

Discussion
Firm-Level Input Price Changes and Their Effects:
A Deep Learning Approach

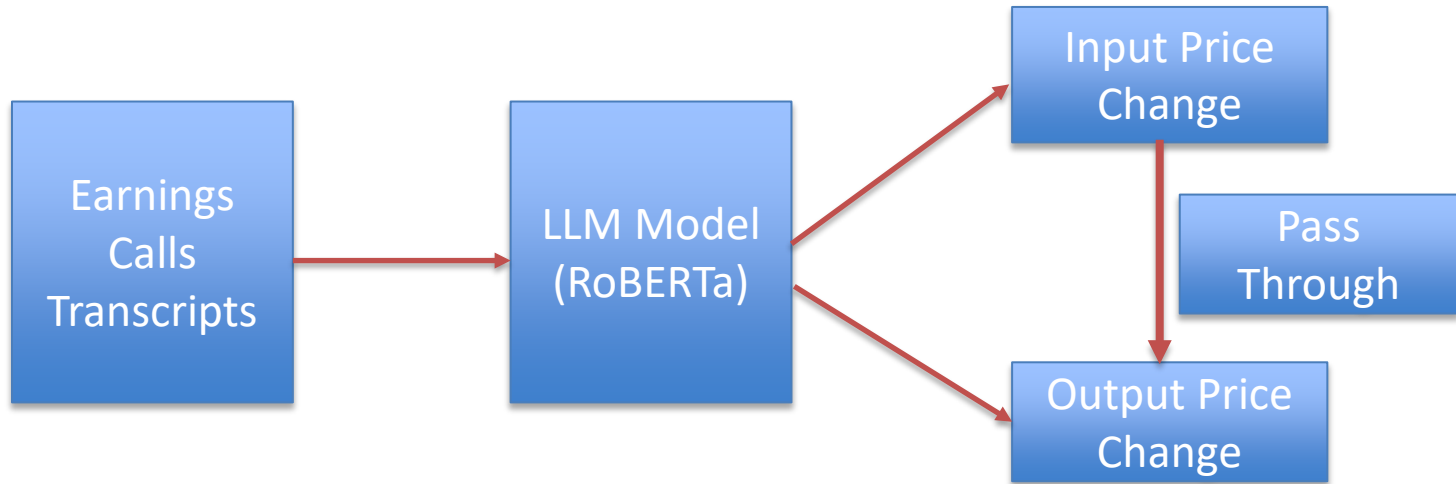
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ABFER 2025

Paper Presented At

- AFA, CICF, CFEA, CETAFE, FMA, MFA, SITE, Swedish House of Finance Conference, UF Conference, UT Dallas Conference
- Babson, Florida State, Georgia Tech, Texas A&M, Miami

Overview



Pass through: how much of a cost shock (e.g., input price, tariff, tax) gets transmitted to the final retail price?

Paper in one slide

- Novel, large-scale **text-based measures** of firm-level **input and output price changes** using **deep learning** on earnings call transcripts
- **Extract firm-level input and output price change measures** across 15 years (2007–2021) using RoBERTa fine-tuned on hand-labeled data.
- Document **five stylized facts**:
 1. Median firm sees **input price increase every 7 months, decrease every 30 months**.
 2. Input price changes contain **both aggregate and firm-specific components** (each ~50%).
 3. Average **pass-through** of input to output price: **0.55 in same quarter**, declines thereafter.
 4. Input price changes **predict future COGS**.
 5. **Stock prices fall** (–37 bps CAR) with input cost increase mentions, suggesting a negative investor response.

Motivation

- Traditional IO theories predict how cost shocks affect pricing and pass through
- **Problem:** But testing **pass-through** empirically at the firm level is hard
 - No good firm-level input price data
 - Output price data noisy or unavailable
- **Solution:** this paper overcomes this applying a deep learning technology on earnings calls

IO Intuition – Cournot Model

- Simple Cournot Model
- Demand: $P(Q) = a - bQ$, where $Q = \sum q(i)$
- Firm i 's profit: $\pi(i) = (P(Q) - c(i)) \times q(i)$
- First-order condition:
- $q(i) = (a - c(i) - b Q(-i)) / (2b)$
- **When $c(i) \uparrow$, then $q(i) \downarrow \rightarrow Q \downarrow \rightarrow P \uparrow$**

IO Intuition - The Role of Market Power

- A cost increase $\Delta c(i)$ **reduces** the firm's optimal quantity
- In response, **market price increases**
- But
 - In **competitive industries** ($P \approx MC$), each firm adjusts aggressively -> **higher pass through**
 - In **concentrated industries** ($P \gg MC$), strategic restraint -> **lower pass through**
- In equilibrium: **market structure affects the pass-through rate**

Empirical Design & Main Results

Equation (4): Input Price Change Measure

$$\text{InPrChg}_{i,t} = \frac{\# \text{InputUp}_{i,t} - \# \text{InputDown}_{i,t}}{\# \text{Sentences in Transcript}_{i,t}}$$

Pass-through Regression (Eq. 21):

$$\text{OutPrChg}_{i,t+h} = \theta_i + \beta_h \text{InPrChg}_{i,t} + \text{Controls} + \varepsilon_{i,t}$$

- $\beta_0 = 0.55$, significant and declining in future quarters.

