Economic Efficiency and Sectoral Dynamics: The Macroeconomic Impact of Markup-Reducing Antitrust Policies

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Abstract

This paper develops an IO–New Keynesian DSGE model to quantify how upstream antitrust that compresses markups propagates through production networks. I embed a structural antitrust shock to the Dixit–Stiglitz elasticity in a parsimonious two-sector IO–Rotemberg model, map the shock into the log-markup gap used in the NK Phillips curves, and calibrate the model to standard macro and BEA moments. Using Dynare's perfect-foresight solver I report deterministic IRFs to a one-off permanent antitrust impulse and complement them with comparative steady-state calculations. The results show a permanent reduction in upstream markups produces immediate sectoral disinflation and a modest short-run contraction in downstream output and consumption, while monetary easing and lower intermediate costs gradually reverse the hit and raise downstream activity and consumption in the new steady state. Quantitatively, the path and welfare implications depend on markup persistence, IO shares, and policy responsiveness. The paper highlights that antitrust can yield lasting real gains via cost pass-through, but policymakers must weigh short-run distributional demand effects and the interaction with monetary policy.

1 Introduction

Antitrust policy has long been central to U.S. economic governance, aiming to promote competition, curb monopoly power, and reduce inefficiencies. By targeting excessive markups and dominant practices, antitrust enforcement seeks to enhance productivity, lower consumer prices, and spur innovation (Lamoreaux & Novak, 2020; Boldrin & Levine, 2019; Shapiro, 2019; Kaplow & Shapiro, 2007). Yet the effects of such policies extend well beyond the firm or sector directly targeted. Because modern production is highly interconnected, the consequences of antitrust interventions propagate across industries and through the broader macroeconomy (Philippon, 2019a; Keyte, Burke, Pakes, Schwartz, & Yurukoglu, 2018).

A central channel is through markups. Reducing markups directly lowers costs and changes relative prices, which in turn affects output, wages, and consumption patterns. For example, when an upstream industry faces a markup reduction, the benefits are not confined to its own consumers: downstream industries that rely heavily on its intermediates also gain from cheaper inputs. These gains can be substantial in sectors with high input dependence, creating indirect but economically meaningful spillovers (Blonigen & Pierce, 2016).

This interconnectedness highlights the importance of analyzing antitrust within an input–output (IO) framework that captures sectoral linkages. Standard industrial-organization approaches often focus narrowly on firm- or sector-level welfare. But to fully evaluate antitrust in an economy with dense production networks, one must trace how shocks to upstream markups diffuse across sectors, alter relative prices, and interact with aggregate demand and monetary policy.

In this paper I take a step in this direction by developing a two-sector IO–New Keynesian DSGE model with Rotemberg price-adjustment frictions to study how targeted reductions in sectoral markups, the type that follow antitrust interventions, propagate through supply chains and the macroeconomy. The central question is simple, when policymakers compress the markup share of a given sector, how do those antitrust policies travel through input–output linkages, alter downstream cost incentives, and ultimately affect sectoral output, aggregate activity, and long-run macroeconomic efficiency and welfare? A related policy question I address is how the short-run effects differ from the long-run gains once prices, factor allocations, and monetary policy adjust.

Addressing these questions, the framework embeds a structural antitrust shock, modeled as a change in the Dixit–Stiglitz elasticity that compresses upstream markups and quantifies how this propagates through production linkages and policy responses. The approach is deliberately parsimonious, allowing for clear identification of the key channels, producer surplus, cost pass-through, and monetary adjustment, while retaining the general equilibrium structure needed to assess aggregate and long-run effects.

This paper makes three contributions. First, it develops a parsimonious two-sector IO–New Keynesian DSGE model with Rotemberg price frictions that embeds an antitrust shock to upstream markups. Unlike most macro-IO studies, which focus on productivity or technology shocks, I explicitly model policy-driven changes in market power, providing a new bridge between antitrust and DSGE macroeconomics. Second, I quantify how markup reductions propagate across sectors through input–output linkages and monetary policy, showing that the short-run effects differ qualitatively from the long-run gains- a modest initial contraction in downstream activity and consumption is followed by a durable expansion as lower input costs and policy accommodation dominate. Third, by complementing impulse responses with comparative steady-state calculations, the paper provides a clean measure of long-run level changes, avoiding common misinterpretations of cumulative IRFs in models with permanent shocks.

Taken together, these contributions highlight a new role for antitrust in macroeconomic stabilization and growth. The analysis shows that policies aimed at reducing upstream markups can generate meaningful and lasting real gains, but that their short-run distributional and demand effects depend critically on sectoral linkages and the stance of monetary policy.

The paper delivers three main findings. First, a permanent compression of upstream markups produces immediate sectoral disinflation and a modest short-run contraction in downstream output and consumption. Mechanically, this arises because the upstream producer surplus and nominal receipts fall, which given the model's resource constraint and endogenous factor prices, affects equilibrium allocations in the short run. Second, over the transition, lower intermediate prices and accommodative monetary policy reverse the initial hit, and downstream marginal costs fall, real activity and consumption rise, and the economy moves to a higher real steady state once price levels and factor allocations adjust. Third, the quantitative magnitudes and welfare implications depend critically on markup persistence, input–output shares, and the monetary authority's responsiveness; these margins therefore matter for policy design.

This work connects two literatures, the macro–IO literature on production networks and shock transmission (e.g., Baqaee & Farhi, 2019; Acemoglu, Carvalho, Özdağlar & Tahbaz-Salehi, 2012; De Loecker & Warzynski,2012) and empirical or antitrust work documenting elevated markups and potential gains from competition (e.g. De Loecker, Eeckhout & Unger, 2020; Philippon, 2019b). By embedding a structural antitrust shock in a tractable NK framework, the paper clarifies the short-run distributional effects and the longer-run aggregate benefits of pro-competition policy, and it highlights the crucial role of monetary policy in shaping transitional dynamics. The remainder of the paper sets out the model, the calibration and linearization, the simulation results, robustness checks, and welfare implications.

