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Implicit Coordination in Sellers' Inflation: How Cost Shocks Facilitate Price Hikes

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Abstract

Supply shocks are now widely recognized as a driver of the recent inflation bout, but the role of firms' pricing strategies in propagating input cost shocks remains contested. In this paper, we review the state of the academic debate over sellers' inflation and assess whether, in line with this theory, economy-wide cost shocks have functioned as an implicit coordination mechanism for firms to hike prices. We use a dataset containing 138,962 corporate earnings call transcripts of 4,823 stock-market listed U.S. corporations from the period 2007-Q1 to 2022-Q2 to conduct sentiment analysis via both dictionary-based natural language processing and a large language model approach. We find that large input price shocks (as well as their co-occurrence with supply constraints) correlate with positive sentiments expressed in executives' statements about cost increases. Qualitative analysis provides further insights into the reasoning behind executives' optimism regarding their ability to turn an economy-wide cost shock into an opportunity to raise prices and protect or even increase profits.

Keywords: Inflation, profits, price coordination, sentiment analysis, earnings calls

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1 Introduction

The return of inflation since 2021 has raised pressing questions concerning firm price-setting behavior in times of emergencies. The COVID-19 pandemic and the war in Ukraine engendered supply shocks in systemically significant sectors such as energy, food commodities, and transportation, which have rippled through economies (Weber et al., 2024). Accusations of firms taking advantage of emergencies in their pricing behaviors have featured in headline news and election campaigns. A lot is at stake, for both theory and policy. If this inflationary episode was primarily driven by demand-side factors, then the pre-pandemic models and policy practices need no revision. In this case, fighting inflation could safely be entrusted to monetary policy alone. If, by contrast, firms' pricing behavior and cost shocks played an important role in stoking inflation, the global economy will be vulnerable to inflation from similar shocks resulting from climate change, trade wars, and mounting geopolitical tensions. Theories and models must be updated and policies put in place to prevent such future price hikes.

Four years into the debate, disagreement remains over the degree to which supply side factors mattered for inflation, but that they did matter to some extent is hardly controversial (Blanchard and Bernanke, 2023; Bank for International Settlements, 2022; Dao et al., 2024). Yet, the *mechanism* by which cost shocks in some specific sectors have propagated through the economy, generating general inflation, remain understudied. A key reason is that analyzing the propagation of supply shocks through value chains means studying *how firms actually set prices*. Practically, such research is hindered by the paucity of firm-level input cost and pricing data. Theoretically, this question receives less attention than it deserves because of a tendency to assume pricing to be a simple matter of supply and demand, or otherwise a straight forward expression of market power.

Economists studying price-setting behavior have dealt with the paucity of firm-level pricing data in various ways. Most common are theoretical pricing models based on game theory (Miller et al., 2021) or menu cost approaches (Auclert et al., 2024). To understand managerial motivations and rationales, a separate literature on pricing uses survey-based methods (Blinder, 1998; Candia et al., 2024). Neither of these literatures has aimed to bridge the theoretical and empirical gap between firm-level managerial decision-making, coordination across firms, and inflation.[1]

Abba Lerner's (1958) concept of sellers' inflation builds such a bridge. Sellers' inflation refers to an inflation induced by the pricing decisions of firms rather than by the wage demands of workers. Weber and Wasner (2023) examine why large firms could raise prices in the face of recent emergencies—thus inducing sellers' inflation—even though the same firms had kept prices stable before the pandemic despite already high levels of corporate concentration. They argue that price-making firms with market power only hike prices if they expect their competitors to do the same. Otherwise, hiking prices risks losing market share to competitors, which undermines profitability. Whereas collusion and norms of price leadership are widely acknowledged as coordinators for price hikes, Weber and Wasner (2023) propose an additional mechanism: large cost shocks that hit all competitors can function as an *implicit coordinating mechanism* for firms, since firms know that their competitors face the same conditions and hence have strong incentives to raise prices. Via this coordination mechanism, price increases in upstream sectors such as energy and transportation are transmitted to downstream sectors, turning a change in relative prices into an increase in the general price level. Additional supply constraints can further enhance the coordination power of cost shocks.

In this paper we study *how* increases in costs, which in other periods were often absorbed by firms, could be passed on through the economy during the recent inflation. To this end, we operationalize the implicit coordination mechanism and develop an original method to test it empirically on a large sample of firms. Our starting point is that, generally speaking, cost increases are bad news for businesses, who strive to cut costs. By contrast, large, economy-wide cost increases that are salient to all firms in a sector can be good news, if they can coordinate price hikes, and can hence enable an increase in unit profits. As an ECB study has recently explained, "in the presence of an input cost shock, increases in unit profits and their contribution to inflation can be consistent with a constant mark-up" (Hahn, 2023). If firms know that their competitors will price

[1]Policymakers are aware of this blind spot. For instance, the European Central Bank's "Challenges for Monetary Policy" (ChaMP) initiative has made firm price-setting a research priority.

in ways that seek to protect their markups in response to a cost shock, they can each individually increase their unit profits without losing market share. Since firms tend to avoid price wars and are reluctant to lower prices when costs come back down, they can also enjoy windfall profits when the cost shock eases (Weber and Wasner, 2023). As a result, we expect corporate leaders to express relatively *positive* sentiment when discussing economy-wide cost increases on earnings calls with investors and analysts since they open a window of opportunity for increases in profits. However, in the absence of economy-wide cost shocks, we expect corporate leaders to express relatively *negative* sentiment when discussing cost increases that affect only their company.

To test the cost shock coordination hypothesis, we scale up the analysis of firm-level evidence from earnings calls in Weber and Wasner (2023) and use a big data approach. Our dataset comprises 138,962 earnings calls transcripts of 4,823 stock-market listed U.S. corporations during the period 2007-Q1 - 2022-Q2. We combine qualitative analysis with quantitative natural language processing (NLP) methods and large language models (LLMs) to construct indexes capturing corporate executives' sentiment when discussing increases in costs. For our baseline Cost Increase Sentiment Index, we count positive and negative words that managers frequently use when discussing cost increases in earnings calls. This baseline index captures the sentiment towards cost increases among around 2,000 U.S. companies each quarter in an easily understandable and replicable manner. To corroborate the results obtained with this baseline index, we also construct a more context-sensitive sentiment index using ChatGPT4. Each of these indexes serves as a proxy for executives' expectations regarding their ability to pass on input cost increases by raising the prices of their outputs. We regress the Cost Increase Sentiment Index on measures of economy-wide input costs. For the latter, we use an intermediate input price index provided by the Bureau of Economic Analysis (BEA) as well as NLP- and LLM-constructed indexes to capture economy-wide changes in input prices and supply constraints. In developing the various indexes, we build upon recent economic applications of NLP and LLM methods, employing state-of-the-art models, while also disclosing the underlying sentiment qualifiers as well as the prompts used (Albrizio et al., 2023;

Dayen and Mabud, 2022; Gosselin and Taskin, 2023; Mabud, 2022a,b; Owens, 2022a,b; Windsor and Zang, 2023; Young et al., 2021).

Our quantitative results are consistent with the hypothesis that economy-wide cost shocks coordinate price hikes. We find a significant positive relationship between the Cost Increase Sentiment Index and indicators of input price shocks, as well as with the combination of input price hikes and supply constraints. The sentiment firm executives express when discussing increases in their own input costs is more positive in the presence of large, economy-wide cost shocks and supply disruptions than in their absence.

Besides feeding into the NLP workflow, the qualitative analysis also sheds light on how cost shocks serve as a coordinating mechanism that translates increases in costs into generalized inflation. We find that executives directly explain how the expected price increases of their competitors create an opportunity to raise prices themselves. They also explain that supply constraints reduce competitive pressures and, emphasizing the demand-side, that the cost shock made customers judge price increases more favorably.

If, in the face of major supply shocks, firms do not absorb cost increases but instead perceive them as good news—as they facilitate price hikes and hence higher profits—this has important implications for price stability in a world of overlapping emergencies. Climate change, future pandemics, deglobalization, trade wars, and mounting geopolitical tensions are among the global trends that can trigger future supply and cost shocks. Monetary policy is not designed to contain supply-shock driven inflation. This suggests that many economies face an inflation governance gap (Van 't Klooster and Weber, 2024).

No one policy instrument can fill this gap; a toolbox approach to managing inflation is needed instead. New policy tools such as buffer stocks can increase the resilience of upstream, systemically significant sectors in order to prevent the most harmful cost shocks (Weber and Schulken, 2024). Since these upstream sectors provide inputs for sectors across the economy, they have the greatest potential to unleash economy-wide sellers' inflation when their prices spike (Weber et al., 2024). Anti-trust policy and anti-price gouging laws in turn can help mute the coordinating effect of cost shocks. If firms have to fear penalties, legal investigations, and reputational damage when they increase prices in ways that increase profits in response to a shock, firms can be less certain that their competitors will increase prices and the coordinating effect of cost shocks could be weakened. Windfall profits taxes can both contribute to the containment of inflationary pressures from excess price hikes while offsetting the negative redistributional effects of sellers' inflation.

The next section develops our theory on economy-wide cost shocks as coordinating mechanisms in price hikes, relates this to sellers' inflation and states our hypotheses. Section 2 provides a review of evidence on the role of profits in driving inflation, structured by the stages of sellers' inflation. Section 4 introduces our data and describes the qualitative and quantitative methods and index construction we use to test our hypotheses. Section 5 presents the quantitative and qualitative results. The conclusion discusses policy implications.

2 Theory: Cost shocks as price coordinators in sellers' inflation

Drawing on long-standing insights in institutionalist economics, Weber and Wasner (2023) put forward the hypothesis that large economy-wide spikes in input prices and supply constraints can function as implicit coordinating mechanisms for price-making firms. In the absence of such a coordination mechanism, firms may be hesitant to raise prices even when they are price makers because they fear losing market share. The coordination mechanism allows price spikes in upstream, systemically important sectors to turn into general inflation. Since the inflation results from the pricing decisions of sellers, it is an instance of what Lerner (1958) called "sellers' inflation".

2.1 Sticky prices, pricing coordination and inflation stages

Following Kaldor (1985), Galbraith (1957), and others, Weber and Wasner (2023) distinguish two broad types of pricing regimes: First, pricing in commodity markets, where even large, powerful firms are by and large price takers in the sense that they cannot directly set prices, but rather take prices determined by supply and demand in financial, futures, and/or spot markets. These prices are highly volatile and not market-clearing, as market participants hold inventories.

The second pricing regime regards pricing in concentrated markets for manufactured goods and services, where firms are price makers. When demand rises, such price-making firms react by increasing their capacity utilization and drawing down inventories, rather than by increasing prices. This implies that prices are not necessarily profit maximizing. As Galbraith (1957, p.128) argues, there is a trade-off between prices that maximize profits in the short-run and in the long-run. If firms decide to increase prices in response to short-run increases in demand before a sector's capacity is fully utilized, they risk losing customers to competitors and hence shrink their market share and long-run profitability. Today, the danger of losing market share in response to price hikes is particularly severe, as competitors are in command of "just-in-time" production networks that allow an instant ramp-up of supply in response to increases in demand. Simply put, for price-making firms with market power, a short-run increase in demand on its own is not a sufficient condition to raise prices. Instead of setting profit-maximizing prices following a marginalist logic, price-making firms set prices by targeting markups over rough estimates of average costs as long as this does not undermine their market share.

However, the trade-off between protecting market shares and targeting markups disappears if firms' price hikes are coordinated. In the heyday of organized labor, sectoral bargaining agreements provided corporations a coordinating device to increase prices, since it affected all firms at once. Such wage increases were widely publicized and, as such, also created legitimacy for price increases on the part of customers (Galbraith, 1957, p.129). Such sector-wide cost increases are thus different from firm-specific cost hikes. Firms tend to absorb firm-specific cost increases at the expense of short run profitability, since price hikes in response would undermine their market share and hence long-run profitability.

Among the mechanisms that can coordinate price hikes, outright collusion and norms of price leadership are generally acknowledged. Weber and Wasner (2023) theorize that large spikes in input prices and supply constraints known to everyone in the industry can function as coordinating mechanisms in a similar manner as bargaining agreements once did. Such economy-wide cost shocks can originate from the volatile price dynamics in commodity markets that provide ubiquitous inputs. In response to such economy-wide cost shocks, firms raise their prices based on the expectation that their competitors will do the same, which means that there is no strict trade-off between protecting market shares and protecting markups over rising costs.

Also note that incumbent firms in concentrated markets tend not to lower prices, since this risks launching a price war and a destructive form of competition that drives down market-wide profitability, which firms with substantial market shares try to avoid. This implies that when costs eventually fall and firms with pricing power keep prices stable, they can achieve a markup increase and realize even higher profits.

As a result of this price-making behavior, and in line with the coordination failure explanation of sticky prices, price-making firms tend to keep prices relatively fixed in the absence of a mechanism to coordinate price increases (Ball and Romer, 1991; Blinder, 1998). This provides an explanation for why consumer prices generally remained relatively stable during a decades-long rise in markups (De Loecker et al., 2020; Konczal and Lusiani, 2022): major shocks were absent during the pre-pandemic period of rising markups.[2] Markups increased as powerful firms kept prices broadly stable while cutting costs. It can also explain why, during the pandemic, consumer prices rose in the midst of global shocks.

In the following we analyze statements of corporate executives on earnings calls to examine whether cost shocks function as a mechanism for implicit pricing coordination. The implicit coordination hypothesis suggests that firms respond to, and therefore perceive, increases in input prices differently when such changes are large and common to competitors, as compared to when they are minimal or specific to individual firms. In the case of firm-specific cost shocks, firms tend to absorb cost increases, which at least

[2]One notable exception is the commodity price boom that preceded the 2008 financial crash, which in fact coincided with a rise in U.S. CPI inflation that precipitously reversed after the third quarter of 2008 as the recession manifested. This is discussed in the context of our results in Section 5.1.1.

temporarily lowers their profitability. But in the case of a general cost shock, firms do not face the same trade-off between their market share and their short-run profitability, and hence can price in ways that protect their markups. In fact, protecting markups in response to cost shocks can even enhance short-run profitability, as we illustrate in the next section. The prospect of enhanced short-run profitability without the downside of lost market shares sets economy-wide cost shocks apart from firm-specific increases in costs.

Our empirical strategy to measure this difference in executives' perception relies on sentiment analysis. Specifically, we expect firms' sentiment about individual cost increases to be relatively negative, in contrast to their sentiment towards economy-wide cost shocks, which should be relatively positive. Thus, our main hypothesis is as follows:

Hypothesis 1 *Firms express a more positive sentiment towards economy-wide cost shocks compared to firm-specific increases in costs.*

We also expect that, if firms face economy-wide supply constraints for their inputs in addition to such cost shocks, the coordinating effect is stronger. The reason for this is that the ability of firms to expand their supply and gain market share at the expense of their competitors is impeded. Hence, our second hypothesis is a more restrictive version of the first:

Hypothesis 2 *Firms express a more positive sentiment toward economy-wide cost shocks when they coincide with supply constraints compared to firm-specific increases in costs.*

Weber and Wasner (2023) conceptualize sellers' inflation as a three-stage process: (1) At the *impulse* stage, shocks due to the emergencies of pandemic and war set off price spikes in systemically significant upstream sectors. This occurred in volatile commodity markets, for example for energy and food, where even large firms are by and large price takers (price regime 1 as defined in Section 2.1). (2) At the *propagation* stage, these price spikes function as an *impulse* for implicit price coordination among price-making firms seeking to protect their markups against the cost shock (Section 2.1).[3] And (3) at the *conflict* stage, labor attempts to fend off declines in real wages. The link between the *impulse* and *propagation* stages is the implicit coordination of price hikes we examine in this paper.

