost shock of 1 percent is associated with a 0.05 percent decrease in real output. Beyond its economic importance, this finding also lends credibility to our identification strategy of a supply effect. In terms of the differential effect of concentration, we find that the 0.02 increase in HHI observed during our sample period results in a twofold increase in output's response relative to the average response.

Robustness. We conduct a series of robustness tests. First, we replicate our analysis using the share of sales coming from the largest firms in a given industry as an alternative measure of concentration. Second, we use an alternative specification where we model year-over-year prices and costs (and cost shocks), instead of price and cost levels with autoregressive terms, as we do in our benchmark. Third, we consider alternative models to compute the cost shocks. Fourth, we replicate our analysis excluding sectors with fewer than 20 firms at any point in time. Fifth, we also consider alternative cost measures (such as the cost of goods sold). All of these tests produce results that are similar to our benchmark results.

4 Conclusion

Industry concentration has increased significantly in the United States in the past 20 years, and this trend has accelerated since the onset of the COVID-19 pandemic. We construct a measure of industry cost shocks from firm-level shocks and find that an increase in industry concentration is associated with a significant increase in the pass-through of costs into prices. Our findings shed some light on the current inflationary pressures and the linkages between inflation dynamics and rising market concentration. In particular, our results suggest that the recent rise in concentration is an amplifying factor for the pass-through of current cost shocks emanating from supply shortages, energy price shocks, and labor market tightness.

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