2 Literature Review

2.1 Theoretical Foundations

Antitrust policies are designed to reduce market power, specifically through the reduction of markups that firms charge over marginal costs. Markups are typically higher in monopolistic or oligopolistic markets where firms face less competition and can set prices without significant pressure from rivals. The theoretical framework surrounding markup reductions stems from the work of economists like Paul Krugman and Edward Chamberlin, who emphasize that reducing markups leads to lower prices and increased welfare. Additionally, markup reductions can stimulate greater efficiency by increasing the incentive for firms to innovate, reduce costs, and allocate resources more effectively.

The concept of input-output analysis, first developed by Wassily Leontief, is particularly useful in understanding how changes in one sector can affect others. The input-output model captures the interdependencies between industries by showing how the output of one industry becomes the input for another. In this context, input-output analysis can be used to trace the impacts of markup reductions through various sectors of the economy, allowing policymakers to assess not only direct effects but also indirect and induced effects that might be less apparent. This interconnected view is critical for understanding the full economic implications of antitrust policies.

2.2 Antitrust Policy: Overview of U.S. Antitrust Laws

U.S. antitrust laws are designed to promote fair competition and prevent anti-competitive practices that could harm consumers and the economy. The main pieces of antitrust legislation include:

- **Sherman Antitrust Act (1890):** The Sherman Act is the cornerstone of U.S. antitrust law, prohibiting anti-competitive agreements and monopolistic practices. Section 1 outlaws contracts, combinations, or conspiracies that restrain trade, while Section 2 makes it illegal to attempt to monopolize or conspire to monopolize any part of interstate commerce.

- **Clayton Antitrust Act (1914):** The Clayton Act builds upon the Sherman Act by addressing specific anti-competitive practices that were not covered by the earlier legislation. It prohibits mergers and acquisitions that substantially lessen competition, as well as discriminatory pricing and exclusive dealing arrangements that harm competition. The Act also created the Federal Trade Commission (FTC) to oversee enforcement.

Together, these laws are intended to prevent monopolies, promote market competition, and protect consumers from anti-competitive behavior, fostering a more dynamic and equitable economy.

2.3 Empirical Studies

Several studies have explored the effects of markup reductions and antitrust policies on market competition and firm performance. For example, research by Blonigen and Pierce (2016) finds that U.S. antitrust policies have had a significant effect on reducing prices and improving efficiency in industries such as manufacturing and telecommunications. Similarly, studies by Gellhorn, Kovacic, and Calkins (2019) have analyzed the effectiveness of specific antitrust measures like price-fixing investigations and mergers, concluding that these interventions often lead to lower markups and higher consumer welfare.

However, there is limited empirical work on the broader, economy-wide impacts of these policies using input-output models. While some studies have used input-output analysis to examine the economic effects of trade or environmental policies (e.g., Miller & Blair, 2009), fewer have directly linked markup reductions to sectoral output changes through this method. A notable exception is the work of Färe and Grosskopf (2004), who used input-output analysis to evaluate the productivity gains from competition-enhancing policies, although their focus was on technical efficiency rather than markup reductions.

2.4 Research Gap

Despite the rich body of literature on antitrust policies and markup reductions, a significant gap exists in studies that combine markup reduction with sectoral interdependencies in a comprehensive input-output framework. Most existing studies focus on either sectoral output changes or the microeconomic effects of individual antitrust actions, but few integrate both perspectives. Additionally, while some research has employed input-output analysis to measure the economic impacts of policy changes, it has not fully explored how markup-reducing measures might reverberate through interlinked sectors.

This gap in the literature calls for a more detailed and integrated approach, combining theoretical insights on markup reductions with empirical input-output models to analyze sector-specific and economy-wide effects. By doing so, this study will advance the understanding of how antitrust policies shape U.S. industry dynamics and the overall economy. The findings can guide future research and policy development aimed at optimizing competition and improving economic outcomes through targeted markup-reducing interventions.

3 Data and Sources

This study relies on several key data sources to construct the input-output model and estimate the effects of markup reductions on sectoral outputs:

1. **BEA Input-Output Tables**: The Bureau of Economic Analysis (BEA) provides the detailed annual input-output tables for the U.S. economy. These tables offer information on the flows of goods and services between industries, as well as sectoral output, value-added, and intermediate input data. The most recent input-output table, typically available on a yearly or biennial basis, will be used to construct the baseline model for this analysis.

2. **Price Markup Data**: Data on industry-specific markups (i.e., firm-level data on the difference between prices and marginal costs) will be drawn from sources such as the Economic Census and sector-level studies by the Federal Reserve or Bureau of Labor Statistics. These data will allow for the quantification of markup reductions across different sectors, which will then be incorporated into the model to simulate the impacts of antitrust policies.

3. **Elasticity Estimates**: Industry-specific elasticity estimates, particularly price-elasticity of demand and supply, will be gathered from economic literature and previous studies. These estimates will inform how changes in prices due to markup reductions influence demand and production across sectors.

4. **Antitrust Data**: Information on existing and proposed U.S. antitrust policies, including those related to price-fixing, mergers, and monopolistic behavior, will be sourced from government reports and regulatory filings from agencies such as DOJ and FTC (Federal Trade Commission). This data will be used to identify the potential magnitude of markup reductions resulting from antitrust enforcement.

4 Markup Adjustments in a Leontief Input-Output Model

This section develops a Leontief input-output model to examine how adjustments in markup (gross operating surplus) within Sector X (in this case, represented as Manufacturing) influence sectoral input costs and output levels. Liu and Tsyvinski (2023) highlight that changes in sectoral markups can propagate through the input-output network, affecting both upstream and downstream industries. Specifically, reducing markups in an upstream sector decreases the sector's output prices, which benefits downstream sectors by lowering their input costs and potentially increasing their output (Liu & Tsyvinski, 2023).

Using the Supply-Use tables from the Bureau of Economic Analysis (BEA), I analyze how antitrust-induced cost reductions, through markup reductions in the upstream manufacturing sector propagate across downstream industries by recalculating the Leontief inverse.

The underlying mechanism is that lowering markups in the manufacturing sector reduces the price of manufacturing output, which, in turn, lowers input costs for downstream industries such as construction and transportation. As a result, these sectors experience reduced input costs, improving cost efficiency and enhancing their productivity (Grassi, 2017). For example, a 10% permanent reduction in manufacturing markups could lower the cost of raw materials for construction firms, enabling them to produce more at a lower cost. Similarly, transportation companies relying on manufactured vehicles and equipment would benefit from reduced capital costs, potentially leading to expanded services and increased economic output.