If price-making firms do not absorb cost shocks that occur at the *impulse* stage but instead pass them on through price hikes, local price spikes are turned into sellers' inflation as a result of the pricing decisions of sellers at the *propagation* stage. The main cost shock coordination mechanism is reinforced by a number of feedback loops at the *propagation* stage. Like wage bargaining agreements, economy-wide cost shocks can provide legitimacy for price hikes in the eyes of consumers, contributing to a decline in demand elasticity which reinforces firms' abilities to raise prices. In addition, the onset of generalized inflation further contributes to an environment conducive for further rounds of price increases, in essence providing additional implicit coordination among competitors. Figure 1 illustrates the mechanisms and feedback loops through which economy-wide cost shocks are turned into sellers' inflation. However, while such feedback loops can contribute to the perpetuation of inflation, they do not by themselves lead to a self-sustained inflationary spiral. If inflationary inertia diminishes, renewed cost shocks are necessary for new rounds of price hikes.

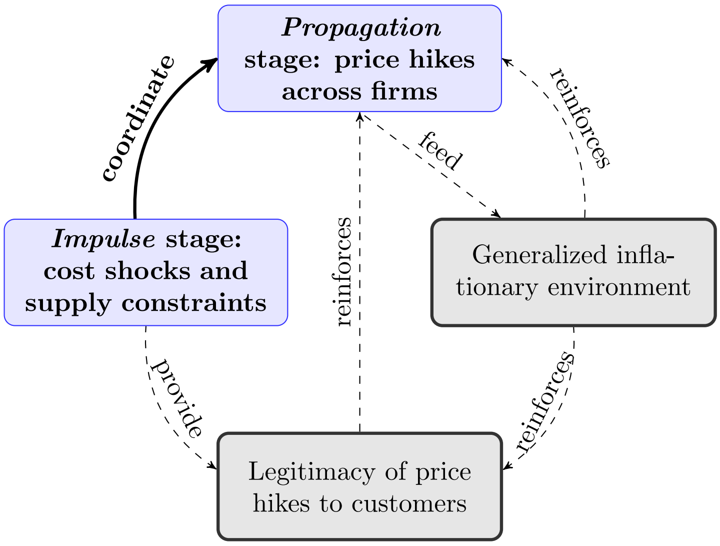
2.2 The role of profits at different inflation stages

The debate over sellers' inflation and the role of profits has, at times, been muddled by confusion surrounding the definition of "profits", and the channels through which profits are connected to inflation. In this section we try to clarify some of these confusions.

Regarding *definitions* of profits, four concepts need to be distinguished: (1) profits (the residual income deriving from sales after accounting for costs, which can further be defined before- or after-taxes, capital depreciation, interest payments, etc.); (2) profit

[3] Weber and Wasner (2023) called this stage the "propagation and amplification" stage to emphasize the different pass-through rates corresponding to stable or increasing markups and profit margins heterogeneously occurring in response to rising costs from the *impulse* stage. Here we refer to this as the *propagation* stage, where both *markup protection* and *markup increase* mechanisms can occur (see below), for conceptual simplicity.

Figure 1: Cost shock coordination and feedback loops



Notes: The flow chart illustrates the mechanisms and feedback loops through which economy-wide cost shocks and supply constraints allow for the implicit coordination of price hikes among firms. Economy-wide cost shocks enable firms to implicitly coordinate price increases and also lend legitimacy to these hikes in the eyes of consumers. This perceived legitimacy further reinforces firms' abilities to raise prices. The coordinated price hikes contribute to a generalized inflationary environment, which, in turn, reinforces the cycle of implicit coordination and continued price increases.

margins (profits as a percentage of sales or revenue); (3) markups (price over marginal costs in neoclassical theory or over "normal unit costs" in Post-Keynesian theory (Lavoie, 2022, ch. 3.6);[4] and (4) the profit share of income (aggregate profits as a percentage of national income). Each of these variables may behave differently depending on the *channel* through which profits play a role in inflation.

Media narratives tend to refer to "greedflation" as suggesting that an increase in profitability across the board has been the main driver of inflation. However, the relationship between prices and profits depends on the different stages of the inflationary process and the exact notion of profits under consideration. Table 1 summarizes the links between

[4]Note that markups and profit margins are not the same. First, profit margins are measured as a residual result of sales, while markups are set (or "targeted" given uncertainty over actual unit costs) by firms *before* sales. Second, in theory, profit margins may or may not change in line with movements in markups. For example, a standard assumption in Post-Keynesian theory is that firms set prices as a markup over "normal" unit labor costs and imported unit material costs, where overhead labor costs at a *normal* rate of capacity utilization are included in the determination of "normal" unit labor costs (Lavoie, 2024). Hence, markups are relatively independent of the economic cycle and more accurately portray market power. On the other hand, profit margins vary with changes in capacity utilization and the economic cycle, as they represent the difference between unit price and unit cost (including overhead labor costs), implying that profit margins will be higher if capacity utilization rises. Thus, under these assumptions, profit margins and markups would move in sync only if capacity utilization is constant or if overhead labor costs are negligible.

price hikes, the four profit variables, and the stages of sellers' inflation.

At the *impulse* stage, increases in output prices without any proportional increase in costs can result in windfall profits and higher markups and margins for firms operating in those sectors. Note that heightened profits deriving from the impulse stage are particular to individual firms and sectors, meaning that this effect may or may not be large enough to manifest in an increase in the profit share of income or in aggregate measures of markups or profit margins depending on whether other firms absorb the cost increases and offset the margin/markup increases that occur at the *impulse* stage.

The *propagation* stage involves two distinct channels connecting rising profits with inflation. The primary and most impactful channel is propagation in the form of *markup protection* against cost increases, which likely plays the central role at the aggregate level. *Markup protection* against cost shocks results in an increase in unit profits as a matter of accounting (Hahn, 2023). When widespread, this can manifest as an increase in the profit share of income while aggregate measures of markups stay constant (Colonna et al., 2023; Lavoie, 2024; Nikiforos et al., 2024). Profit margins may remain constant or even increase if unit overhead costs are declining with rising capacity utilization. Widespread *markup protection* in response to cost shocks is sufficient to generate sellers' inflation.[5]

By contrast, the second channel positing a connection between profits and inflation in the *propagation* stage is one where markups and profit margins rise as firms raise prices by more than the level that would keep markups constant. This *markup increase* channel can occur, for example, due to expectations of future cost shocks (Glover et al., 2023) or the pro-cyclical increase in labor productivity in the context of the pandemic recovery (Nikiforos et al., 2024). In the press, such an increase in markups and profit margins has often been considered as the hallmark of so-called "greedflation" (e.g. Hogg, 2023; Inman, 2023). But note that profits and the profit share of income can rise in the *propagation* stage even if aggregate markups and profit margins fall, if the cost shock in imported intermediate goods is large and wages do not immediately adjust (Nikiforos et al., 2024).

[5]Hence, if aggregate markups remain constant, this does not disprove the occurrence of sellers' inflation, but rather is consistent with *markup protection* as the dominant channel at the *propagation* stage.

Table 1: Movements in prices and profit variables throughout stages of sellers' inflation

<table>
<tr><th rowspan="2"></th><th rowspan="2">Impulse stage</th><th colspan="2">Propagation stage</th><th rowspan="2">Conflict stage</th></tr>
<tr><th>Markup protection</th><th>Markup increase</th></tr>
<tr><td>Prices</td><td>Increase in critical upstream sectors</td><td colspan="2">Increase in response to cost shocks</td><td>Increase depends on firms' responses to wage increases</td></tr>
<tr><td>Profits</td><td rowspan="4">Increase in critical upstream sectors</td><td colspan="2">Increase</td><td rowspan="3">Wage increases can lead to decrease</td></tr>
<tr><td>Profit margins</td><td rowspan="2">Constant*</td><td rowspan="2">Increase</td></tr>
<tr><td>Markups</td></tr>
<tr><td>Profit share of income</td><td colspan="2">Increases</td><td>Declines if labor successfully recuperates wage losses</td></tr>
</table>

Notes: The table summarizes how price hikes, profits, profit margins, markups, and the profit share of income are influenced by the stages of sellers' inflation. *Profit margins may rise in the *propagation* stage even with constant markups (*markup protection*) if capacity utilization is rising (and hence unit overhead costs are declining).

3 Empirical evidence for sellers' inflation

There is by now a large empirical literature on the role of firms and profits in the return of inflation. The following overview of the empirical evidence to date is structured by the three stages of sellers' inflation summarized in the previous section.

Beginning with the *impulse* stage, it is now widely recognized that supply shocks were among the factors that sparked and/or drove inflation. Supply shocks correspond to upstream price spikes. Numerous studies have demonstrated the inflationary impact of supply shocks in specific sectors, for example, the prominent role of oil and gas price shocks (Breman and Storm, 2023) and shipping rates (Carrière-Swallow et al., 2023) as well as the general proliferation of bottlenecks as important explanatory factors for the onset of inflation (Adolfsen et al., 2024; Bank for International Settlements, 2022; Bivens and Banerjee, 2023; Dao et al., 2024; Ferguson and Storm, 2023; Minton and Wheaton, 2023; Rees and Rungcharoenkitkul, 2021; Stiglitz and Regmi, 2023). Economists have employed theoretical (Kharroubi and Smets, 2024) and econometric methods and found significant causal effects of supply shocks on inflation in the U.S. (Ball et al., 2022;

Blanchard and Bernanke, 2023; Comin et al., 2023; Liu and Nguyen, 2023; Young et al., 2021) and in the euro area (Acharya et al., 2023; Pallara et al., 2023), providing strong evidence for an *impulse* stage which ignited inflation.

The correlate of sharp increases in prices at the impulse stage have been sharp increases in profits. Prominent examples include exploding profits in the energy sector (Arce et al., 2023; Breman and Storm, 2023; Jung and Hayes, 2023; Wildauer et al., 2023; Semieniuk et al., 2024), in food commodities (ETC Group, 2022; United Nations Conference on Trade and Development, 2023), and skyrocketing shipping freight rates and profits due to shipping container bottlenecks under disjointed lock-downs and re-openings across the globe (Etter and Murray, 2022; House Committee on Oversight and Reform, 2022).

Regarding the *propagation* stage, numerous studies have found strong evidence of the pass-through of cost shocks—especially from the energy sector—to output prices (Adolfsen et al., 2024; Arquié and Thie, 2023; Dao et al., 2024; Lafrogne-Joussier et al., 2023; Lu et al., 2024; Minton and Wheaton, 2023; Mrabet and Page, 2023; Wildauer et al., 2023). Evidence in support of the *propagation* of cost shocks from upstream sectors includes broad increases in the profit share of income (Arce et al., 2023; Bivens, 2022; Hansen et al., 2023; Ministry of Finance and Public Credit of Columbia, 2023; OECD, 2023), which is consistent with widespread *markup protection* in response to heightened intermediate input and/or import prices (Castro-Vincenzi and Kleinman, 2023; Colonna et al., 2023; Lavoie, 2024).

However, much controversy has been drawn over the *markup increase* channel. A primary reason for this controversy is that the connections between rising profits and inflation proposed by scholars and central bank officials (e.g. Bivens, 2022; Lagarde, 2023; Schnabel, 2022; Weber and Wasner, 2023) have often been misconstrued as assertions that the *markup increase* channel was the predominant force driving inflation. This misinterpretation was reinforced by media coverage on "greedflation". But as laid out above, the *markup increase* channel is not the only nor the most important channel linking profits to inflation.

The *markup increase* channel can exist for a sizable set of firms without being the dominant force driving inflation in the aggregate. Weber and Wasner (2023), for example, document a high variability of changes in profit margins among firms throughout the pandemic. From the sellers' inflation perspective, we would not expect to see a correlation between markups and output prices on the industry or aggregate levels. Some measurable increases in industry-level markups can also originate at the *impulse* stage rather than the *markup increase* channel at the *propagation* stage. This is consistent with the industry-level decompositions of changes in markups during the pandemic in Davis (2024), Konczal and Lusiani (2022), and Jung and Hayes (2023), which show starkly increased markups in the mining and oil and gas sectors, for example.

As a result of a misconstrued interpretation regarding *markup increases*, the notion of sellers' inflation has been criticized with the observation that an increase in the profit share of income can rise under conditions of *markup protection* against rising intermediate input costs (Lavoie, 2024). In fact, as we have pointed out, the *markup increase* channel is not a necessary condition for sellers' inflation, and Weber and Wasner (2023) suggest that it is secondary to *markup protection*.[6] But whereas in the respective studies input cost hikes are often portrayed as exogenous, in sellers' inflation the *impulse* stage is an important part of the relation between profits and inflation, and large increases in markups can be associated with the initial upstream price spikes where these price spikes are not imported.[7] Finally, even if *markup protection* has been the dominant trend at the *propagation* stage as opposed to *markup increases*, a rise in the profit share of income points to the fact that the burden of inflation ultimately falls on workers, rather than rising wages playing the dominant role in inflation.

With regards to evidence of the *markup increase* channel and its importance in contributing to inflation, studies have employed various methods and show mixed results. It is unsurprising that the relation between inflation and markups is not clear cut, since

[6] Gallo and Rochon (2024), Matamoros (2023), Nikiforos et al. (2024), and Storm (2023) provide more thorough discussions of such critiques and the consistency with sellers' inflation and other notions of "profit inflation".

[7] For this reason, an important policy conclusion of Weber and Wasner (2023) is that, in an era of instability where supply shocks are likely to continually emerge, policy should aim to contain price hikes at the *impulse* stage to prevent inflation from the onset.

it depends on how large *markup increases* are at the *impulse* stage and how widespread they are at the *propagation* stage. Nevertheless, a number of studies find a positive relation between markup increases and inflation. For example, Konczal and Lusiani (2022), and Davis (2024), and Glover et al. (2023) estimate markups via Compustat data and document a substantial rise in aggregate U.S. markups between 2019 and 2021, and Unite (2024) documents significant increase in profit margins across a large sample of firms in the U.K., providing some evidence that the *markup increase* channel could have played a role in driving inflation in the aggregate.[8] Faryaar et al. (2023) find a similar increase in markups in Canada, but note that this increase was modest compared to CPI inflation, suggesting the *markup increase* channel could have played a minor role. Matamoros (2023) estimates changes in aggregate markups as the difference between the rate of inflation and changes in total prime costs for six developed economies, finding that markups rose substantially in 2022 in all but one country. Capolongo et al. (2023) employ a VAR model and find that markups played a larger role in increasing unit profits than supply factors in the aggregate in Europe.

Another set of research investigates the *markup increase* channel by analyzing the role of markups in the *pass-through* of supply shocks. Nikiforos and Grothe (2023), Scanlon (2024), Setterfield (2023), and Wildauer et al. (2023) present models with various channels by which rising markups can amplify inflationary pressures deriving from supply shocks. For the Euro Area, Acharya et al. (2023) provide evidence that firms with higher markups before the pandemic were more likely to maintain or increase their markups when facing supply-chain constraints and a high demand for their products; Adolfsen et al. (2024) find that firms' profit margins expand when there is a supply shock in gas; and Arquié and Thie (2023) find that firms in the French manufacturing sector with higher markups are better able to pass through changes in energy prices than ones with lower markups, with

[8] Davis (2024) furthermore shows that the increase in aggregate sales-weighted markups of U.S. listed non-financial firms between 2019 and 2021 was driven by a larger concentration of sales among high-markup firms, "suggesting not only a sellers' inflation characterized by firms' ability to sustain profits, but in fact a 'winners' inflation', wherein top-markup firms amassed competitive gains specifically via expanded market share". Aggregate markups then returned to pre-pandemic levels in 2022, consistent with the notion "that the supply disruptions of the pandemic grant only temporary market power, which fades after initial shocks pass through downstream sectors", leading to an aggregate predominance of *markup protection*.

firms in the least competitive sector exhibiting a pass through of energy price shocks of more than 100 percent. Similarly, Franzoni et al. (2023) leverage a global dataset with firm-level financial information to find that firms with higher market power both disproportionately benefit from supply chain backlogs in their own industry and are better able to pass on cost shocks, with the largest firms in an industry experiencing higher markups and profitability following supply chain shortages.