Stock Price Regression (Eq. 26):

$$\text{CAR}_{i,t} = \theta_i + \beta \text{InPrChg}_{i,t} + \text{Controls} + \varepsilon_{i,t}$$

- $\beta \approx -0.37$, economically meaningful, robust across specifications.

Comments

- **Measure**
- **IO Dimensions Beyond Market Structure**

Main Measure

$$\text{InPrChg}_{i,t} = \frac{\# \text{InputUp}_{i,t} - \# \text{InputDown}_{i,t}}{\# \text{Sentences}_{i,t}}$$

- $\# \text{InputUp}_{i,t}$ = Number of sentences that mention input price increases.
- $\# \text{InputDown}_{i,t}$ = Number of sentences that mention input price decreases.
- This gives a **normalized, net intensity** of upward input cost discussions in earnings calls.

Comment 1 – Sentence Weighting

- **Consider 2 sentences:**
 - “We are seeing **slight pressure** on packaging costs.”
 - “Our input costs have **skyrocketed** across the board.”
- Measure treats all sentences that mention input price increase **equally**
 - **Skyrocketed >>> slight pressure**
- **Suggestion: Alternate measure**
 - Use a **sentiment or intensity model** to assign weights to each sentence
 - **Weights could be**
 - Adjectives (e.g., “mild” vs. “severe”)
 - Modal verbs (“may increase” vs. “are increasing sharply”)
 - $\text{InPrChg}_{i,t} = (\sum w_{i,j} - \sum w_{i,k}) / \text{\#sentences}$
 - j = input price increase sentence, k = input price decrease sentence

Comment 2 – Input Cost Categories

- **All input costs are aggregated** — no distinction between labor, raw materials, logistics, energy, etc. Reasonable first choice.
- **Suggestion: Classify sentences into broad categories**
 - “wage inflation” → **labor**
 - “steel, resin, aluminum” → **raw materials**
 - “freight, shipping” → **logistics**
- **Allows a richer pass-through model**
 - Which input component has the highest/lowest pass through?
 - Labor? Raw material?

Comment 3 – Validation with BLS Data

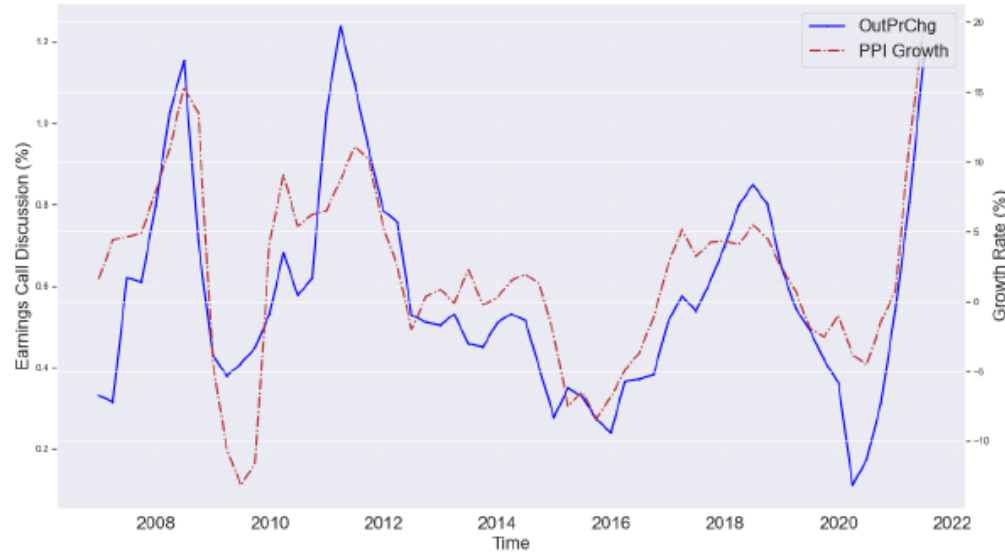
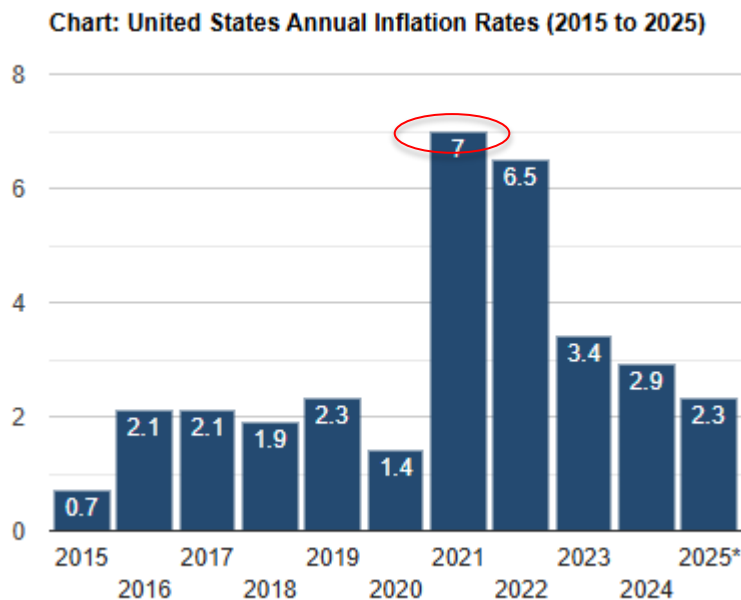