The analysis identifies sectors most dependent on manufacturing inputs and quantifies their responsiveness to lower input prices. By linking markup adjustments to cost-driven productivity changes, this approach highlights the broader economic implications of pricing dynamics in interdependent industries.

4.1 Markup Adjustments and the Transformation of Sectoral Costs and Output

In this analysis, I utilized the BEA 2017 input-output Supply-Use tables, covering 402 product-sector industries, to examine how adjustments in markup (gross operating surplus) in one sector (in this case, the manufacturing sector) affect the input costs and outputs for sectors that rely on manufacturing inputs. The Use Table shows how industries (columns) use inputs from other industries (rows). The following systematically outline this transformation.

4.1.1 Adjusting Markup and Identifying Dependence on Manufacturing

The analysis examines sectoral dependence on manufacturing by identifying industries that heavily rely on manufacturing inputs and assessing the impact of a reduction in markup (gross operating surplus).

The Leontief inverse is a fundamental component of input-output analysis, capturing the total economic output required to meet a unit increase in final demand. Using the BEA's industry transaction matrix, I constructed the *direct requirements matrix* (A) and derived the *Leontief inverse* (L) using the standard formula:

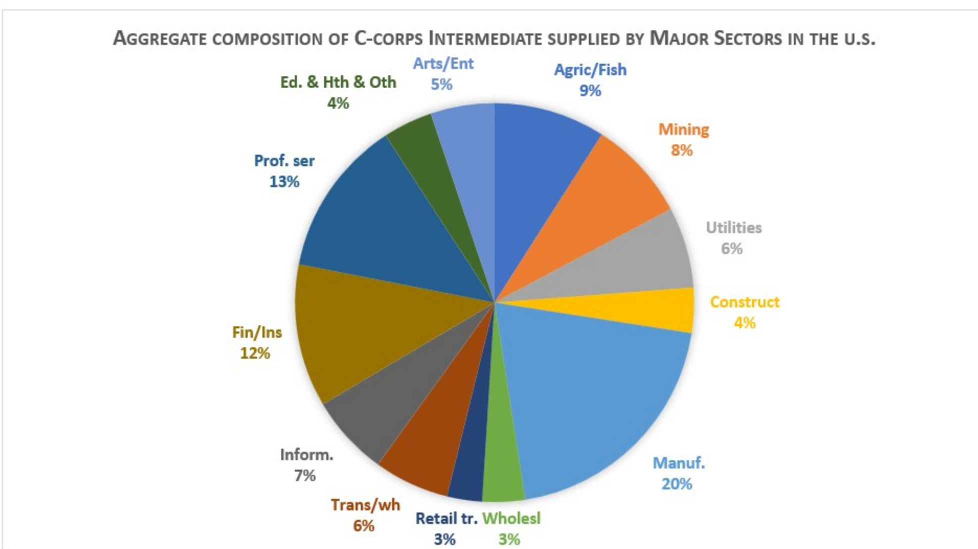
$$L = (I - A)^{-1} \tag{1}$$

where I is the identity matrix. This inverse reflects the interdependencies among sectors, showing how output in one industry responds to changes in another.

In the Use Table, the Manufacturing sector (Sector X) consists of both intermediate inputs and value-added components, including gross operating surplus (GOS), compensation of employees, and taxes on production. The values in the Manufacturing column represent the dollar amount of inputs purchased by the manufacturing sector from other sectors, whilst values in the manufacturing row indicate the dollar amount of inputs purchased by other sectors from manufacturing. Higher values indicate that a sector relies more heavily on manufacturing inputs.

Using the direct requirements table, these values represent the proportion of input required per dollar of output for each sector. Figure 1 gives clearer dependency measure in the aspect percentage of inputs sourced from manufacturing for each industry. This is done by dividing each value in the Manufacturing column by the total input purchases of that sector. I rank industries by their dependence on manufacturing to identify which sectors rely heavily on manufacturing inputs in Table 1.

Figure 1: Sectoral Dependence on Manufacturing Inputs



In an input-output framework, the Gross Operating Surplus (GOS) represents the markup or profit margin retained after accounting for other costs. Markup plays a crucial role in determining the price and cost structures of industries.

To assess how markups affect output price and cost in manufacturing, I isolated sector X *(proxied as the manufacturing sector)* and applied a shrinking adjustment factor to reflect cost reductions in this sector. Thus, hypothetically, an antitrust policy that introduces a 10% reduction in GOS effectively lowers the total cost structure of the sector, leading to a decline in manufacturing output prices.

This price reduction can have ripple effects across the economy, as sectors reliant on manufacturing inputs experience cost savings, potentially increasing demand and altering sectoral output levels. However, the extent of this pass-through depends on several factors. First, the market structure plays a crucial role, as price adjustments differ under perfect competition compared to imperfectly competitive markets where firms have pricing power. Second, manufacturing firms' responses to lower markups—such as adjusting wages, altering their use of intermediate inputs, or modifying production processes determine the magnitude and distribution of cost reductions across the economy.

4.1.2 Markup Reduction and Price Setting in Manufacturing and its Adjustment to Sectoral Input Costs

When we talk about a markup reduction, we usually mean a reduction in the price firms charge relative to their costs. To understand how a 10% reduction in Gross Operating Surplus (GOS) affects manufacturing input costs and output prices, I proceed with the following steps:

Step 1: Computation the Initial Total Cost and Output Price of Manufacturing

The total cost (C_m) of manufacturing consists of intermediate inputs, GOS, wages, and taxes on production. It is expressed as:

$$C_m = ITM_m + GOS_m + W_m + T_m \equiv TI_m$$

Where:

- C_m is the total cost of manufacturing output.
- ITM_m represents intermediate inputs—goods and services purchased by the manufacturing sector from other industries.
- GOS_m represents the gross operating surplus (markup), which is the profit margin for manufacturing.
- W_m and T_m denote wages and taxes related to labor compensation and production, respectively.
- TI_m represents total industry output of manufacturing.