In contrast, Hornstein (2023) and Leduc et al. (2024) estimate markups using national income accounting data and find that aggregate U.S. markups did not rise during the pandemic, while Bijnens et al. (2023) find that markups declined in Belgium. Palazzo (2023) further find no substantial increase in the net capital share—which they argue is a better measure of profitability in national income accounts—or the profit margins of publicly traded firms. Alvarez et al. (2024) leverage product-level price and cost data from a global manufacturer of non-durable household products, finding that "total" markups—measured as retail prices over unit variable production costs—remained constant from 2018 to 2023, but that manufacturing markups spiked in the second half of 2020 while retail markups spiked in 2022, with the latter coinciding with high CPI inflation. Their results, although specific to a subset of goods, are consistent with the idea that the *markup increase* channel heterogeneously manifested at different stages of the supply chain at different times due to them belonging to different pricing regimes, while *markup protection* proliferated on the whole, as rising markups for some sectors were offset by falling markups for others. Bilyk et al. (2023) find that markups increased in commodity-producing sectors but remained stable in consumer-oriented sectors in Canada. This is consistent with markup increases at the *impulse* stage and *markup protection* at the *propagation* stage. In addition, Conlon et al. (2023) find no correlation between rising markups and prices on the industry level in the U.S., and Baioni and Tomás (2023) similarly finds a lack of correlation between markups and prices in the aggregate for Italy, which the latter claims debunks "sellers' inflation". Yet, as illustrated above, sellers' inflation does not require a predominance of the *markup increase* channel and, due to the different nature of firms' pricing abilities across sectors, would not necessarily predict a correlation between markups and output prices on the industry or aggregate levels.

Another set of evidence comes from inflation decompositions using the gross value added deflator as a measure of inflation. Such a decomposition shows the shares of inflation that have been captured by labor and capital in the form of higher wages and profits.[9] During the onset and peak of inflation, the share captured by profits was at its highest, while labor shares remained relatively low. It was only as inflation began to cool that the share accounted for by labor rose in some quarters, indicating that aggregate wage increases followed, rather than drove, the inflationary surge. This was demonstrated in early decompositions of the gross value added deflator in the U.S. (Bivens, 2022; Weber and Wasner, 2023) and has further been found to hold in the Euro Zone (Arce et al., 2023; Hansen et al., 2023; Schneider, 2024) and in Colombia (Ministry of Finance and Public Credit of Columbia, 2023). The observed sequence of a high share of inflation captured by profits during the period of high inflation followed by a rising share captured by labor in a period of falling inflation is consistent with the stages of sellers' inflation. The rising share of inflation accounted for by profits corresponds to the *impulse* and *propagation* stages—whether through the prevalence of the *markup protection* or *markup increase* channel. The flip side of this is a falling share of inflation accounted for by wages. But eventually wages catch up, which corresponds to the *conflict* stage. The role of *conflict* in inflation has received renewed attention (e.g., Lorenzoni and Werning, 2023a,b; Romaniello and Stirati, 2024).

In sum, recent research has established that price spikes emerging at the impulse stage were passed on. However, the question raised by Weber and Wasner (2023) of *why* firms could pass on cost increases rather than absorb them has not received further treatment beyond the small sample studied in their paper.[10] If firms are generally reluctant to

[9]Given a fixed level of real output, an increase in prices leads to an increase in aggregate nominal income, which will be distributed between profits, wages, and other non-labor costs, such as consumption of fixed capital, net taxes on production, and interest payments. The "shares of inflation" captured by wages and profits refers to the shares of this increase in aggregate nominal income attributable to inflation accounted for by wages and profits.

[10]That firm pricing was important is more widely recognized. For example, in a June 2023 statement by ECB President Christine Lagarde, she noted: "Certain sectors of the economy in particular had taken advantage of the mismatch between supply constrained by bottlenecks and demand enhanced by recovery and a situation of everybody's in the same position, we are all going to increase prices which can be concerted practice, which can be just market driven practices; and in those circumstances those

raise prices under "normal" conditions for fear of losing market share (Blinder, 1998; Fabiani et al., 2007), the widespread *propagation* of cost hikes in the post-pandemic period requires explanation. The implicit coordination examined in this paper provides the missing mechanism.

4 Data and methods

The main obstacle to testing our hypotheses is that firm pricing strategies, let alone implicit coordination, are difficult to observe and measure. Economy-wide firm-level input cost and pricing data are unavailable. The main methods to study firm pricing behavior are interviews and surveys (Álvarez et al., 2006; Blinder, 1998; Candia et al., 2024; Fabiani et al., 2007; Greenslade and Parker, 2012; Hall and Hitch, 1939; Park et al., 2010; Silberston, 1970) and, more recently, survey experiments (Coibion et al., 2018, 2020). It should be clear, however, that firms may not be fully honest or transparent in their survey responses. Blinder (1998), for instance, excluded "questions about oligopolistic collusion, limit pricing, and other concerns of industrial organization specialists" in order to "prevent the idea that the survey was from the Justice Department". In this context, surveys may be subject to various biases and not provide wholly accurate conclusions into the factors driving firm pricing decisions. Furthermore, such surveys are conducted on a one-time basis, making it difficult to track changes in price-setting rationale over time and under different economic contexts.

In order to overcome these obstacles, we scale the approach followed by Weber and Wasner (2023): To measure management perceptions of cost shocks at the firm level, we use transcripts of corporate earnings calls. We operationalize "perceptions" as the *sentiment* associated with statements about cost increases. Whereas under "normal" conditions we would expect that the sentiment towards rising costs for any one individual firm is negative, we theorize that when cost shocks are large and economy-wide, this sentiment will actually be positive.

sectors have taken advantage to push costs through entirely without squeezing on margins and for some of them to push prices higher than just the cost push" (EP, 2023).

4.1 Data

Earnings calls are public conference calls between corporate executives, investors, and financial analysts. They have become routine for listed companies in the U.S. and follow a standardized script. In the first part, the CEO or CFO presents the company's quarterly results. The second part consists of a Q&A, during which management responds to questions asked by analysts and investors. Although earnings calls—transcripts of which are usually made public—are by no means private conversations, they do provide a unique window into the thinking of public companies' senior management. A growing set of recent contributions has utilized earnings calls to study phenomena such as firm-level climate change exposure and corporate discount rates (Sautner et al., 2023; Gormsen and Huber, 2022), as well as firm pricing behavior and inflation (Dayen and Mabud, 2022; Mabud, 2022a,b; Owens, 2022a,b; Young et al., 2021). By using sentiment analysis to measure executives' feelings or perceptions as expressed in earnings calls, we follow the approach of a number of recent studies by central banks and the IMF (Albrizio et al., 2023; Windsor and Zang, 2023; Gosselin and Taskin, 2023).

On the one hand, a limitation of the reliance on earnings calls to discern idiosyncratic price-setting behaviors is similar to that of surveys: since earnings calls are public, executives and analysts are careful to prevent the disclosure of behaviors which might be illegal or considered unsavory. Another source of potential bias stems from the fact that executives have strong incentives to report what investors want to hear (Cao et al., 2023). On the other hand, a major advantage of earnings calls is that they are continually released, thus revealing how executives react to dynamic events in real time. This allows us to discern how individual pricing behaviors change under evolving contexts. Furthermore, if we can assume that firms are aware of the signaling function of earnings call statements, then there is also the possibility of a certain reflexivity. By stating on earnings calls that they plan to respond to cost shocks by hiking prices, firms can reassure each other in a price hike. The earnings call communication becomes part of the implicit coordination.

Weber and Wasner (2023) conducted qualitative analysis on a small-sample of earnings calls pertaining to large "superstar" firms (Autor et al., 2020; Eeckhout, 2022) in their study, employing an inductive approach to analyze sellers' inflation. While such a sample provides a snapshot into the behaviors of large, powerful firms, to further validate the implicit coordination hypothesis for the economy as a whole, we test the hypothesis on a large sample.

This study leverages the Capital IQ earnings call dataset to test the hypothesis that economy-wide cost shocks function as implicit coordinating mechanisms. We analyze 138,962 earnings calls transcripts corresponding to 4,823 firms over a period of 62 quarters (see Tables 2 and 6). The dataset contains the transcripts of earnings calls pertaining to publicly listed firms from 2004 to the present, where the number of transcripts increases over time. It further delineates whether each segment of an earnings call is a presentation of quarterly results, a question from an analyst or investor, or an answer from an executive. Due to the limited sample size in early years and the most recent quarters at the time of writing, we restrict our analysis to earnings calls taking place between 2007-Q1 to 2022-Q2.[11] We further limit our analysis to U.S. headquartered firms and exclude transcripts from firms in sectors in which we assume that firms are generally not price makers in the ways we described in Section 2.1, such as commodity sectors, finance, and real estate.[12] The combined revenue of the firms included in our analysis between 2007-Q1 to 2022-Q2 accounts for 15.1 percent of GDP over that same period.

4.2 Methods

To test our hypotheses on this dataset, we use a mixed-methods approach, combining qualitative and quantitative techniques. Qualitative coding serves a dual purpose. One part feeds into the NLP workflow, as described in greater detail below. In addition,

[11]Although there are significantly fewer earnings calls transcripts available in 2007 compared to the rest of our sample (Table **??**), we retain the year 2007 in our analysis so that our sample includes observations before the extraordinary year of 2008, which saw a sharp jump and then precipitous decline in commodity prices with the onset of the financial crash. Since our NLP variables are constructed on the aggregate level (see below), their values in 2007 still contain information from more than 2,800 transcripts.

[12]Sectors excluded from our analysis are oil and gas extraction (BEA code: 211), mining, except oil and gas (212), federal reserve banks, credit intermediation, and related activities (521CI), securities, commodity contracts, and investments (523), funds, trust, and other financial vehicles (525), housing (HS), and other real estate (ORE). Table 6 in Appendix A shows the number of firms and combined revenue per industry included in our analysis.

Table 2: Number of earnings calls and firms per year

Year	Transcripts	Companies
2007	2,962	1,641
2008	7,264	2,281
2009	7,580	2,182
2010	9,335	2,683
2011	10,372	2,768
2012	9,929	2,681
2013	9,688	2,594
2014	9,650	2,574
2015	9,385	2,533
2016	9,190	2,556
2017	9,414	2,570
2018	9,439	2,561
2019	9,482	2,595
2020	9,647	2,625
2021	10,269	2,832
2022	5,356	2,751

Notes: Number of earnings calls transcripts and firms per year in the data set. 2022 only includes Q1 and Q2.

human-eye reading of earnings call fragments is indispensable to ensure that the theorized mechanism and feedback loops—illustrated in Figure 1—do, in fact, feature in executives' thinking and decision-making. The qualitative results presented in Section 5.2 stem from the formal coding of 400 randomly selected earnings call fragments (see below); and from the open-ended coding of an additional sample of roughly equal size that was obtained from a targeted search for (1) "cost" AND "market share" AND "competition"; (2) "pricing power" OR "strategic pricing".[13]

For the quantitative analysis, we use natural language processing (NLP) methods to produce indicators that serve as proxies for firm-level input cost developments and pricing intentions. From these indexes, we generate descriptive statistics and run regressions to test our hypotheses. In doing so, we build on a series of central bank and IMF working papers that have used NLP methods on earnings calls to measure firm-level pricing behavior and inflation expectations (Albrizio et al., 2023; Gosselin and Taskin,

[13]This targeted search focused on the period of the recent inflation and on the sectors manufacturing, accommodation and food services, transportation and warehousing, and retail.

2023; Windsor and Zang, 2023; Young et al., 2021). We move beyond this literature in three ways. First, rather than using text classification only for descriptive purposes, we construct variables from the text to test a theory about pricing behavior. Second, our method for constructing these variables addresses well-known issues with standard NLP methods by utilizing large language models (LLMs). Specifically, we use LLMs to capture the different meanings of a word in different sentences, something that traditional NLP methods struggle with. Third, as a robustness check to our NLP-constructed indexes (which were aided by the use of LLMs), we further construct parallel indexes entirely via LLMs using OpenAI's GPT4 API. These methods are described in detail below.

4.2.1 Dependent variable: Sentiment indexes

The first challenge is to construct a variable that captures how executives discuss cost increases in earnings calls. When the sentiment they express towards cost increases is positive, our variable should take a value greater than 0. By contrast, a value of less than 0 should indicate negative sentiment. This Cost Increase Sentiment Index is our dependent variable. The statistical setup is geared towards predicting fluctuations in the Cost Increase Sentiment Index using indicators of economy-wide cost shocks and supply constraints as independent variables.

We construct two cost increase sentiment variables. For the first of these, we closely follow existing economic studies that have built sentiment indexes using preprocessed earnings call transcripts (Hassel and Palier, 2020; Albrizio et al., 2023; Taskin and Ruch, 2023). We determine the sentiment towards cost increases in a specific earnings call by aggregating sentiment scores around each mention of the phrase "cost increase" in the call. The sentiment scores around each mention are calculated by taking the difference between the count of positive-toned words and the count of negative-toned words within the r-words range of mentions of the term "cost increase". We then divide the result by the total number of words in a given earnings call. The formula we use is as follows:

$$Sentiment_{it}^{C} = \frac{1}{|B_{it}|} \sum_{b \in B_{it}} \left\{ 1^{CI}(b) \times \left(\sum_{c \in C^{r}(b)} S(c) \right) \right\}, \tag{1}$$

where B_{it} represents the total number of words in the earnings call of a firm i at time t, while $1^{CI})(\cdot)$ is an indicator function that takes the value 1 if an input word or bigram corresponds to the key term of the sentiment index—where the key term here is "cost increase"—and 0 if not. $C^r(b)$ denotes a set of words in the r-terms range that come before and after word b. After experimenting with r parameter values such as 5, 10, and 15, we found that setting the r parameter to 15 yielded index scores that were closest to those assigned by our qualitative coders. In order to match sentiment scores to our primary independent variable—which is available on the quarterly level (Section 4.2.3)—we then aggregate the sentiment scores for each quarter on the economy-wide level by taking the average of the scores of all transcripts in the quarter.[14]

The function $S(c)$ in Equation 1 is defined as follows:

$$S(c) = \begin{cases} +1 & \text{if } c \in S^+ \\ -1 & \text{if } c \in S^- \\ 0 & \text{otherwise,} \end{cases} \tag{2}$$

Here, $S+$ and $S-$ represent lists of positive- and negative-toned words. During the index construction, we initially used positive-tone and negative-tone words from the conventional Loughran and McDonald (2011) sentiment dictionary. However, the resulting sentiment scores were not precise enough for our qualitative coders to meaningfully relate them to their own assessments. We therefore compiled our own lists of positive and negative words instead, following a similar approach to Albrizio et al. (2023). Specifically, we had two teams (of two coders each) analyze 200 (400 in total) randomly selected earnings

[14]The data provide two pieces of information that can be used to assign each earnings call to a quarter: the date on which the earnings call took place, and the "headline" title of the call, which contains the name of the firm and the fiscal quarter the earnings call pertains to (e.g. "Firm Name, Q1 2006 Earnings Call, Mar-22-2006"). The headline can be misleading, because it refers to the fiscal quarter *as defined by the firm itself*, which may or may not overlap with the calendar quarter of the same name. We therefore rely on the date of the earnings call to assign the call to a calendar quarter. Earnings calls transpiring in the months February through April are assigned to Q1, May through July to Q2, August through October to Q3, and November through January to Q4 (January earnings calls are assigned to Q4 of the prior year). Since the dates on which earnings calls take place are not standard, this process occasionally assigns two earnings calls from the same firm to the same quarter. When this happens, we read the headline title of both earnings calls and assign the earnings call from that firm with the earliest headline fiscal quarter to the prior quarter. We repeat this process until there are no more than one earnings call for each firm in all quarters.

call paragraphs to determine whether they discuss cost increases and, if so, whether these cost increases are discussed positively, negatively, or neutrally, particularly in the context of a perceived ability to pass on such increases in costs by raising output prices.