Figure 1: Aggregate PPI and the aggregate text-based output price change measure. This figure shows the year-over-year growth rate of the aggregate Producer Price Index (PPI) by commodity (all commodities) and the cross-sectional mean of the text-based aggregate output price change measure. Both lines are at quarterly frequency.

- **Correlation of with BLS data**
 - $\text{InPrChg}_{i,t}$ can't be validated as data for BLS index of input price cost begins in Dec 2018.
 - Now, you have data until March 2025.

Comment 4 – OOS Accuracy Test Over Different Inflation Regimes



- Training sample of 50 transcripts
 - Jan2021-Jun2021
- RoBERTa: in-sample accuracy around 90% over the high inflation sub-sample
- OOS test over randomly drawn statements.
- **OOS over inflation regimes**
 - **High inflation regimes**
 - **Low inflation regimes**

IO Dimensions Beyond Market Structure

- **Asymmetric Pass-Through**
- **Portfolio Effect**
- **Vertical Integration**
- **Strategic Disclosure**

Comment 5: Asymmetric Pass-Through

- **Peltzman (2000, JPE):** Firms may raise prices more easily than they reduce them.
- Split price change measures into:
 - $\ln \text{PrChg}^{\text{Up}}$
 - $\ln \text{PrChg}^{\text{Down}}$
- **Are text-based measures of pass-through consistent with Peltzman (2000)?**
- **Is the pass through coming more from $\ln \text{PrChg}^{\text{Up}}$ than $\ln \text{PrChg}^{\text{Down}}$?**

Comment 6: Portfolio Effect - Multi-Product Firms and Pass-Through Dilution

- **Gandhi, Yin (2021, AEJ):** In multi-product firms, cost shocks that affect only one product are often “diluted”
- Firm sells many differentiated products; only one product faces a cost increase
 - Firm may not fully pass through that cost increase to the consumer.
- Raising the price of one product risks losing customers not just to rivals, but to its own other products.
- **Firm’s portfolio and pass-through dilution**
 - Single-product firm => higher pass-through more likely
 - Multi-product firm => pass-through diluted
 - High substitution between products => stronger dilution (higher cannibalization risk)

Comment 7: Vertical Integration

- **Atkin, Faber, Gonzalez-Navarro (2018, QJE), Hortacsu & Syverson (2007, REStud):** vertically integrated firms show less pass-through
- When a firm owns multiple stages of production, **an input price shock can be smoothed across stages**
 - **Upstream:** raw materials, components
 - **Downstream:** assembly, retail, final sales
- **Internal transfer of prices are not market determined => dampened pass-through (Tesla?)**

Comment 8: Strategic Disclosure and Language Games

- Firms may strategically **under-report or overemphasize** price changes in calls, depending on competitive pressure or investor scrutiny.
- Transcripts have two sections
 - **Prepared Remarks:** pre-scripted management statements -> may reflect deliberate price signals
 - **Q&A Section:** analyst questions and management responses -> may capture unfiltered or spontaneous remarks
- $\text{InPrChg}^{\text{Prepared}} = (\# \text{InputUp} - \# \text{InputDown}) / \# \text{Sentences}(\text{Prepared})$
- $\text{InPrChg}^{\text{QA}} = (\# \text{InputUp} - \# \text{InputDown}) / \# \text{Sentences}(\text{QA})$
- Particularly important for price reaction

Inflation Prediction

- **Future Work: Can aggregate firm views predict macro inflation?**
 - Can inflation be predicted using deep learning tech on earnings call transcripts?
- **A different paper**
 - Integrating views of firm management across all sectors
 - Important for central banks, credit rating agencies, asset managers, financial analysts

Overall...

- **An excellent paper on pass through using deep learning tech**
- **Rich avenues for IO testing using this dataset**
- **Good luck!**