This equation represents a cost structure identity, illustrating how the value of total output is allocated across its components. While "cost" is typically associated with wages and inputs, from an accounting perspective, Gross Operating Surplus (GOS) is also considered a cost component, as it reflects the return necessary to maintain capital in use. Therefore, GOS is included in the equation because national accounting conventions, as outlined in the System of National Accounts (SNA) framework, treat it as part of the overall cost structure. This ensures a complete allocation of sectoral output. However, it is important to note that this does not imply GOS directly determines the output price per unit.

The output price depends on how firms set prices relative to costs and markups. In price-setting behavior, firms apply markups over costs to determine output prices. The actual price per unit of manufacturing goods would be:

$$P_m = \frac{C_m}{Q_m} + \epsilon$$

Where:

- P_m represents the manufacturing sector's price,
- Q_m is the total industry output of manufacturing, and
- ϵ denotes the markup

Step 2: Shrinking Markup in Manufacturing by 10%

A reduction in GOS implies a decrease in markup, leading to a lower total cost of manufacturing. Applying a 10% reduction, we obtain:

$$GOS'_m = (1 - 0.1) \cdot GOS_m$$

After adjusting GOS, the updated total manufacturing cost and output price are:

$$C'_m = ITM_m + GOS'_m + W_m + T_m$$

and

$$P'_m = \frac{C'_m}{Q_m} + \epsilon$$

Since $C'_m < C_m$, this indicates that manufacturing output prices have decreased, which in turn lowers input costs for other sectors relying on manufacturing.

The underlying assumption here is that antitrust policy prevents manufacturing firms from exercising market power, requiring them to adjust by reducing their markups. In this context, firms fully pass on the cost reductions to consumers by lowering prices, while keeping output unchanged.

Step 3: Computing the Percent Decline in Total Output for Manufacturing

Note that C_m is equivalent to total industry output (TI_m), hence, to assess the impact of markup reduction, I calculated the percentage change in *total output* for the manufacturing sector. This is given by:

$$\%\Delta X = \left(\frac{C'_m - C_m}{C_m}\right) \cdot 100 \tag{2}$$

Alternatively, we can write equation (2) as:

$$\%\Delta X = \left(\frac{C'_m}{Q_m} - 1\right) \cdot 100 \tag{3}$$

using the ratio of the new manufacturing price P'_m, I then write change in output as:

$$\Delta X = P'_m - (1 + \epsilon) \tag{4}$$

I then define the reduction factor P'_i as:

$$P'_i = (1 - \Delta X)$$

where $\%\Delta X$ represents the percentage decline in manufacturing output. This reduction factor is applied to the direct requirements table to compute an updated version, which is used to recalculate the Leontief inverse:

$$L' = (I - A')^{-1} \tag{5}$$

Step 4: Adjusting Input Costs for Downstream Sectors

A reduction in markup lowers production costs for other industries dependent on manufacturing inputs. To model this, I applied the same cost-reduction factor to the input coefficients in the direct requirements matrix (A), then recalculated the Leontief inverse.

The direct requirements table (**A** matrix) quantifies the dependency of each sector on manufacturing inputs. A decrease in manufacturing prices leads to cost savings for dependent sectors. For each sector j, the new input cost is:

$$\text{New Input Cost} = \sum_i A_{ij} \times P'_i$$

where:

- A_{ij} represents the input coefficient of sector i (Manufacturing) into sector j.
- P'_i is the new, lower price for manufacturing inputs.

Since the direct requirements table structures inputs column-wise, summing over i captures the total change in input costs for sector j.

4.1.3 Impact on Output of Downstream Sectors

The total output of manufacturing (X_m) is composed of:

$$X_m = \sum Z_{mj} + Y_m$$

where:

- Z_{mj} = intermediate inputs from manufacturing to other sectors j,
- Y_m = final demand for manufacturing.

Value-added (VA_m) in manufacturing includes:

$$VA_m = W_m + \Pi_m + T_m$$

where:

- W_m = wages,
- Π_m = gross operating surplus (markup),
- T_m = taxes.

A 10% reduction in the markup (Π_m) lowers total value-added, leading to a decrease in sectoral input costs passed on to dependent sectors. The following outline systematically presents the procedure for analyzing their implications for sectoral output.

i. Propagation to Other Sectors Through Input Costs

The input-output table shows how much each sector relies on manufacturing. A reduction in manufacturing prices due to lower markups decreases the cost of intermediate inputs for dependent sectors. To analyze how these cost reductions propagate through the economy, I recalculated the Leontief inverse, tracing the resulting declines in *intermediate input costs* across industries.

The direct cost reduction for sector j due to cheaper manufacturing inputs is:

$$\Delta P_j = \alpha_{mj} \cdot \Delta P_m$$

where:

- P_j = price level or cost of inputs for sector j.
- α_{mj} = share of manufacturing inputs in sector j's total costs,
- ΔP_m = price change in manufacturing due to markup reduction.

Since markup reduction lowers the price of manufacturing outputs, the production costs for dependent sectors decline, boosting their potential output productivity.

ii. Adjusting Gross Output in Downstream Sectors

The total gross output equation for each dependent sector is given by:

$$X_j = \sum Z_{ij} + VA_j$$

where:

- Z_{ij} = intermediate inputs,
- VA_j = value-added in sector j.

If manufacturing output prices drop, sector j benefits from cheaper inputs ($\sum Z_{ij}$ declines), which increases productivity because firms can now produce more at a lower cost.

The output change for each sector j is:

$$\frac{\Delta X_j}{X_j} = -\sigma_j \cdot \frac{\Delta P_j}{P_j}$$

where:

- σ_j = elasticity of output with respect to input cost,
- $\frac{\Delta P_j}{P_j}$ = relative price change from lower manufacturing costs.

If $\Delta P_j < 0$ (costs decline), then $\Delta X_j > 0$ (output increases), showing a productivity gain in dependent sectors.

Here, I leverage the sectoral input–output tables with regression technique to quantify the output elasticity as:

$$\ln(X_j) = \alpha + \sigma_j \cdot \ln(C_j) + \epsilon_j \tag{6}$$

where:

- C_j = Input cost (cost of intermediate goods) of the downstream sector j
- ϵ_j = Error term

4.1.4 Aggregating the Economy-Wide Effects

Since multiple sectors use manufacturing as an input, the overall economy-wide effect is captured by:

$$\sum_j (\alpha_{mj} \cdot \Delta X_j)$$

where:

- α_{mj} = dependency weights of sector j on manufacturing inputs,
- ΔX_j = output increase in sector j.