After each coding team had reconciled their codes, we had ChatGPT4 code the same paragraphs, with the additional instruction to list keywords relevant to the coding decision for each paragraph. Keywords for paragraphs that both human coders and ChatGPT4 coded as positive were added to our list of positive-toned words. Keywords for paragraphs that both human coders and ChatGPT4 coded as negative were added to our list of negative-coded words. As a result, we obtain scores that, according to the qualitative coders, more clearly distinguish positive discussions of cost increases from negative discussions. The final list of positive and negative words is provided in Appendix B.

However, an issue we could not avoid is the misclassification of positive or negative sentiment in the context of more complex cost increase discussions. Both hard-to-follow negations and discussions in which the timing is unclear remain a problem for standard NLP methods. To investigate whether this limitation biases our index, we constructed a second cost increase sentiment variable by having ChatGPT4 provide a sentiment score for all paragraphs with cost increase mentions.

To do this, we sent each earnings call paragraph containing a mention of "cost increase", along with a prompt, to the OpenAI API. The central instruction in the prompt is to code the sentiment around each mention of cost increase as +3 if the sentiment is predominantly positive and as -3 if the sentiment is predominantly negative. To make ChatGPT4's coding generally more consistent, we inserted generic example sentences into the prompt that illustrate which sentences our qualitative coders would code with +3 or -3. The full prompt is provided in Appendix C. Scores returned by OpenAI were aggregated in the same way as our dictionary-based scores.

In summary, the described approaches yield a cost increase sentiment variable constructed using standard NLP methods (henceforth called the dictionary-based Cost Increase Sentiment Index) and an additional cost increase sentiment variable coded using ChatGPT4 (henceforth called the GPT-based Cost Increase Sentiment Index). To make the standard NLP variable comparable with the ChatGPT4 variable, we additionally Z-standardize it. Since LLMs such as ChatGPT4 are more opaque as methodological tools as compared with standard NLP methods more common in the literature, we leverage the dictionary-based index as our primary dependent variable and treat the GPT-based index as a robustness metric.

4.2.2 Index validation

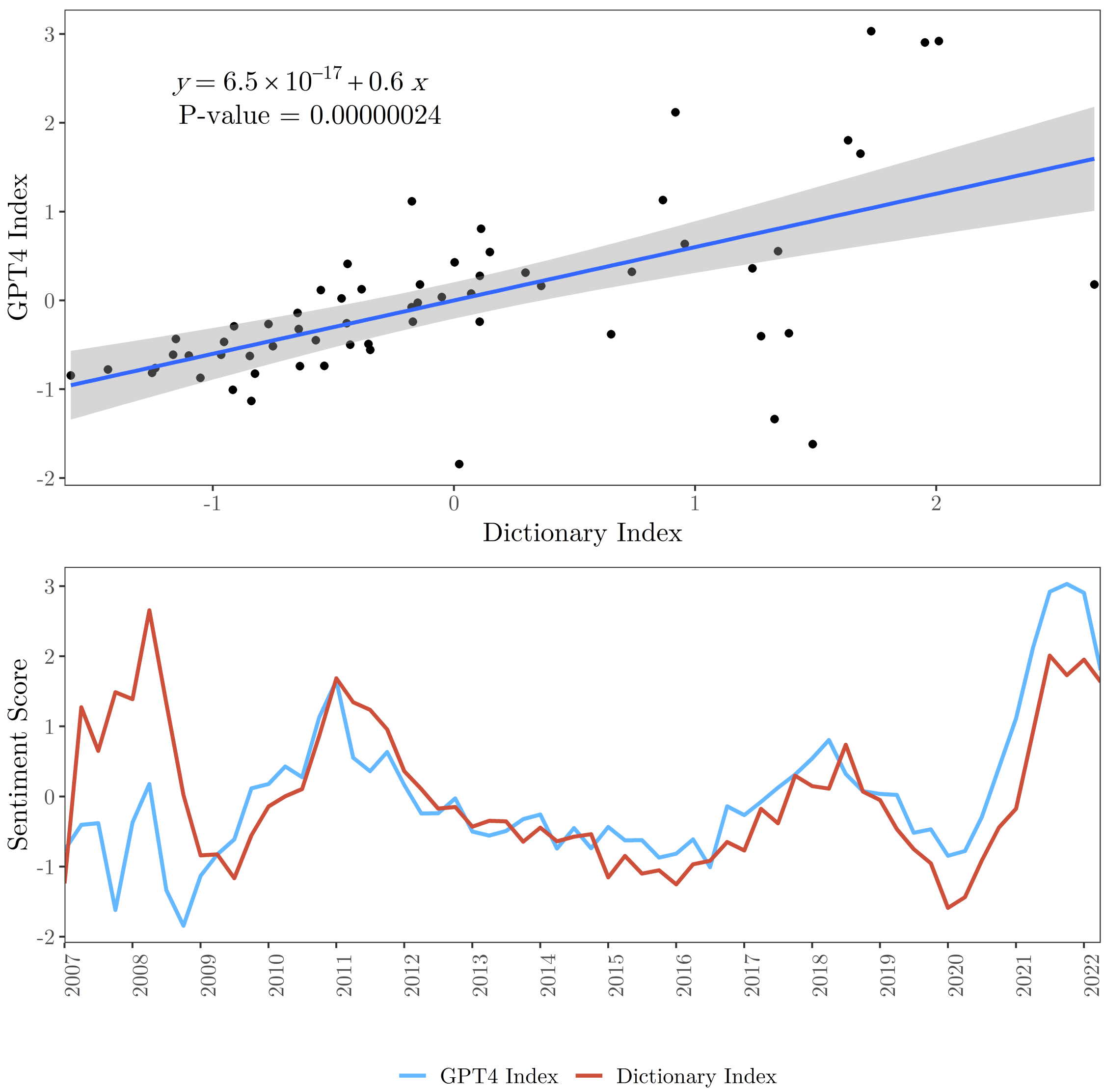
To validate whether the dictionary-based Cost Increase Sentiment Index meaningfully captures firm sentiment towards increases in costs, Figure 2 shows a scatter plot (top) and a time series (bottom) of both the dictionary-based and GPT-based Cost Increase Sentiment Indexes, showing very similar trends between them. While standard dictionary-based NLP methods often struggle to accurately discern sentiment in the context of more complicated discussions, under the assumption that LLMs such as GPT-4 are better able to take context into account when assigning a sentiment score, the strong correlation between our dictionary-based index and the GPT-based index provides evidence that this limitation does not significantly bias the dictionary-based index.[15]

Furthermore, Figure 3 shows a scatter plot (top) and time series (bottom) of the dictionary-based Cost Increase Sentiment Index and average firm-level profits, calculated as the sum of quarterly profits of all firms in Compustat which are in our earnings calls dataset (matched by GVKEY) divided by the number of companies in each quarter. While the figure is not intended to suggest any causal relationships, it is noteworthy that the Cost Increase Sentiment Index appears to somewhat broadly track with average firm-level profits over time. Although profitability can be influenced by a myriad of factors beyond a firm's capacity to pass through increased input costs, the alignment provides a preliminary indication that firms' sentiments towards cost increases may be associated with their ability to maintain or enhance profitability. It also presents another external validation for our index.

Finally, to further validate that the dictionary-based Cost Increase Sentiment Index

[15]Discrepancies between the dictionary-based and GPT-based Cost Increase Sentiment Index in earlier quarters are likely attributable to the lower number of available transcripts (Table 2).

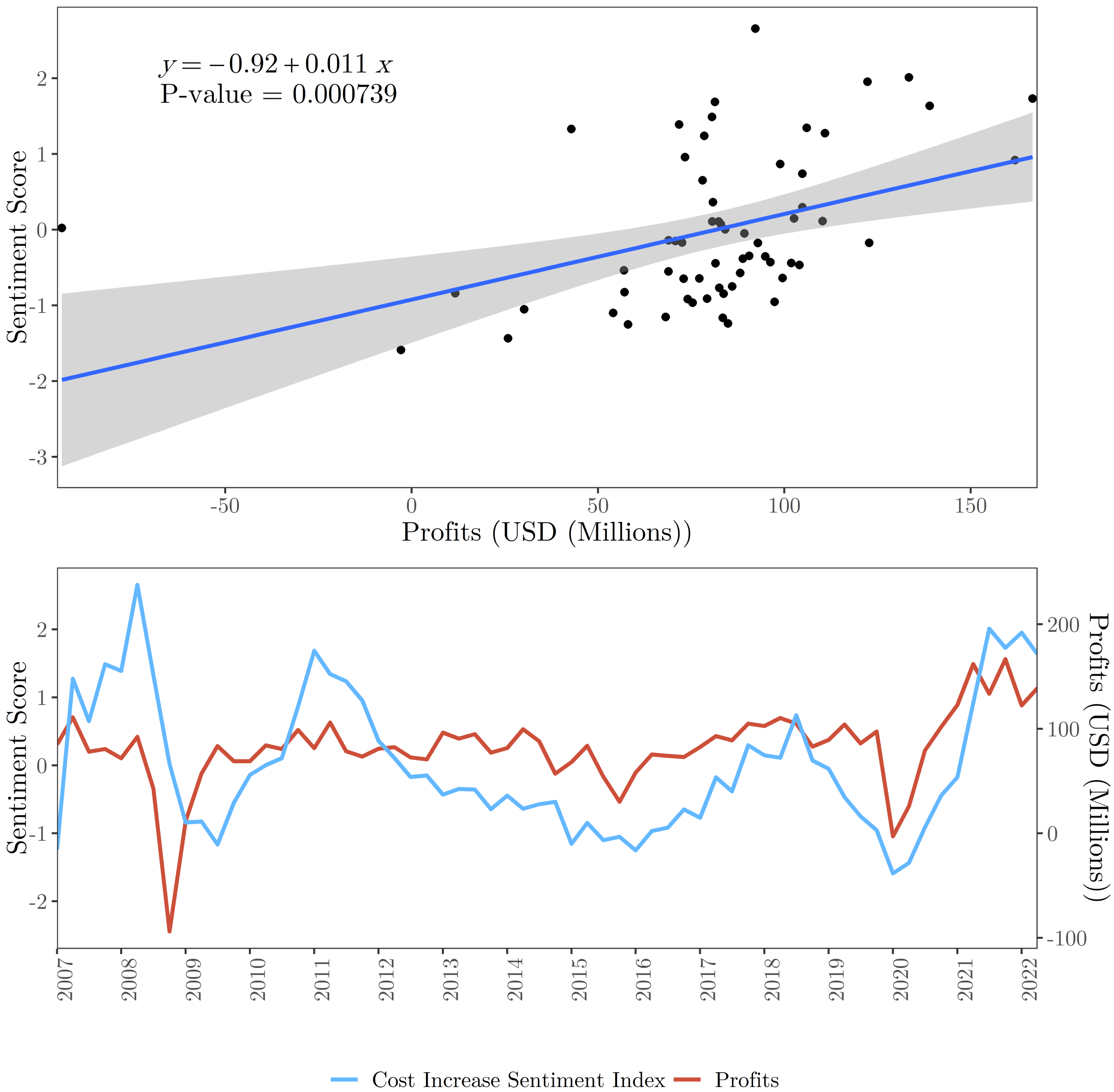
FIGURE 2: Cost Increase Sentiment Index: dictionary-based and GPT-based indexes



Notes: Top: Quarterly Cost Increase Sentiment Index constructed with our manually compiled dictionary (x-axis) vs. quarterly Cost Increase Sentiment Index constructed via ChatGPT4 (y-axis), including simple OLS regression line equation and p-value. Bottom: Quarterly time series of the GPT-based index (blue) and the dictionary-based index (red).

meaningfully captures firm sentiment towards increases in costs, two researchers read a random sample of passages containing the phrase "cost increase", manually assigned a positive or negative score based on their own interpretation of the passage, and compared their results to the dictionary-based Cost Increase Sentiment Index. The researchers largely assigned the same sentiment (positive or negative) as the dictionary based sentiment index, indicating that our manually-constructed dictionary is generally successful in determining whether a positive or negative sentiment is expressed when the phrase "cost

Figure 3: Cost Increase Sentiment Index vs average firm-level profits



Notes: Top: Quarterly average firm-level profits (x-axis, \$100bn) vs. the dictionary-based Cost Increase Sentiment Index (y-axis). Bottom: Quarterly time series of aggregate firm-level profits (red) and the dictionary-based Cost Increase Sentiment Index (blue). "Average firm-level profits" refers to the sum of quarterly profits of all publicly-listed firms in Compustat which are in our earnings calls dataset (matched by GVKEY) divided by the number of companies in each quarter. "Profits" refers to the Compustat variable "Income Before Extraordinary Items" (ibq), which are after taxes, interest, depreciation, and amortization.

increase" is used in a context where corporate executives are expressing their perceptions of their ability to pass on increases in costs. The results of this manual validation are discussed in greater detail in Appendix D.

4.2.3 Independent variables: Cost shocks, supply constraints, and demand

Our hypotheses concern firm sentiment towards increases in costs—more specifically, increases in costs deriving from hikes in input prices and supply constraints. This requires measurements of changes in input prices and supply constraints. For the former, we primarily rely on the chain-type price index for intermediate inputs for all industries from the Bureau of Economic Analysis's (BEA) GDP by Industry accounts. These accounts provide an economy-level input price index reflecting the input prices of intermediate goods firms face in their production costs. We interpret annual percent changes in the input price index as a reflection of general changes in input costs firms face throughout the economy.

As a robustness check, we additionally develop our own indicator of economy-wide changes in input prices using standard NLP methods with our dataset of earnings calls transcripts. We do this by constructing a sentiment index around the key term "input cost(s)", but with a different dictionary of positive and negative words than the one used to construct the Cost Increase Sentiment Index. The use of different dictionaries reflects our aim to capture distinct aspects of executive sentiment. Whereas the latter dictionary was developed to capture firms' "feelings towards" increases in costs in the context of a perceived ability to pass on costs via output price hikes, here we aim to detect *changes in input prices themselves* from executives' speech. For example, for the Cost Increase Sentiment Index, the word "opportunity" was identified as a positive word to capture favorable sentiment towards cost increases, which pertains to instances of firm executives stating an "opportunity to price" in discussions mentioning cost increases. By contrast, the word "opportunity" is not meaningful to detect movements in input costs themselves. Instead, words such as "rise" are classified as positive because they indicate an increase in input costs, while "fall" is considered negative for signaling a decrease.

The construction of a sentiment index as a proxy for actual changes in a variable of interest, as opposed to perceptions of the variable of interest, is consistent with sentiment indexes used to track supply constraints and levels of supply and demand as in Gosselin and Taskin (2023), Windsor and Zang (2023), and Young et al. (2021). We construct this index, henceforth called the NLP Input Price Index, according to Equation 1 with the dictionary developed by Windsor and Zang (2023) for this purpose.[16] The Pearson correlation coefficient between the resulting NLP Input Price Index and the BEA Input Price Index is 0.82.

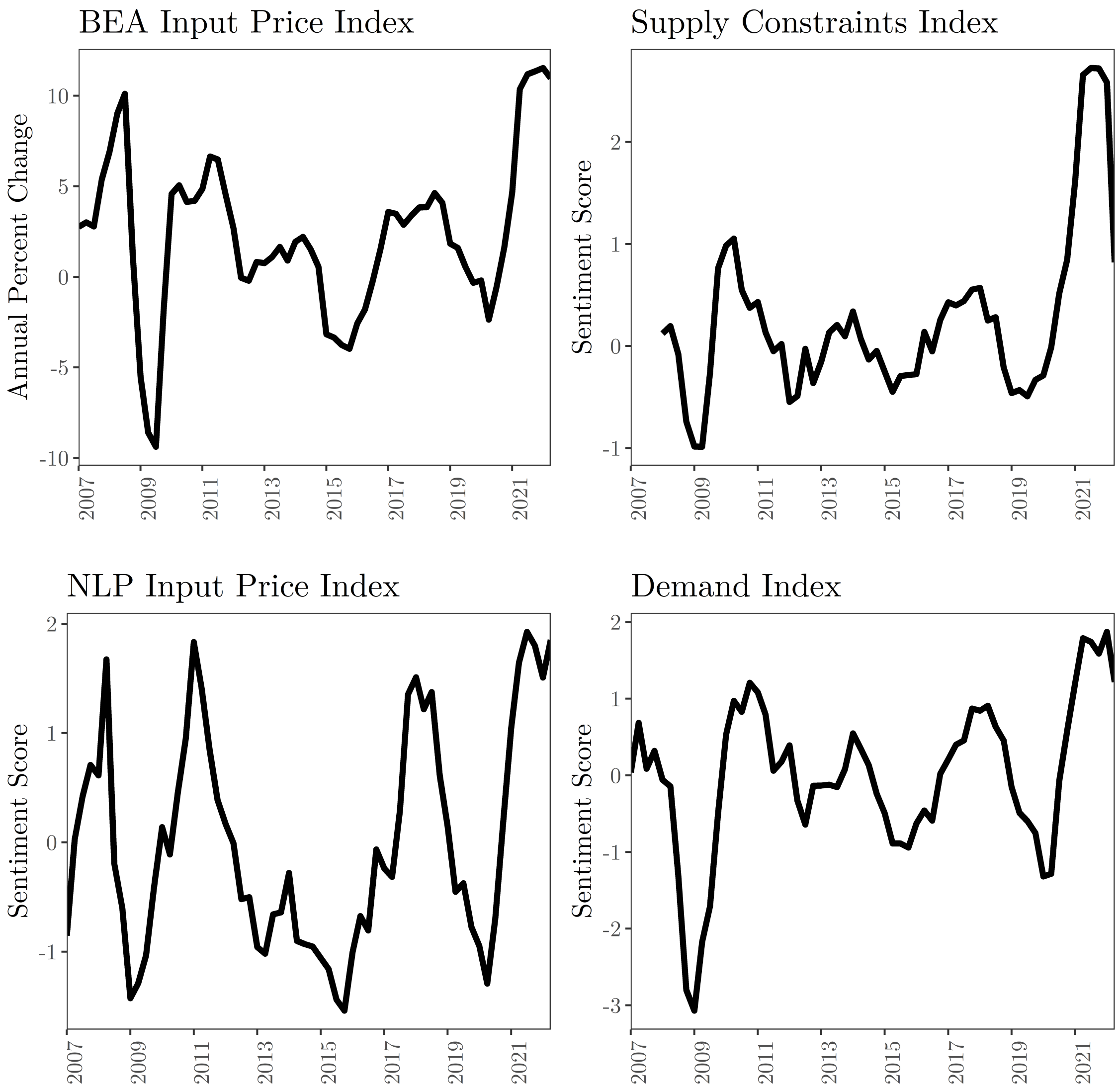
We furthermore construct two sentiment indexes around mentions of the term "supply constraint(s)" and the word "demand" in the same manner as our NLP Input Price Index. As in the NLP Input Price Index, the Supply Constraints and Demand Indexes aim to measure increases or decreases in the prevalence of supply constraints and in demand. We use the Demand Index as a control variable in our hypothesis testing described below. Figure 4 provides time-series plots of the BEA Input Price Index (top left), the NLP Input Price Index (bottom left), the Supply Constraints Index (top right), and the Demand Index (bottom right).[17]

In addition to the dictionary-based Demand and Supply Constraint Indexes, we also construct GPT-based Demand and Supply Constraints Indexes. We construct these GPT-based indexes because terms and phrases like "demand" and "supply constraints", similar to "cost increases", can have different meanings in different sentences. To account for this, we encode earnings call transcripts in which "demand" and "supply constraints", as well as close synonyms, appear, using distinct GPT prompts according to the previously described process. Table 3 gives an overview of all indexes used in our regression analysis, as well as of control variables from other, non-textual sources. For each of the key terms for which we construct an NLP index—"cost increase", "input costs", "supply constraints", and "demand"—Figure 5 shows the frequency with which the key terms are mentioned, measured as the number of times the key term is used divided by the number of transcripts in each quarter.

[16]We chose "input cost(s)", rather than "input price(s", as our key term from which to construct this index because our manual reading of earnings calls samples indicates that the former term is far more often used in discussions contextually related to changes in input prices. However, we refer to this variable as the NLP Input Price Index because it serves as an alternative indicator of changes in input prices in place of the BEA Input Price Index, as well as to avoid confusion with our dependent variable, the Cost Increase Sentiment Index.

[17]All dependent and independent variables passed ADF and KPSS tests for stationarity, except for the dictionary-based Supply Constraints Index. For the latter, we take the first annual difference.

FIGURE 4: Independent variables



Notes: Top left: Annual Percent Change in the BEA Input Price Index. Bottom Left: NLP Input Price Index (Pearson correlation coefficient between the NLP Input Price Index and the BEA Input Price Index is 0.82). Top right: Supply Constraints Index (first annual difference). Bottom right: Demand Index.

4.2.4 Empirical setting

The cost shock coordination hypothesis suggests that the sentiment around increases in costs is more positive in the presence of economy-wide cost shocks and supply disruptions, given that they function as implicit coordinating mechanisms allowing firms to safely raise their own prices. In the absence of such economy-wide shocks, the hypothesis suggests firm sentiment towards cost increases should be negative, as individual firms are compelled by competitive forces to absorb any increases in input costs only they experience, which

Table 3: List of variables

Generated via	Dependent variable	Source
Dictionary	Cost Increase Sentiment Index (dictionary-based)	Earnings calls
GPT4	Cost Increase Sentiment Index (GPT-based)	Earnings calls
Generated via	**Independent variable**	**Source**
—	BEA Input Price Index	BEA
Dictionary	NLP Input Price Index	Earnings calls
Dictionary	Supply Constraints Index (dictionary-based)	Earnings calls
GPT4	Supply Constraints Index (GPT-based)	Earnings calls
Dictionary	Demand index (dictionary-based)	Earnings calls
GPT4	Demand index (GPT-based)	Earnings calls
—	CPI	BLS
—	Profits	Compustat

Notes: The table lists all variables appearing in figures and regressions, the data source for the variable, and, for indexes constructed from the earnings calls, whether the index was generated via a dictionary or via ChatGPT4.

results in downward pressures on profits. To test this hypothesis, we therefore examine the correlation between the Cost Increase Sentiment Index and indicators of economy-wide cost shocks and supply constraints. Note, however, that our regression models are not designed to establish causal relationships but rather to explore patterns that align with our theoretical framework. Combined with our qualitative analysis, these correlations offer descriptive evidence that supports our hypothesis.

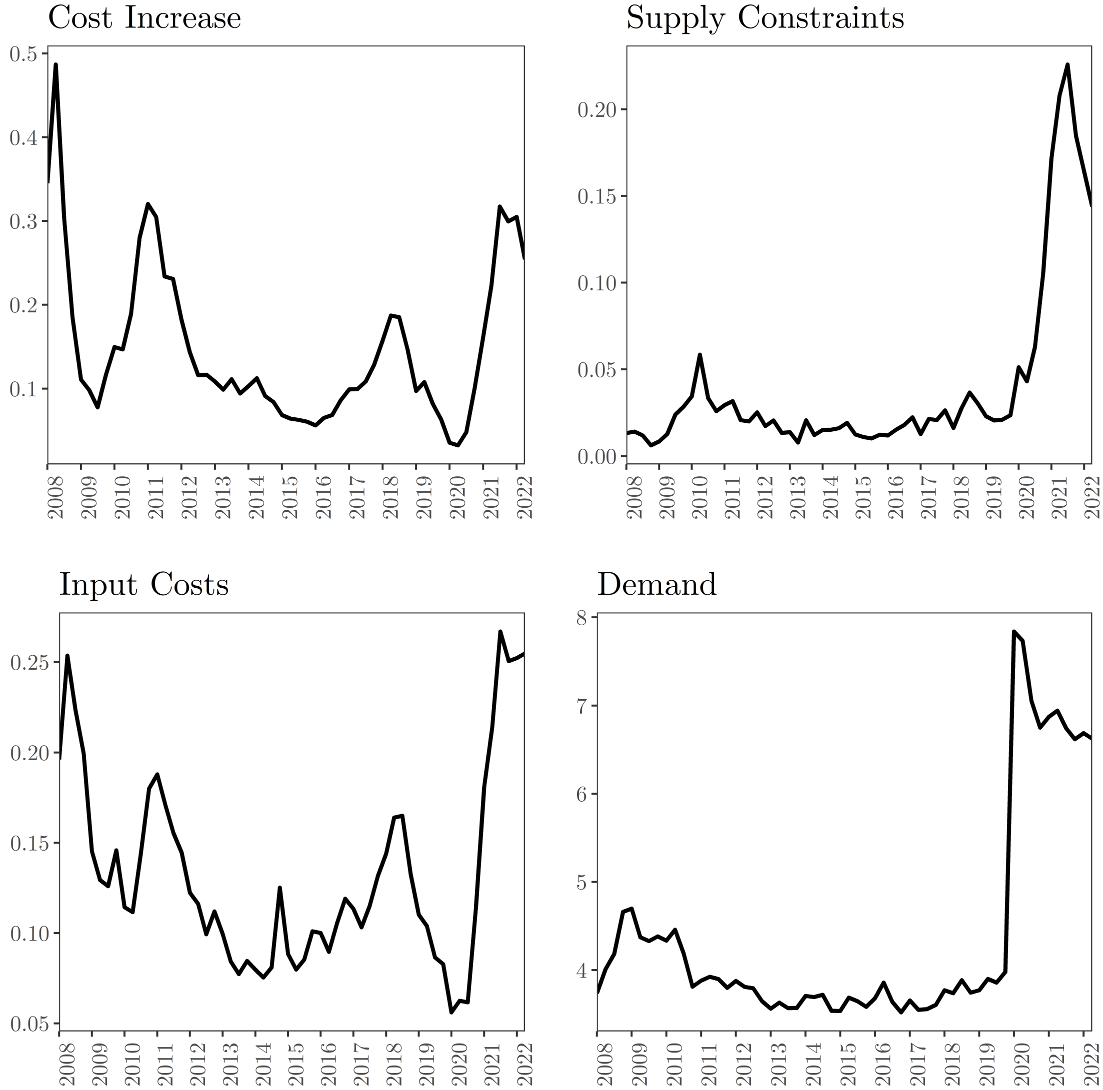
Our primary regression specification testing Hypothesis 1 is as follows:

$$\text{Sentiment}_t = \alpha + \beta_1 \Delta\text{InputPrice}_t + \beta_2 (\Delta\text{InputPrice}_t)^2 + \beta_3 \text{Demand}_t + \epsilon_t \qquad (3)$$

where Sentiment_t is the Cost Increase Sentiment Index in quarter t, $\Delta\text{InputPrice}_t$ is the annual percent change in the BEA Input Price Index, and Demand_t is the Demand Index. Since our hypothesis implies that the sentiment towards increases in costs is positive particularly in the context of *large* cost shocks, we include a squared term on $\Delta\text{InputPrice}_t$.

It is important to note that, while the BEA Input Price Index at times exhibits *negative* changes, the Cost Increase Sentiment Index measures firm-level responses to *increases* in costs. In other words, in quarters where the annual percent change in the

Figure 5: Key Term Frequencies



Notes: Frequency of the usage of key terms for which NLP indexes are constructed, measured as the number of times the key term is used divided by the number of transcripts in each quarter. The four key terms are: "cost increase" (top left), "input costs" (bottom left), "supply constraints" (top right), and "demand" (bottom right).

BEA Input Price Index is negative, the Cost Increase Sentiment Index measures the average sentiment of those firms facing an *idiosyncratic increase in their own costs*, despite the fact that input prices throughout the economy are on average declining. Therefore, the cost shock coordination hypothesis suggests that the Cost Increase Sentiment Index should be low in quarters when the annual percent change in the BEA Input Price Index is negative, since the average economy-wide decline in input prices implies the absence of the cost shock implicit coordinating mechanism—hence individual firms facing idiosyncratic cost increases will have greater pressure to absorb such costs. Consequently, positive, significant values of β_1 and β_2 would be consistent with Hypothesis 1.

To test the combined impact of supply constraints with economy-wide cost shocks as in Hypothesis 2, we further test the following model:

$$\begin{aligned}\text{Sentiment}_t =& \alpha + \beta_1 \Delta\text{InputPrice}_t + \beta_2 \text{SupplyConstraints}_t \\ &+ \beta_3 (\Delta\text{InputPrice}_t \times \text{SupplyConstraints}_t) \\ &+ \beta_4 \text{Demand}_t + \epsilon_t \end{aligned} \tag{4}$$

where $\text{SupplyConstraints}_t$ is the Supply Constraints Index constructed as outlined in Section 4.2.3. Hypothesis 2 implies that the coefficient on the interaction term between InputPrice_t and $\text{SupplyConstraints}_t$ in Equation 4 should be positive, as the co-occurrence of economy-wide cost shocks and supply constraints corresponds to a heightened ability to pass on cost increases, and hence to a higher sentiment towards cost increases.