Sectors with higher reliance on manufacturing (higher α_{mj}) will experience larger output increases. Nonetheless, if an antitrust policy forces the manufacturing sector to reduce its markup, the expected impact on output prices and cost transmission depends on how firms respond to the policy intervention.

While a mandated reduction in markups could lead to lower output prices, which would then propagate through the input-output matrix to other sectors that rely on manufacturing as an input, the extent of this pass-through is influenced by market structure and firm behavior.

Under perfect competition, cost reductions are more likely to be fully reflected in lower prices, ensuring a broad transmission of these effects across the economy. However, if manufacturing firms possess significant market power, they may respond strategically to the imposed markup reduction. Instead of fully lowering prices, firms might absorb the cost changes by adjusting wages, altering their input mix, or offsetting the lost markup through efficiency improvements. Consequently, the transmission of cost reductions to downstream sectors may be incomplete, limiting the broader economic impact of the antitrust intervention and highlighting the complexities of enforcing competition policy in concentrated markets.

4.2 Conclusion

In effect, lowering the markup (gross operating surplus) in manufacturing has the potential to reduce input costs for other sectors, enabling cost savings that can drive productivity improvements. However, the extent of this benefit depends on how manufacturing firms respond to the imposed reduction in markups. If firms fully pass through the cost reductions by lowering prices, downstream sectors experience direct cost savings. Yet, in markets where manufacturing firms retain pricing power, they may absorb the markup reduction through adjustments in wages, input mixes, or efficiency improvements, leading to an incomplete transmission of cost savings to other sectors.

Despite these market dynamics, the output effect depends on the degree of reliance each sector has on manufacturing inputs and their price-output elasticity. Sectors that are highly dependent on manufacturing—such as construction and transportation—are still likely to experience the most significant productivity gains, as even partial cost reductions lower their production expenses. This perspective shifts the focus from a consumption-driven final demand response to a cost-driven sectoral productivity improvement, where input cost reductions play a key role in shaping sectoral performance and overall economic efficiency.

5 Macroeconomic Model to Capture Dynamic Adjustments

While the Leontief input-output model effectively captures sectoral interdependencies and the propagation of cost changes, it remains a static framework that lacks behavioral responses and dynamic adjustments over time (Miernyk, 2020). A macroeconomic dynamic stochastic general equilibrium (DSGE) model is necessary to provide a more comprehensive explanation of these dynamics, as it accounts for firms' and consumers' optimizing behavior, market-clearing conditions, and intertemporal decision-making (Caliendo, Parro, & Tsyvinski, 2022).

Unlike the input-output model, which assumes fixed production coefficients, a general equilibrium framework can endogenize price and quantity adjustments in response to changing input costs, capturing substitution effects, investment responses, and shifts in labor and capital allocation (Fadinger, Ghiglino, & Teteryatnikova, 2022). This is crucial for understanding how lower markups in manufacturing translate into broader economic shifts, including wage adjustments, firm entry and exit, and long-term productivity growth. By integrating these dynamic feedback mechanisms, a general equilibrium model offers a more complete representation of the transmission channels driving changes in sectoral output and costs.

This section presents a New Keynesian-type general equilibrium model incorporating an input-output production network to analyze the macroeconomic effects of markup-reducing antitrust policies.

The model captures the dynamic interactions between sectors, where reductions in markup are introduced as a policy tool. By embedding sectoral interdependencies through the input-output framework, the model evaluates how these reductions influence output, costs, and overall economic efficiency, while also accounting for price adjustments and sectoral adjustments to policy changes. The results provide insights into the broader economic impacts of antitrust interventions on sectoral performance and efficiency.

5.1 The Hybrid Input-Output New Keynesian (IO-NK) Model Setup

The Hybrid Input-Output New Keynesian (IO-NK) DSGE model combines the New Keynesian macroeconomic framework with the sectoral production networks captured by the Input-Output (I-O) model. The New Keynesian model typically focuses on the macroeconomic equilibrium, incorporating key features such as sticky prices, nominal rigidities, and imperfect competition. It is often used to understand how monetary policy and shocks to aggregate demand affect output and inflation in the short run. The Input-Output (I-O) network, on the other hand, captures the interdependencies between sectors in an economy, highlighting how changes in one sector affect others through production and consumption linkages.

By embedding the I-O structure into the NK model, the IO-NK framework captures the transmission of shocks across sectors while incorporating sticky prices and wages. A key feature of this model is the inclusion of antitrust markup reduction shocks, which alter the price markup within the manufacturing firms, reflecting shifts in market power and competition policies. These shocks influence both sector-specific dynamics and aggregate economic outcomes, offering a comprehensive understanding of how changes in market structure and competition interact with macroeconomic factors like inflation, output, and employment.

5.2 Bridging Input-Output Models and the New Keynesian Framework

To bridge the New Keynesian (NK) model with the Input-Output (I-O) network, I integrate the I-O structure directly into the New Keynesian framework by modeling the sectoral production functions from the I-O model within the dynamic decision-making environment of the NK model. Rather than using a single representative production function, as in traditional NK models, the IO-NK model explicitly allows for multiple interconnected sectors that interact with each other through the input-output relationships. Each sector in the economy produces output that is used by other sectors as intermediate input, and this intersectoral dependence shapes the overall economic dynamics.

In the IO-NK model, nominal rigidities and price stickiness govern the short-term fluctuations in output and inflation, while the I-O relationships determine how shocks, such as changes in demand or supply, propagate through the economy. For instance, a shock in the demand side (like a monetary policy shock) would have a ripple effect across sectors due to the input-output linkages. Similarly, cost-push shocks, such as those resulting from changes in the price of intermediate goods due to antitrust markup reduction policy, can be modeled as sectoral price markups or supply-side disturbances, which in turn affect sectoral production and the overall inflationary dynamics.

Moreover, incorporating shocks related to market power (e.g., changes in antitrust regulations leading to markup reductions) can alter the competitive environment within each sector. These changes influence the markups charged by an upstream industry (in this case, manufacturing), which affect the cost structure in each sector and, consequently, the aggregate price level and inflation in the economy. The IO-NK framework therefore provides a deeper insight into how sector-specific policies (such as antitrust interventions) and shocks to sectoral linkages interact with broader macroeconomic conditions.

The bridge between the New Keynesian and Input-Output models can be established by embedding sectoral interdependencies into the dynamic framework of the NK model. The result is a richer two-sector framework that captures both the macroeconomic transmission of shocks and the sectoral feedback effects that arise through production linkages and market power dynamics, particularly under nominal rigidities and evolving market structures. This combination allows for a comprehensive analysis of policy interventions and external shocks that affect both individual sectors and the economy as a whole.

Below is a simplified New Keynesian DSGE model with an input–output production network to examine the impact of markup-reducing antitrust policies. The key features include Calvo price rigidities, sectoral interactions via intermediate inputs, and the propagation of markup changes throughout the economy.

Model setup

1. **Overview**

   I develop a two-sector New Keynesian model with heterogeneous firms and input–output linkages, embedding time-varying markup dynamics to capture both macroeconomic efficiency effects and sectoral spillovers. Antitrust interventions enter as shocks that reduce upstream desired markups, propagating through the IO network and affecting aggregate output, inflation, and sectoral cost structures. The main building blocks are:

   - *Households:* Maximize lifetime utility over consumption and labor supply, subject to a standard budget constraint and rational expectations.

- *Firms:* Monopolistically competitive producers in each sector set prices according to Calvo stickiness, yielding New Keynesian Phillips curves with endogenous markups.
- *Monetary Authority:* Follows a Taylor-type rule to stabilize inflation and output under rational expectations.
- *Input–Output Network:* Downstream firms use a fixed share of upstream intermediates (from an IO matrix), generating sectoral interdependencies and spillover multipliers.

The model assumes an antitrust policy compels manufacturing firms to reduce markups, but it does not necessarily eliminate market power altogether—firms may still retain some ability to set prices strategically.

2. **Model Structure**

The model explicitly incorporates sectoral heterogeneity through differences in productivity and input–output linkages—while assuming fully Calvo-type nominal price rigidities and flexible wages under rational expectations. Here, wages float so that the only nominal friction comes from firms' price-setting, making it clearer how antitrust-induced changes to markups and price rigidities propagate through the two-sector economy. The manufacturing sector initially operates under imperfect competition (e.g., monopoly, oligopoly, or monopolistic competition), allowing firms to set markups above marginal cost.

Time is discrete — denoted by t with a consumer demand side consisting of a continuum of household agents facing the same intertemporal utility maximization problem.

A. Household Optimization

In this IO–NK hybrid model, there is a representative household composed of a continuum of identical agents who live for an infinite sequence of discrete periods. In each period t, the household supplies labor L_t and earns nominal labor income W_tL_t; it then chooses consumption C_t and next-period bond holdings B_t subject to its period budget. Equivalently, after receiving wage income and any returns on previously held bonds, the household allocates available resources between current consumption and purchases of one-period nominal bonds (with gross return R_{t-1}). Their objective is to maximize expected lifetime utility, which I model using a standard constant relative risk aversion (CRRA) function in consumption:

$$\max_{\{C_t,L_t,B_t\}} \quad E_0 \sum_{t=0}^{\infty} \beta^t \Big[\frac{C_t^{1-\sigma}}{1-\sigma} - \chi \, \frac{L_t^{1+\varphi}}{1+\varphi}\Big], \quad \sigma > 1, \; \varphi \geq 0. \tag{7}$$

Here, households discount future utility by a factor $\beta \in (0,1)$. Their preferences exhibit constant relative risk aversion with coefficient $\sigma > 1$, indicating that utility is strictly increasing and concave in C_t. The disutility of labor is scaled by $\chi > 0$ with curvature parameter $\varphi \geq 0$, the inverse of the Frisch elasticity of labor supply.

Households also face the budget constraint, which includes labor income $W_t\, L_t$, and returns from holding bonds from previous period:

$$P_t^C\, C_t + B_t \;\leq\; W_t\, L_t + R_{t-1}\, B_{t-1} \tag{8}$$

where the variable B_t is the household's one-period nominal bond holdings, and P_t^C is the price index for the consumption bundle and W_t is the nominal wage.

Household optimality: Let λ_t denote the Lagrange multiplier on the household's nominal budget constraint. It is convenient to work with the time-normalized multiplier

$$\nu_t \equiv \beta^{-t}\lambda_t,$$

so that ν_t equals the marginal utility of consumption measured in consumption-good prices. Under rational expectations, the intertemporal first-order conditions imply the familiar consumption Euler equation and the intratemporal labor supply condition, while the bond FOC pins down the expected evolution of the multiplier.

1. Consumption FOC:
$$\frac{\partial \mathcal{L}}{\partial C_t} = 0 \quad\Longrightarrow\quad \nu_t \;=\; \frac{C_t^{-\sigma}}{P_t^C}.$$
2. Labor supply (real wage form).
$$\frac{\partial \mathcal{L}}{\partial L_t} = 0 \quad\Longrightarrow\quad \chi\, L_t^{\varphi} \;=\; \nu_t\, W_t \quad\Longrightarrow\quad \chi\, L_t^{\varphi} \;=\; \frac{W_t}{P_t^C}\, C_t^{-\sigma},$$

which equates the marginal disutility of labour to the marginal benefit of working (real wage times marginal utility of consumption).

3. Bond FOC and Euler equation.
$$\frac{\partial \mathcal{L}}{\partial B_t} = 0 \quad\Longrightarrow\quad \lambda_t \;=\; \beta R_t\, E_t[\lambda_{t+1}],$$

or, in terms of ν_t and the gross inflation rate $\pi_{t+1} \equiv P_{t+1}^C / P_t^C$ [1], yields the **Euler Equation for Consumption:**

$$\nu_t \;=\; \beta\, E_t\!\left[\frac{R_t}{\pi_{t+1}}\, \nu_{t+1}\right] \Longrightarrow\; C_t^{-\sigma} \;=\; \beta\, E_t\!\left[\frac{R_t}{\pi_{t+1}}\, C_{t+1}^{-\sigma}\right]. \tag{9}$$

These conditions succinctly summarize the household's optimality. The intratemporal condition pins labor supply as a function of the real wage and marginal utility of consumption,

[1] Throughout the paper, we define inflation in gross terms as $\pi_{t+1} \equiv P_{t+1}^C / P_t^C$, where P_t^C is the consumption price index. This convention is standard in dynamic macroeconomic models, including New Keynesian DSGE frameworks, as it simplifies multiplicative expressions in Euler equations and asset pricing. In empirical applications, inflation is often reported in net terms as $\hat{\pi}_{t+1} = \pi_{t+1} - 1$, which measures the percentage rate of change in prices. When calibrating or comparing to data, we convert between the two definitions as needed.

while the Euler equation governs optimal intertemporal consumption choices under nominal bonds and inflation.