5 Results

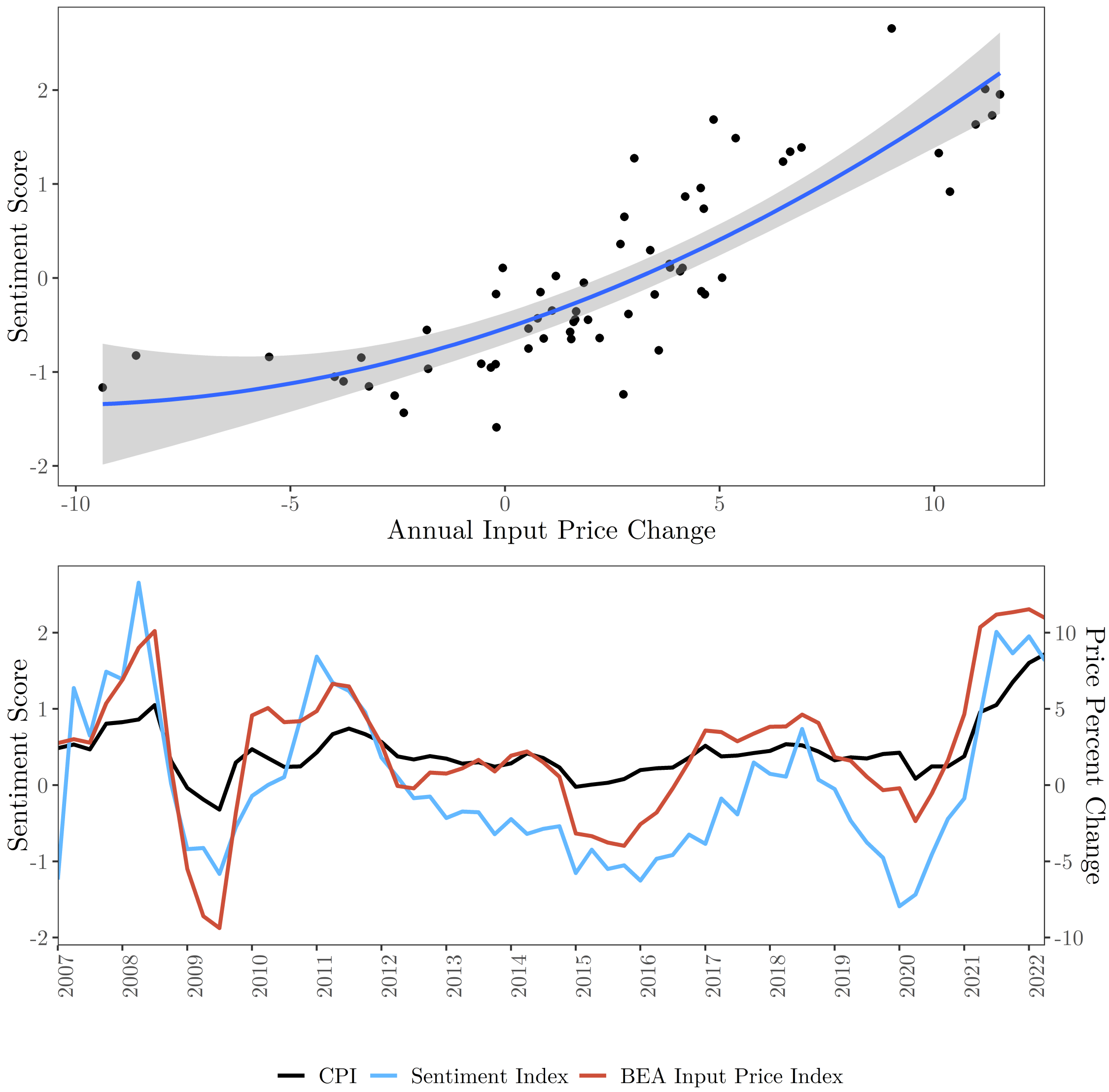
5.1 Quantitative results

5.1.1 Descriptive results

Figure 6 shows the relationship between the Cost Increase Sentiment Index and annual changes in the BEA Input Price Index. The top panel shows a scatter plot between the two variables, with each point representing one quarter of observation. A regression line corresponding to a quadratic relationship in line with Equation 3 is included. The bottom panel of Figure 6 shows the time series of the Cost Increase Sentiment Index, the annual percent change in the BEA Input Price Index, and CPI inflation.

Figure 6 demonstrates that quarters with large positive changes in the BEA Input Price Index coincide with higher sentiment scores. These descriptive results are consistent with the cost shock coordination hypothesis: when cost shocks are large and common to competitors, firms are able to safely pass on increases in costs without the fear of losing

Figure 6: Cost Increase Sentiment Index and BEA Input Price Index



Notes: Top: Economy-wide Cost Increase Sentiment Index vs annual percent changes in the BEA Input Price Index. Each observation represents one quarter. The regression line corresponds to a quadratic relationship in line with Equation 3. Bottom: Time series showing the Cost Increase Sentiment Index (blue, left y-axis), the annual percent change in the BEA Input Price Index (red, right y-axis), and annual CPI inflation (black, right y-axis).

market share, and hence exhibit a more positive sentiment towards increases in costs. By contrast, when the BEA Input Price Index is low or negative—indicative of an absence of generalized cost hikes—the sentiment score is lower. This is consistent with idea that, absent economy-wide cost shocks, the individual firm facing idiosyncratic increases in costs is more likely to absorb such costs rather than pass them on, which negatively impacts profitability and hence evokes a negative sentiment towards cost increases.

The concurrent large increases in the Cost Increase Sentiment Index and the BEA

Input Price Index are particularly salient in the post pandemic inflation. However, instances of simultaneous increases in both variables also occurred in 2007-2008, 2011, and 2018, without subsequent periods of high inflation. These cases, especially in 2011 and 2018, might be attributed to the relatively moderate increases in the BEA Input Price Index—peaking at 6.6 percent in 2011 and 4.6 percent in 2018—which were insufficient cost shocks to trigger widespread price hikes. In contrast, the pandemic-era input price inflation reached levels exceeding 10 percent. Notably, even in the absence of a period of sustained inflation following 2008, CPI inflation did reach 5.3 percent in 2008-Q3 before precipitously declining due to the global financial crisis and ensuing recession. Our hypothesis and descriptive results therefore suggest that the commodity price boom of that era could have potentially ignited an inflationary process if not for the economic downturn.

5.1.2 Regression results

Table 4 shows the Cost Increase Sentiment Index regressed on annual percent changes in the BEA Input Price Index.[18] Consistent with Hypothesis 1, the Cost Increase Sentiment Index is positively correlated with the annual percent change in the BEA Input Price Index. As the sentiment index is a z-score, the coefficient on the BEA Input Price Index in column 1 of Table 4 can be interpreted as follows: each percentage point increase in the BEA Input Price Index is associated with a higher Cost Increase Sentiment Index Score by 0.19 standard deviations. This implies that a hypothetical 10 percent increase in the BEA Input Price Index would correspond to a 1.9-standard-deviation increase in the Cost Increase Sentiment Index. The negative intercept suggests that, in the absence of broad input price inflation, the average sentiment of individual firms facing idiosyncratic increases in costs is negative. The divergence in sentiment between firm-specific and economy-wide cost shocks is the core of Hypothesis 1.

Columns 2 and 3 introduce a squared term on annual percent changes in the BEA Input Price Index as in Equation 3. The significant positive coefficient on the squared

[18] All specifications use Newey-West standard errors to account for autocorrelation.

term is consistent with the notion that quarters with a particularly large increase in the BEA Input Price Index are correlated with higher values of the Cost Increase Sentiment Index. Put plainly, the larger the cost shocks, the more likely firms discuss cost increases in a positive manner—using more positive words such as "favorable", "great", and "improvement". The lack of positive significant coefficients on the Demand Index in Columns 3 and 4 suggests that higher demand, by itself, may be insufficient to coordinate widespread price hikes across the economy.[19] Column 4 corresponds to Equation 4 and shows a negative coefficient on the Supply Constraints Index and a positive coefficient on the interaction between the BEA Input Price Index and the Supply Constraints Index. This suggests that, while the presence of supply constraints on their own would be negatively associated with firm perceptions of an ability to pass-through idiosyncratic cost increases, the combination of economy-wide cost hikes and supply constraints evince a positive association, which is consistent with 2.

To be clear, our regression framework does not aim to capture causal relations. Instead, our results demonstrate that corporate executives tend to discuss increases in costs more positively in the presence of large economy-wide cost shocks and their co-occurence with supply constraints. Our index validation and qualitative analysis affirm that this positive sentiment is often indicative of a firm's perceived ability to pass on their increases in input costs. Conversely, negative sentiment is indicative of a firms' perceived compulsion to absorb firm-specific cost increases. In this context, we interpret our regression results as descriptive evidence suggestive that large cost shocks can function as an implicit coordinating mechanism. An environment of generalized cost hikes and supply constraints allows firms to aim to protect their profit margins by passing on increases in costs, which they would otherwise be more likely to absorb.

[19]Note, however, that the Demand Index exhibits positive significant coefficients in our robustness specifications (Section 5.1.3. This is consistent with the notion that strong consumer demand is enabling the pass-through of input price hikes. Nonetheless, even in those specifications (Columns 1, 2, and 4 of Table 5), the coefficients on the squared term of the BEA Input Price Index and the interaction between the BEA Input Price Index and the Supply Constraints Index remain positive and significant, suggesting that cost shocks and supply constraints are associated with higher sentiment scores even when controlling for demand.

TABLE 4: Cost Increase Sentiment Index Regression on BEA Input Price Index and Supply Constraints Index

	Cost Increase Sentiment Index_t (z-score)			
	(1)	(2)	(3)	(4)
YoY BEA Input Price Index_t (%)	0.185*** (0.027)	0.153*** (0.021)	0.164*** (0.024)	0.205*** (0.028)
YoY BEA Input Price $\text{Index}^2{}_t$ (%)		0.007*** (0.002)	0.007*** (0.002)	
Supply Constraints Index_t (z-score)				−0.632*** (0.234)
Input Price_t * Supply Constraints_t				0.052*** (0.016)
Demand Index_t (z-score)			−0.057 (0.093)	0.061 (0.124)
Constant	−0.433*** (0.137)	−0.536*** (0.107)	−0.555*** (0.103)	−0.501*** (0.075)
Observations	62	62	62	58
R^2	0.679	0.726	0.728	0.772
Adjusted R^2	0.673	0.717	0.714	0.755

Notes: In all columns the regressand is the dictionary-based Cost Increase Sentiment Index. In Rows 1 and 2, YoY BEA Input Price Index refers to the year-over-year (annual) percent change in the BEA Input Price Index. Row 2 refers to the square of the annual percent change in the BEA Input Price Index. Row 3 refers to the dictionary-based Supply Constraints Index (first annual difference). Row 4 refers to the interaction between the BEA Input Price Index and the Supply Constraints Index. Row 5 refers to the dictionary-based Demand Index. Column 3 corresponds to Equation 3 and Column 4 corresponds to Equation 4. All regressions use Newey-West standard errors. *p<0.1; **p<0.05; ***p<0.01

5.1.3 Robustness

Table 5 shows the results of four alternative specifications for our regressions to ensure the robustness of our results. First, we vary the way in which we account for autocorrelation. Columns 1 and 2 of Table 5 are analogous to Columns 3 and 4 of Table 4, but use two lagged observations of the dependent variable with standard OLS instead of Newey-West standard errors.[20] Second, we use alternative indices. Column 2 replaces the BEA Input Price Index with the NLP Input Price Index. To test the robustness of the dictionary-based indexes, Columns 3 and 4 substitute the dictionary-based versions of the Cost Increase Sentiment Index, the Supply Constraints Index, and the Demand Index for the GPT-based versions introduced in Sections 4.2.1 and 4.2.3.[21]

The robustness checks in Table 5 broadly confirm our main results in Table 4. First, the coefficients on the squared term, which captures the cost shock, remain positive and significant when we use two lagged observations to account for autocorrelation with the dictionary-based Cost Increase Sentiment Index as the dependent variable (Column 1) and when we swap the dictionary-based indexes for the GPT-based indexes (Column 3). Given that there are more observations with large positive changes in the BEA Input Price Index than large negative changes—for example, 19 percent of observations show an increase of more than 5 percent, while only 8 percent of observations show a decrease lower than -5 percent (Figure 6)—the robustness of the significant positive coefficient on the squared term is consistent with the notion that quarters with a particularly large increase in the BEA Input Price Index are correlated with higher values of the Cost Increase Sentiment Index. Hence, this is consistent with Hypothesis 1. The significance of the coefficient on the linear term of the input price change is not robust to the alternation in specification in Columns 1 and 3, but this is consistent with the idea that it takes cost shocks as opposed to smaller cost increases to coordinate price hikes.

Second, in contrast to Table 4, the coefficient on the Demand Index is positive and

[20] Two lagged observations are chosen based on minimizing AIC and BIC criteria. The coefficients are not shown in the table for lack of space. In Column 1, both lagged variables show positive, significant coefficients, while only the first lagged variable shows a positive, significant coefficient in Column 2.

[21] Both columns use Newey-West standard errors. The incorporation of lagged observations of the dependent variable instead of Newey-West standard errors, as in Columns 1 and 2, do not change the sign or significance of the coefficients.

significant in Columns 1, 3, and 4 of Table 5. As noted above, our hypothesis is not inconsistent with the idea that higher demand can help enable the pass-through of input price hikes. Third, the interaction term between the NLP Input Price Index and the Supply Constraints Index in Column 2 of Table 5 is insignificant. On the other hand, the interaction term between the BEA Input Price Index and the Supply Constraints Index is positive and significant in Column 4. Our conclusion is that our empirical quantitative evidence in support of Hypothesis 2 is not as robust as that in support of Hypothesis 1. Appendix Section E additionally shows the results of regressions corresponding to Equation 4 utilizing a cost shock dummy variable, confirming that large cost shocks are associated with more positive sentiment towards cost increases.

5.2 Qualitative results

How did corporate executives expect the cost shock that hit the economy from mid-2021 onward to affect their pricing behavior? What was the reasoning behind bullish expectations such as that of consultancy company Perficient that, in the second quarter of 2022, approvingly cited "the climate we're in", and explained its "great success" in passing through cost increases, and thus having "a lot of pricing control"? Our analysis is guided by the theoretical framework summarized in Figure 1. This section presents evidence of three arguments made by executives explaining why they perceived an unusual pricing opportunity. The first, and most important, concerns expectations about competitors' pricing in response to cost shocks, *i.e.*, the cost shock coordination mechanism. Second, executives invoke supply constraints, which undermine the ability of competitors to increase their market share and hence reduce competitive pressures. The third pattern emphasizes demand-side factors, namely that customers showed greater understanding for price increases in times of cost shocks and supply constraints. In the following, all emphases in quotes are ours.

As an example of how firms articulate the coordinating effect of cost shocks, consider this quote from TJX Companies, a clothing retailer, explaining that they can raise prices because they know other firms are doing so, too:

TABLE 5: Robustness: Lagged Dependent Variables and GPT-Based Cost Increase Sentiment Index

	Dependent variable:			
	Dictionary Index_t		GPT Index_t	
	(1)	(2)	(3)	(4)
YoY BEA Input Price Index_t (%)	0.041 (0.026)		0.025 (0.025)	0.117^{***} (0.020)
YoY BEA Input Price $\text{Index}^2{}_t$ (%)	0.004^{**} (0.002)		0.012^{***} (0.002)	
Dictionary-Based Indexes				
NLP Input Price Index_t (z-score)		0.387^{***} (0.095)		
Supply Constraints_t Index (z-score)		0.195 (0.142)		
NLP Input Price * Supply Constraints_t		−0.039 (0.070)		
Demand Index_t (z-score)	0.253^{***} (0.088)	0.020 (0.097)		
GPT-Based Indexes				
Supply Constraints_t Index (z-score)				−0.007 (0.122)
BEA Input Price * Supply Constraints_t				0.072^{***} (0.010)
Demand Index_t (z-score)			0.593^{***} (0.098)	0.319^{**} (0.135)
Constant	-0.179^{**} (0.085)	−0.037 (0.049)	-0.357^{***} (0.089)	-0.330^{***} (0.108)
2 Lags of CISI	Y	Y	N	N
Newey-West SEs	N	N	Y	Y
Observations	60	58	62	62
R^2	0.876	0.900	0.780	0.768

Notes: The regressand in Columns 1 and 2 is the dictionary-based Cost Increase Sentiment Index, and in Columns 3 and 4 the GPT-based Cost Increase Sentiment Index. Row 1 refers to the year-over-year (annual) percent change in the BEA Input Price Index. In rows 3 to 6, all sentiment indexes refer to dictionary-based indexes, with those rows corresponding to the NLP Input Price Index, Supply Constraints Index, the interaction between the NLP Input Index and the Supply Constraints Index, and the Demand Index. In rows 7 to 9, all sentiment indexes refer to GPT-based indexes, with those rows corresponding to the Supply Constraints Index, the interaction between the BEA Input Price Index and the Supply Constraints Index, and the Demand Index. Columns 1 and 2 use standard OLS and include two lagged observations of the dependent variable (not shown), and columns 3 and 4 use Newey-West standard errors. $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

> I'm looking at this inflationary price increase as a major opportunity for us at TJX to get even more aggressive about adjusting our retails than we've been. [...] We're always monitoring the value about how we stack up against everybody else. But the one thing that's happening is *everyone is getting here with these same cost pressures*. So our merchants are diligent. [...] And we have just a high degree of confidence in the ability to do a significant amount this coming year to offset really the lion's share, I think, of these cost pressures. (TJX Companies, Q2 2022)

In this quote, TJX linked the general cost shock to the pricing strategies of competitors in order to explain why it saw a window of opportunity for more aggressive pricing.