In other words, the Euler equation is the household's no-arbitrage condition ensuring that holding bonds versus consuming today yields the same expected value once real returns and time preferences are accounted for. It equates today's marginal utility of consumption to the expected discounted marginal utility tomorrow adjusted by the real (inflation-corrected) return. This condition is fundamental to intertemporal consumption choice and underlies the transmission mechanism in modern DSGE models.

Labor Supply Condition: By choosing the consumption-good price index as our numéraire, and normalized to unity ($P_t^C = 1$), the real wage is $w_t = W_t$. The labor-supply condition equates the marginal disutility of supplying an extra hour of work (the loss of leisure) to the marginal benefit– namely, the real wage paid or the consumption it finances. Formally,

$$\chi L_t^{\varphi} = W_t\, C_t^{-\sigma}, \tag{10}$$

means that at the optimum, the extra utility forgone by working a bit more exactly matches the additional consumption utility financed by the higher real wage. This balance anchors labor market responses in New Keynesian models.

Bond-Pricing and Steady-State Holdings: The household's intertemporal first-order condition for the risk-free bond under rational expectations is

$$\lambda_t \;=\; \beta\, R_t\, E_t[\lambda_{t+1}], \qquad \lambda_t = U'(C_t) = C_t^{-\sigma}. \tag{11}$$

Defining the one-period bond price $q_t \equiv 1/R_t$ and using (11) yields the familiar asset-pricing relation

$$q_t = \beta\, E_t\!\left[\tfrac{U'(C_{t+1})}{U'(C_t)}\;\tfrac{P_t^C}{P_{t+1}^C}\right] = \beta\, E_t\!\left[\left(\tfrac{C_{t+1}}{C_t}\right)^{-\sigma}\;\pi_{t+1}^{-1}\right]. \tag{12}$$

In a deterministic steady state ($C_t = C^*, L_t = L^*, W_t = W^*, P_t^C = P^C,\ R^* = 1/\beta$), the period-$t$ budget constraint becomes

$$P^C\, C^* + B^* = W^* L^* + R^*\, B^* \tag{13}$$

implies

$$B^* = \frac{W^* L^* - P^C\, C^*}{R^* - 1} = \frac{\beta(W^* L^* - P^C\, C^*)}{1-\beta}. \tag{14}$$

This closed-form expression provides a natural calibration target for steady-state bond holdings in terms of the discount factor β, labor income $W^* L^*$, and consumption C^*.

Intertemporal Household Choice and IO Feedback: Although the IO block provides a static snapshot of inter-industry flows, embedding it in a New-Keynesian framework, where households and firms make forward-looking decisions, requires a lifetime utility objective. The IO table shows how a one-time markup or demand shock affects outputs and incomes in period t; the intertemporal utility function then converts those per-period consumption and labor supply outcomes into a single present-value measure of welfare.

The first-order conditions yield the household's labor-supply and consumption functions, which then feed into the input–output block. This linkage allows us to trace how markup-reducing antitrust policies alter sectoral prices and incomes, propagate through production networks, and ultimately affect aggregate demand and welfare.

B. Firms: Production Structure and Optimal Conditions

The production structure is organized as two vertically linked sectors ($i = 2$), each populated by a continuum of firms with the upstream sector ($i = U$) representing manufacturing, which produces intermediate N goods, and the downstream sector ($i = D$) representing final goods production. The downstream sector utilizes intermediate inputs from the upstream sector to produce the consumption good that ultimately reaches households.

- **Upstream (Manufacturing) Sector:** Operates as a monopolist in the production of intermediate inputs for the downstream sector, setting prices above marginal cost to reflect its market power.
- **Downstream (Final Industries) Sector:** Comprised of competitive or mildly differentiated firms that use labor and the intermediate input from the upstream sector to produce goods for final consumption in the production process.

Both sectors are embedded in a New Keynesian framework. In each of the N-good producers across the two sectors, a representative firm chooses inputs to maximize profit (equivalently, minimize cost) and produces one of the N goods. The production technology of firms in each sector exhibits constant returns to scale (CRS), meaning that scaling all inputs by a given factor leads to a proportional scaling of output.

Even though both sectors feature elements of monopolistic competition for completeness, only the upstream sector exercises monopoly power, implying that it sets prices using a markup over marginal cost. In contrast, the downstream sector is assumed to be competitive (or faces much less market power) in its use of the upstream intermediate input.

i. Upstream Sector (Manufacturing–Monopoly)

The upstream sector (Manufacturing) firms produce intermediate inputs that are used by the downstream industries, with a fixed cost Φ set as a barrier to entry and exit. It consists of firms $j \in [0, 1]$ that use labor $L^M_{j,t}$ and productivity A^M_t to produce differentiated intermediate goods:

$$Y^M_{j,t} \;=\; A^M_t \, L^M_{j,t} \tag{15}$$

Here, each manufacturing firm j produces its differentiated intermediate good $Y_{j,t}^M$ using a linear technology. This means the model assumes symmetric technology, all j-indexed firms draw on the same aggregate productivity level, so none have an intrinsic cost advantage. The term A_t^M denotes sector-wide total factor productivity (TFP) in the manufacturing sector at time t, while $L_{j,t}^M$ is the labor input employed by firm j.

Because the production function is linear in labor, this implies constant returns to scale. The real marginal cost for each firm in manufacturing is therefore simply $MC_t^M = W_t/A_t^M$, where W_t is the nominal wage (normalized by the consumption price index in real terms).