In addition to this core mechanism, earnings calls offer many examples of firm executives referring to the two feedback loops displayed in Figure 1. In the following statement, a pizza delivery company executive explains how industry-wide supply constraints reinforce the coordinating effect of the cost shock:

> [A]cross the industry [we] continue to see some of these staffing challenges and labor cost increases which do result in higher delivery fees. [...] [I]t is an open question as to how much more switching we might see when the cost of delivery continues to rise for consumers. So those are some of the things that we're obviously thinking about and testing here. (Domino's Pizza, Q4 2021)

While they take it as a given that supply constraints and cost increases result in higher delivery fees, they also point to the limits of such pricing strategies on the demand side. This brings us to the third, frequent explanation of pricing opportunities that references customers' "understanding" for price increases. Firms navigate prices as part of their relationships with their customers. If price hikes appear illegitimate, firms risk losing customers. This phenomenon has been widely observed by market analysts and dubbed "excuseflation" (Alloway and Weisenthal, 2023). Knowing that customer attitudes were permissive towards cost increases reassured corporate managers that they could raise prices without losing market share. For example, an office equipment manufacturer explained:

> [C]ustomers generally understand, right? So we've had little pushback. [...] [M]ost of our customers have worked with us and those prices—those price increases have been passed on. (Boxlight Corporation, Q4 2022)

A software company explained that this knowledge also informed how they interpreted the behavior of competitors:

> [W]e're planning on raising our prices to be able to cover our increased cost. And I think our customers understand that, that's what's happening across the board for *almost all of the vendors,* and we're no different. (SS&C Technologies Holdings, Q1 2022)

In business-to-business relationships, customers' understanding for price increases can also derive from their own experience. As an IT manufacturing company explained, many of their business customers were facing the same cost shock:

> [W]e have also been communicating that we're going to pass these increased costs to our customers. And so far, we have not had a single customer that declined to take the business. And they're seeing the same thing that prices are going up across the board. (Viavi Solutions, Q1 2022)

The combined coordinating effect of this mechanism and feedback loops can be illustrated by considering companies that were initially reluctant to increase prices. A restaurant chain-owning company, for example, explained that, at first, it was cautious to raise prices:

> [W]e chose to take a different tack than many during the pandemic. We kind of held prices, and we wanted to just make sure that we were supporting consumers fully. (Brinker International, Q3 2021

However, by the summer of 2021, the cost shock had created a "permission" to price that allowed the firm and its competitors to use their already existing "ability to price":

> We're very aware of what's going on in the industry, and you're seeing some fairly aggressive moves on pricing. [...] I think there is an ability to price and *a permission* in the short run to price. (Brinker International, Q3 2021)

This quote also shows that firms acknowledge that the coordinating effect of cost shocks is temporary: a window of opportunity opens and closes. As the same restaurant chain continued, the described conditions would not last forever: "[Y]ou got to be careful about over time, getting out ahead of the consumer and changing the value dynamics of your brands."

Yet, companies are well aware that, when the shock eases, falling costs present another opportunity for profit increases. Firms expect a windfall profit once the cost shock eases, since they do not plan on lowering prices. A hotel chain spelled spelled this out as follows:

> With input costs going up, labor costs going up and all of those fun things, they're going to be – margins are going to be higher because rate is going to be a lot higher ultimately *when we get past this* for all the reasons I talked about in terms of the pricing power that we have and the broader inflationary environment. That's very helpful to the business. (Hilton Worldwide Holdings Inc., October 2021)

In sum, our qualitative analysis illustrates how cost shocks coordinate price hikes: firms expect their competitors to increase prices while the shock lasts and hence feel safe to do the same. Supply constraints further enhances firms' confidence in increasing prices since they ease competitive pressures on market shares. On the demand side, companies care about the legitimacy of price increases and argue that shocks create an environment of permissiveness. Companies expect windfalls when costs eventually come down, since they do not lower prices symmetrically.

6 Conclusion

This paper makes three contributions to the literature. First, we assess the recent academic debate about the role of profits in inflation. We show that recent empirical evidence is broadly consistent with sellers' inflation. A common misunderstanding in the literature is that sellers' inflation implies that price increases should correlate with markup increases across the board. However, sellers' inflation only requires prices and markups rising together for some upstream sectors such as oil and gas, commodities, and shipping at the *impulse* stage, whereas changes in markups can be heterogenous at the *propagation* stage as firms react to cost shocks. As a matter of accounting, when firms protect markups against rising costs, an increase in unit profits follows.

Second, we provide descriptive evidence in support of the hypothesis that economy-wide cost shocks function as implicit coordinators for price-making firms to hike prices, which translates supply shocks and commodity market fluctuations into price increases across sectors. In the absence of coordination, price-making firms risk losing market share when they increase prices. But economy-wide cost shocks signal to all firms that this is the moment to increase prices and thus coordinate pricing while the window of opportunity s open. If supply constraints occur in addition to cost shocks, that can further strengthen the coordination signal.

To test the cost shock coordination hypothesis, we exploit the fact that, absent economy-wide cost shocks, when individual firms are hit by cost shocks only affecting their business but not that of their competitors, they tend to absorb cost increases to protect their competitive position. From this it follows that we expect firms to express negative sentiments in relation to firm-specific cost increases in the absence of economy-wide shocks and more positive sentiments towards cost increases in the presence of economy-wide cost shocks. We use sentiment analysis on earnings calls of publicly listed U.S. firms to demonstrate that this is the case, finding a positive correlation between a Cost Increase Sentiment Index constructed via traditional dictionary-based NLP-methods and an economy-wide intermediate input price index from the BEA. We confirm the robustness of these results by replacing the dictionary-based sentiment index with one constructed via a ChatGPT4 prompt, as well constructing our own indicator of input price movements.

Third, whereas the existing literature has used NLP and LLM-constructed indexes primarily for descriptive purposes, we feed variables created from earnings calls into regressions that test our theory. This paper also presents a newly compiled dictionary and combines established NLP methods with qualitative analysis and a novel use of LLMs. The new sentiment indexes measure corporate executives' sentiment towards cost increases, the prevalence of supply constraints, and changes in demand. A common challenge in standard NLP methods is to account for context. We address this by using LLMs to capture the different meanings of a word in different sentences which improves the robustness of sentiment analysis.

As an avenue for future work, our Cost Increase Sentiment Index might be useful to inform inflation forecasting. Visual inspection of our descriptive results suggests the co-movement of the input price index and the Cost Increase Sentiment Index appear to lead movements in the CPI (Figure 6).

Our findings have important policy implications. It follows from our analysis that firms are not likely to absorb cost shocks as long as they can expect competitors to hike prices. In a world of climate change, geopolitical tensions, deglobalization, and pandemics, price spikes in systemically significant sectors are likely to recur. Beyond tackling the root causes of these crises, two sets of policies are necessary to prepare for future shocks and contain the risk of renewed bouts of sellers' inflation. First, measures should be taken to reduce price volatility in critical upstream sectors to prevent economy-wide cost shocks in the first place (Weber et al., 2024). This can include physical and virtual buffer stocks that conduct counter-cyclical open market operations to stabilize spot and future prices. Such buffer stocks could be multilayered, operating on the international, regional, and domestic level (Weber and Schulken, 2024). Greater regulation and oversight, sector investigations, and antitrust enforcement in too-essential-to-fail sectors can further help contain sharp price increases. Price controls can be an emergency measure of last resort, if other stabilizaiton efforts fail.

Second, policy measures can be implemented to impose a potential cost on firms that excessively hike prices in response to cost shocks. If firms fear being penalized for markup-protecting price hikes, they can no longer be sure that their competitors will ramp up prices, and the coordinating effect of cost shocks is weakened. Tax on inflation policy (TIP), which require firms to pay a tax proportional to the increase in their prices (Capelle and Liu, 2023), would be the most direct tool to weaken the coordinating mechanism. Price gouging laws are another relevant tool, as firms who hike prices risk being found to have increased prices excessively, leading to penalties and reputational costs. Sectoral inquiries and the prosecution of tacit collusion can also impose costs on firms in ways that undermine the coordination effect of cost shocks.

Containing the risk of future bouts of sellers' inflation by installing a new toolbox of preparedness measures reduces the reliance on interest rate hikes and can contribute to enhancements in supply chain resilience (Van 't Klooster and Weber, 2024). Higher interest rates increase the cost of investments urgently needed to tackle the climate crisis and can thus increase the risk of future shocks (Schmidt et al., 2019; Chen and Lin, 2024). Weakening the coordinating effect of cost shocks and supply constraints with appropriate policy can enhance firms' incentives to invest in resilience. When firms have to fear losses due to cost shocks and supply constraints, they expect investments in supply chain resilience to pay off. If, on the other hand, firms expect supply bottlenecks and cost shocks to increase or at least not harm profitability, such private investments are less likely to come forward.

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Appendix

A Additional summary statistics

Table 6: Number of firms and combined revenue per industry

BEA Code	Industry Description	Number of Companies	% of Total	Revenue (USD bn)	% of Total
334	Computer and electronic products	554	11	15,690	9
42	Wholesale trade	152	3	13,882	8
524	Insurance carriers and related activities	139	3	13,691	7
324	Petroleum and coal products	32	1	12,883	7
4A0	Other retail	195	4	12,822	7
452	General merchandise stores	27	1	11,498	6
325	Chemical products	776	16	11,033	6
513	Broadcasting and telecommunications	139	3	10,177	6
311FT	Food and beverage and tobacco products	106	2	8,122	4
3361MV	Motor vehicles, bodies and trailers, and parts	78	2	6,586	4
514	Data processing, internet publishing, and other information services	436	9	6,338	3
22	Utilities	119	2	6,016	3
3364OT	Other transportation equipment	48	1	5,194	3
333	Machinery	164	3	4,622	3
621	Ambulatory health care services	99	2	3,912	2
511	Publishing industries, except internet (includes software)	208	4	3,022	2
445	Food and beverage stores	16	0	2,437	1
486	Pipeline transportation	60	1	2,411	1
481	Air transportation	28	1	2,180	1
322	Paper products	36	1	1,965	1
23	Construction	71	1	1,947	1
487OS	Other transportation and support activities	14	0	1,947	1
441	Motor vehicle and parts dealers	23	0	1,855	1
722	Food services and drinking places	72	1	1,635	1
5415	Computer systems design and related services	102	2	1,617	1
213	Support activities for mining	64	1	1,613	1
561	Administrative and support services	86	2	1,575	1
331	Primary metals	38	1	1,539	1

Table 6: (continued)

BEA Code	Industry Description	Number of Companies	% of Total	Revenue (USD bn)	% of Total
315AL	Apparel and leather and allied products	52	1	1,523	1
5412OP	Miscellaneous professional, scientific, and technical services	129	3	1,522	1
332	Fabricated metal products	60	1	1,321	1
339	Miscellaneous manufacturing	160	3	1,321	1
622	Hospitals	21	0	1,306	1
335	Electrical equipment, appliances, and components	94	2	942	1
721	Accommodation	29	1	931	1
532RL	Rental and leasing services and lessors of intangible assets	60	1	835	0
326	Plastics and rubber products	26	1	736	0
482	Rail transportation	7	0	722	0
484	Truck transportation	23	0	721	0
512	Motion picture and sound recording industries	23	0	525	0
562	Waste management and remediation services	22	0	478	0
483	Water transportation	18	0	446	0
321	Wood products	20	0	389	0
327	Nonmetallic mineral products	19	0	325	0
337	Furniture and related products	20	0	324	0
323	Printing and related support activities	13	0	282	0
713	Amusements, gambling, and recreation industries	42	1	247	0
111CA	Farms	11	0	225	0
81	Other services, except government	19	0	209	0
623	Nursing and residential care facilities	15	0	193	0
61	Educational services	30	1	189	0
313TT	Textile mills and textile product mills	7	0	168	0
711AS	Performing arts, spectator sports, museums, and related activities	10	0	131	0
485	Transit and ground passenger transportation	5	0	89	0
624	Social assistance	2	0	21	0
113FF	Forestry, fishing, and related activities	1	0	11	0
5411	Legal services	3	0	7	0
–	**Total**	**4,823**	**100**	**184,350**	**100**

Table 6: (continued)

BEA Code	Industry Description	Number of Companies	% of Total	Revenue (USD bn)	% of Total

Notes: Number of firms and their combined revenue for the period 2007-Q1 to 2022-Q2 per industry (BEA classification). Column 4 shows the industry's percentage of the total number of firms (4,823), and column 6 of the total combined revenue (USD 184,350 billion).

B Dictionary construction

Below is the full dictionary of positive and negative words constructed with the methodology described in Section 4.2.1:

Negative qualifiers	Positive qualifiers
affected, brunt, challenge, challenged, challenging, concern, consolidation, constrained, contraction, decline, deleverage, deterioration, detractor, difficult, disrupted, disruptions, down, drag, expensive, frustrating, gap, hard, headwinds, hurdle, impacting, impacts, incur, issue, issues, limited, lost, lower, missed, mitigate, negative, negatively, outages, pressure, pressured, pressures, problem, recovery, shortages, sobering, squeeze, storm, struggle, swallow, tough, unavailable, under-absorbed, unfortunately, unplanned, unprecedented	able, accommodate, achieve, achieving, advantage, agile, amazing, assuming, benefit, benefits, better, build, bullish, capitalize, carry, climbs, comfortable, committed, competitive, confident, consistently, continue, continued, cultivate, decent, delivered, delivering, effectively, efficiency, efficient, exciting, executed, executing, expand, expansion, favorability, favorable, fine, fortunate, forward, good, great, grow, growing, grown, growth, happy, health, healthy, high, higher, highly, improve, improved, improvement, improves, leader, leverage, maintain, manage, manageable, managed, managing, maneuver, nice, nicely, offset, opportunities, opportunity, optimistic, performance, performed, pleased, positive, preserving, profitability, progress, recover, recovery, relationships, reliable, resilient, responsive, robust, saving, solid, stabilize, stabilized, strength, strong, stronger, strongest, success, successful, successfully, sustain, sustainable, synergies, synergy, tailwind, value, well, world-class

C ChatGPT4 prompt

Below is the full prompt submitted to the OpenAI API to construct the GPT-based Cost Increase Sentiment Index described in Section 4.2.1:

> You are tasked with conducting a sentiment analysis on a series of concatenated earnings call paragraphs. Your objective is to evaluate the sentiment of the managers towards input cost increases, which are defined as the additional costs incurred in the market to produce its goods or services, such as raw materials, labor, and energy. In this analysis, it is important to note that companies may be optimistic about cost increases because they are able to handle them and potentially increase prices as a result. You will be provided with a paragraph and your task is to return a sentiment score ranging from -3.0 to 3.0, where -3.0 indicates a very negative sentiment, 0.0 represents a neutral sentiment, and 3.0 signifies a very positive sentiment. It is important that you use only numeric values, including decimals if necessary, to express the sentiment score. Do not include any strings or text in your output, such as “sentiment score: 3.0”. Simply return the numeric sentiment score.
>
> Here are some examples of paragraphs and their corresponding sentiment scores, taking into account the idea that companies may be optimistic about cost increases:
>
> - “We have seen significant increases in the cost of raw materials and other inputs, but we have been able to pass these costs onto our customers without any issues.” (3.0)
>
> - “While input costs have risen, we have been able to offset these costs through increased efficiency and productivity, and we are confident in our ability to continue to do so.” (2.0)
>
> - “Input costs have remained stable, but we are prepared for any potential increases and have plans in place to mitigate their impact.” (1.0)
>
> - “Cost increases have been a challenge, but we have been able to work with our suppliers to find cost-saving solutions and maintain our profitability.” (1.0)
>
> - “We have seen significant cost increases in our supply chain, and while we have been able to absorb some of these costs, we may need to raise prices in the future.” (0.5)
>
> - “Cost increases have been significant and have had a negative impact on our margins. We are exploring ways to mitigate these costs, but it may be a challenge.” (-2.0)

D Manual index validation

To further verify that the dictionary-based Cost Increase Sentiment Index meaningfully captures firm sentiment towards increases in costs, two researchers read a random sample of positively and negatively scored passages containing the phrase “cost increase” and manually assigned a positive or negative score based on their own interpretation of the passage. The results are summarized in Table 7.

Table 7: Cost Increase Sentiment Index Validation

	Passages Expressive of Sentiment	Correct Positive/Negative Score
Positively Scored Passages		
Researcher 1	60.8% (62/102)	93.5% (58/62)
Researcher 2	61.1% (33/54)	87.9% (29/33)
Negatively Scored Passages		
Researcher 1	50.8% (62/122)	85.5% (53/62)
Researcher 2	57.4% (35/61)	85.7% (30/35)

Notes: The table shows statistics relating to the manual validation of positive and negative sentiment scores for the Cost Increase Sentiment Index. Two researchers read samples of earnings calls fragments which were scored positively (Rows 1-2) and negatively (Rows 3-4) by the dictionary-based sentiment index. The first column shows the percentage of fragments where the researchers identified a clear expression of sentiment towards cost increases (number of fragments with clear expression identified / number of fragments read). Out of those fragments with a clear expression of sentiment, the second column shows the percentage of fragments for which the researchers assigned the same sentiment (positive or negative) as the dictionary-based index (number of fragments with same sentiment assignments / number of fragments the researcher identified as clearly expressive of sentiment).

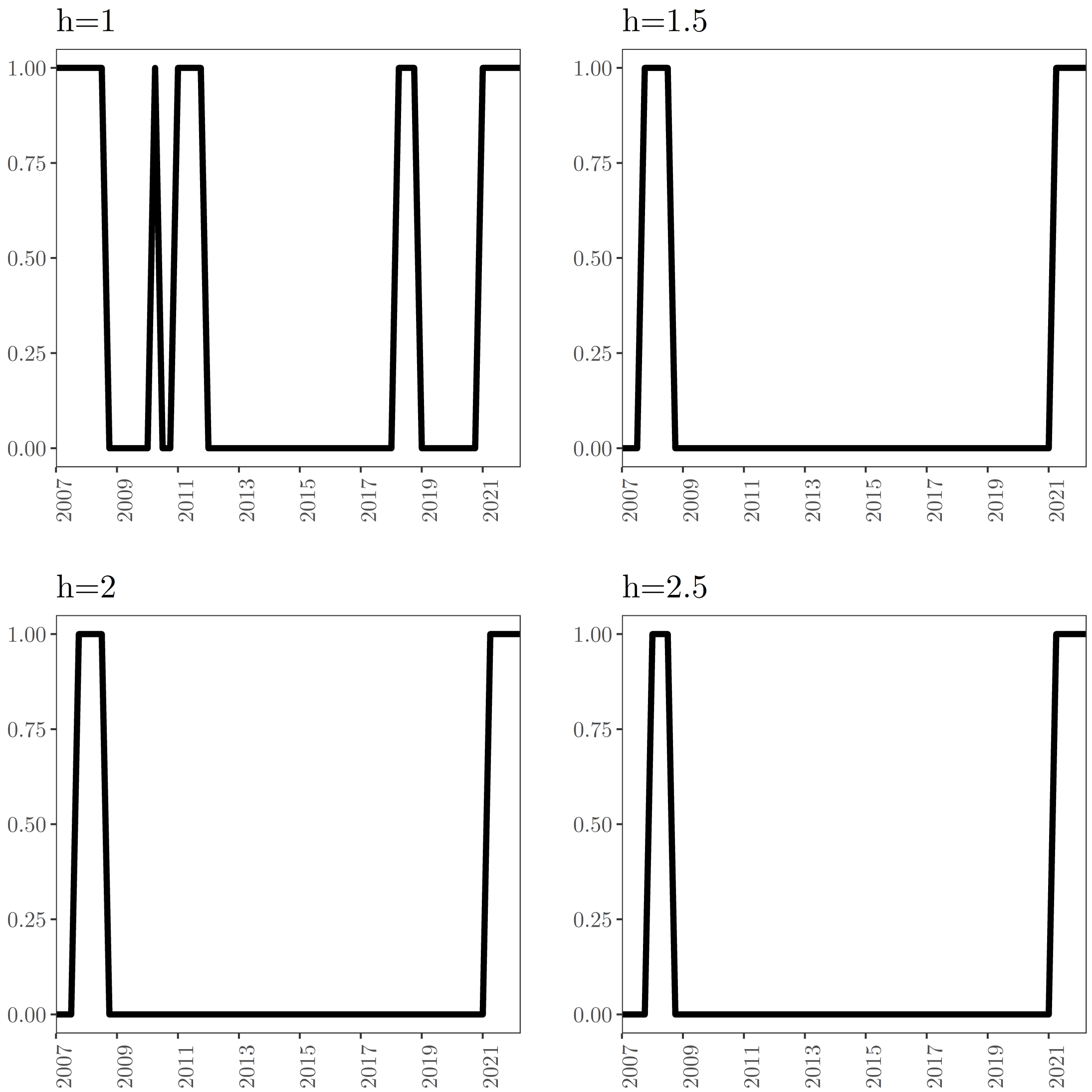
The first column of Table 7 shows the percentage of passages where the researchers identified a clear expression of sentiment towards cost increases. This means that not all passages containing the phrase "cost increase" provided sufficient context for firm executives to convey their attitudes about rising costs or their ability to pass these costs on to consumers. This limitation highlights a challenge inherent in dictionary-based NLP methods, which may struggle to account for nuanced context. Specifically, our researchers determined that approximately 61 percent of the positively scored passages clearly expressed a sentiment related to cost increases, compared to about 50 to 57 percent for the negatively scored passages.

On the other hand, among the passages where researchers identified a clear expression of sentiment, the second column of Table 7 demonstrates that their sentiment assessments closely aligned with those generated by the dictionary-based sentiment index. Our researchers assigned the same sentiment as the dictionary-based index for 88 to 93 percent of positively scored passages and 85 percent of negatively scored passages. This validation indicates that our manually-constructed dictionary is largely successful in determining whether a positive or negative sentiment is expressed when the phrase "cost increase" is used in a context where corporate executives are expressing their perceptions of their ability to pass on increases in costs.

E Cost shock dummy variables

In this section, we replicate the regression results in Section 5.1.2, but replace the continuous BEA Input Price percent change variable with a binary cost shock variable. The binary cost shock variable takes on a value of 1 when a positive annual percent change in the BEA Input Price Index is greater than h times the standard deviation of annual percent changes in the index in periods prior to the quarter, where h is a threshold we define.[22] Figure 7 provides time series of the cost shock dummy variable when $h = 1$ (top left), $h = 1.5$ (bottom left), $h = 2$ (top right), and $h = 2.5$ (bottom right).

FIGURE 7: Cost shock dummy variables



Notes: Cost shock dummy variables, where cost shocks are defined as 1 when the annual percentage increase in the BEA Input Price Index is more than h times the standard deviation of annual input price percent changes over past periods, with $h = 1$ (top left), $h = 1.5$ (bottom left), $h = 2$ (top right), and $h = 2.5$ (bottom right).

[22]As our hypotheses correspond to firms responding to what they *perceive* to be shocks, perceptions can only be based on prior experiences. The standard deviation of annual percent changes in the BEA Input Price Index is therefore taken with respect to prior time periods so that our definition of shocks to input prices do not take future information into account. The chain-type price indexes for intermediate inputs are available quarterly dating back to 2005 and only annually between 1997-2004. For each observation, the standard deviation of annual percent changes in the BEA Input Price Index is therefore taken for all years between 1997-2004 and all quarters from 2005-Q1 up to the quarter of the observation. Input price changes in quarters prior to the time period corresponding to our earnings calls data set are included in these calculations so that our definition of shocks is not biased to price changes that occurred in that period alone. Otherwise, the standard deviation of input price changes in the initial quarters of our data set would be based on very few observations.

Table 8 (9) show regression results corresponding to Equation 4 where $\Delta\text{InputPrice}_t$ is replaced with a cost shock dummy variable CostShock_t where h is 1 and 1.5 (2 and 2.5). Since the cost shock dummy variables only take values of 0 or 1, we exclude specifications corresponding to Equation 3, which includes a squared term. The use of a dummy variable for cost shocks in essence conducts the same test as Equation 3: whether large economy-wide cost shocks are associated with more positive sentiment towards cost increases. In all specifications, the results are broadly in line with those of Table 4: the cost shock dummy variables as well as the Demand Index are positively correlated with the Cost Increase Sentiment Index. In several specifications, the coefficients on the cost shock dummy variables are near values of 1, indicating that quarters in which a cost shock is present are on average associated with an increase in the Cost Increase Sentiment Index by one full standard deviation.

Table 8: Cost Increase Sentiment Index regression on cost shock dummy variables ($h = 1$ and $h = 1.5$)

	Cost Increase Sentiment Index_t (z-score)					
	(1)	(2)	(3)	(4)	(5)	(6)
Cost Shock_t ($h = 1$)	1.568*** (0.207)	1.309*** (0.322)	1.416*** (0.417)			
Cost Shock_t ($h = 1.5$)				1.964*** (0.085)	1.625*** (0.313)	2.180*** (0.229)
Supply Constraints Index_t (z-score)			−0.051 (0.305)			−0.460** (0.219)
Cost Shock_t ($h = 1$) * Supply Constraints_t			0.058 (0.259)			
Cost Shock_t ($h = 1.5$) * Supply Constraints_t						−0.070 (0.126)
Demand Index_t (z-score)		0.253 (0.158)	0.235 (0.227)		0.370*** (0.139)	0.597** (0.237)
Constant	−0.531*** (0.080)	−0.443*** (0.115)	−0.451*** (0.139)	−0.285*** (0.096)	−0.236* (0.129)	−0.196 (0.172)
Observations	62	62	58	62	62	58
R^2	0.559	0.608	0.659	0.486	0.609	0.678
Adjusted R^2	0.552	0.595	0.633	0.478	0.595	0.654

Notes: In all columns the regressand is the dictionary-based Cost Increase Sentiment Index, and the primary independent variable of interest is a cost shock dummy variable, where cost shocks are defined as 1 when the annual percentage increase in the BEA Input Price Index is more than h times the standard deviation of annual input price percent changes over past periods. Row 1 (Row 2) refers to the cost shock dummy variable when $h = 1$ ($h = 1.5$). Row 3 refers to the dictionary-based Supply Constraints Index. Row 4 (Row 5) refers to the interaction between the $h = 1$ ($h = 1.5$) cost shock dummy variable and the Supply Constraints Index. Row 6 refers to the dictionary-based Demand Index. Columns 3 and 6 correspond to Equation 4. All regressions use Newey-West standard errors. *p<0.1; **p<0.05; ***p<0.01

Table 9: Cost Increase Sentiment Index regression on cost shock dummy variables ($h = 2$ and $h = 2.5$)

	Cost Increase Sentiment Index$_t$ (z-score)					
	(1)	(2)	(3)	(4)	(5)	(6)
Cost Shock$_t$ ($h = 2$)	1.964*** (0.085)	1.625*** (0.313)	2.180*** (0.229)			
Cost Shock$_t$ ($h = 2.5$)				1.955*** (0.098)	1.583*** (0.345)	2.180*** (0.229)
Supply Constraints Index$_t$ (z-score)			−0.460** (0.219)			−0.460** (0.219)
Cost Shock$_t$ ($h = 2$) * Supply Constraints$_t$			−0.070 (0.126)			
Cost Shock$_t$ ($h = 2.5$) * Supply Constraints$_t$						−0.070 (0.126)
Demand Index$_t$ (z-score)		0.370*** (0.139)	0.597** (0.237)		0.382*** (0.140)	0.597** (0.237)
Constant	−0.285*** (0.096)	−0.236* (0.129)	−0.196 (0.172)	−0.252** (0.126)	−0.204 (0.133)	−0.196 (0.172)
Observations	62	62	58	62	62	58
R^2	0.486	0.609	0.678	0.436	0.566	0.678
Adjusted R^2	0.478	0.595	0.654	0.427	0.552	0.654

Notes: In all columns the regressand is the dictionary-based Cost Increase Sentiment Index, and the primary independent variable of interest is a cost shock dummy variable, where cost shocks are defined as 1 when the annual percentage increase in the BEA Input Price Index is more than h times the standard deviation of annual input price percent changes over past periods. Row 1 (Row 2) refers to the cost shock dummy variable when $h = 2$ ($h = 2.5$). Row 3 refers to the dictionary-based Supply Constraints Index. Row 4 (Row 5) refers to the interaction between the $h = 2$ ($h = 2.5$) cost shock dummy variable and the Supply Constraints Index. Row 6 refers to the dictionary-based Demand Index. Columns 3 and 6 correspond to Equation 4. All regressions use Newey-West standard errors. *p<0.1; **p<0.05; ***p<0.01

In contrast to Table 4, the coefficients on the Supply Constraints Index and the interaction between the cost shock dummy variables and the Supply Constraints Index in Tables 8 and 9 are not statistically significant. This does not necessarily indicate, however, that the combination of economy-wide cost shocks and supply constraints does not have an association with a heightened ability to pass on increases in costs. For example, Figure 7 shows that the cost shock dummy variable (e.g. $h = 1.5$) is 1 in two periods: 2008 and the pandemic inflation. In both cases, the Cost Increase Sentiment Score is high (Figure 6), hence there is a positive coefficient on the cost shock dummy variable alone. The interaction term between cost shocks (Figure 7) and supply constraints (Figure 4) would have a positive significant coefficient if the sentiment score was *higher* in the period when both the cost shock is 1 and the Supply Constraints Index is high, as compared to when the cost shock variable is 1 and the Supply Constraints Index is low. However, the sentiment score is roughly equally high in both periods. We therefore conclude that the statistical evidence demonstrating that the combination of broad cost shocks and supply constraints provides a stronger implicit coordinating mechanism (Hypothesis 2) than cost shocks alone (Hypothesis 1) is not as robust. Nonetheless, our qualitative analysis indicates that this may be the case. Further research and a dataset spanning a broader time period would be fruitful to find more robust results.