These varieties are aggregated into a composite intermediate input X_t^M, which is the aggregate demand for manufacturing intermediates:

$$X_t^M \;=\; \Big(\int_0^1 (Y_{j,t}^M)^{\frac{\theta-1}{\theta}}\, dj\Big)^{\frac{\theta}{\theta-1}}, \quad \theta > 1. \tag{16}$$

The parameter θ is the Dixit–Stiglitz elasticity of substitution governing how easily downstream producers can substitute between differentiated intermediate-good varieties j. A higher θ means goods are closer substitutes, so a small relative price change prompts a large reallocation of demand, whereas as θ approaches one, each variety enjoys greater market power and goods become poor substitutes.

This formulation ensures that downstream firms face a representative price index P_t^M for intermediate inputs, and it underlies the manufacturing sector's effective markup $\mu_t^M = P_t^M/MC_t^M$ in the upstream sector. In fact, in a Dixit–Stiglitz monopolistic-competition setup, the steady-state markup is

$$\bar{\mu} = \frac{\theta}{\theta - 1}. \tag{17}$$

so θ directly pins down the degree of upstream market power and price-cost margin, such that lager θ corresponds to more competitive pricing and lower markups. The requirement $\theta > 1$ ensures that the CES aggregator is well-behaved (finite aggregate output) and that markups are positive but finite. The use of a CES aggregator means that the demand for each variety $Y_{j,t}^M$ is

$$Y_{j,t}^M \;=\; \left(\frac{P_{j,t}^M}{P_t^M}\right)^{-\theta} X_t^M, \tag{18}$$

where $P_{j,t}^M$ is firm j's price and P_t^M is the CES price index across all j. It says that the quantity of the intermediate good produced by firm j at time t, $Y_{j,t}^M$, equals the total demand for all composite intermediates, X_t^M, scaled by the relative price raised to the power $-\theta$, in which $\left(\frac{P_{j,t}^M}{P_t^M}\right)$ is firm $j's$ price relative to the aggregate manufacturing price index, P_t^M.

Upstream Firm Optimization under Rotemberg Pricing

A representative upstream (manufacturing) firm j chooses a sequence of nominal prices $\{P_{j,t+\tau}^M\}_{\tau \geq 0}$ to maximize expected discounted profits net of quadratic price-adjustment costs, taking as given the aggregate price index P_t^M, the downstream composite demand X_t^M, wages W_t, and productivity A_t^M, and then solves

$$\max_{\{P^M_{j,t+\tau}\}_{\tau\geq 0}} \; E_t \sum_{\tau=0}^{\infty} \beta^\tau \Big[P^M_{j,t+\tau}\, Y^M_{j,t+\tau} \;-\; W_{t+\tau}\, L^M_{j,t+\tau} \;-\; \tfrac{\kappa_M}{2}\Big(\tfrac{P^M_{j,t+\tau}}{P^M_{j,t+\tau-1}} - 1\Big)^2 Y^M_{t+\tau} \Big],$$

where $\beta \in (0,1)$ is the discount factor, and $\kappa_M > 0$ governs the size of the quadratic price-adjustment penalty. The term

$$\tfrac{\kappa_M}{2}\Big(\tfrac{P^M_{j,t}}{P^M_{j,t-1}} - 1\Big)^2 Y^M_t \tag{19}$$

is the adjustment cost which is quadratic in the gross price change and scaled by aggregate manufacturing output Y^M_t, ensuring that firms internalize the real resource cost of price adjustment in units of output. It penalizes large price changes, so firms optimally smooth their pricing over time.

Formally the firm's optimization problem is subject to production technology and the standard CES-demand curve facing variety j in the upstream sector

$$Y^M_{j,t} = \Big(\tfrac{P^M_{j,t}}{P^M_t}\Big)^{-\theta} X^M_t, \quad \theta > 1, \qquad Y^M_{j,t} = A^M_t L^M_{j,t}.$$

Labor FOC (marginal cost): Differentiating the firm's period profit with respect to labor (or equivalently substituting $Y^M_{j,t} = A^M_t L^M_{j,t}$ and differentiating) yields the labor FOC and the intraperiod labor demand / marginal cost condition:

$$P^M_{j,t} A^M_t - W_t \;-\; \kappa^M \left(\frac{P_{j,t}}{P^M_{t-1}} - 1\right)^2 A^M_t \;=\; 0. \tag{20}$$

Rearranging,

$$P^M_{j,t} - \kappa^M \left(\frac{P^M_{j,t}}{P^M_{t-1}} - 1\right)^2 \;=\; \frac{W_t}{A^M_t}. \tag{21}$$

If adjustment costs are small (or ignored), this reduces to the usual marginal-revenue-product condition

$$P_{j,t} A^M_t \;=\; W_t. \tag{22}$$

Because the real marginal cost is defined as the real wage per efficiency unit of labor,

$$MC^M_t \equiv \frac{W_t}{A^M_t}, \text{ and hence } P^M_{j,t} = MC^M_t \text{ if the firm were price-taker.}$$

Since the firm sets a price above marginal cost in monopoly or markup pricing, the equality $P^M_{j,t} = MC^M_t$ will not generally hold – the price FOC below determines the markup. The labor FOC simply defines marginal cost in terms of the wage and technology.

ii. Monopolistic Behavior

Price FOC (Euler condition and Optimal Markup): In levels, using the demand elasticity

$$\frac{\partial Y^M_{j,t}}{\partial P^M_{j,t}} = -\theta \frac{Y^M_{j,t}}{P^M_{j,t}}$$

and collecting the terms that involve $P^M_{j,t}$ (the current revenue term and the adjustment costs that contain $P^M_{j,t}$ both in the current period and in the next period through the ratio in the adjustment cost), the exact (level) first-order condition can be written compactly as

$$E_t\left[(1-\theta)Y^M_{j,t} - \kappa^M\left(\frac{P^M_{j,t}}{P^M_{j,t-1}} - 1\right)\frac{Y^M_t}{P^M_{j,t-1}} + \beta\kappa^M\left(\frac{P^M_{j,t+1}}{P^M_{j,t}} - 1\right)\frac{(P^M_{j,t})^2}{P^M_{j,t+1}}Y^M_{t+1}\right] = 0 \tag{23}$$

This is the (exact) dynamic first-order condition for the reset price under Rotemberg adjustment costs. It balances (i) the marginal gain from raising the current nominal price (revenue effect, including the demand response) against (ii) the current and future marginal adjustment-cost consequences of moving the price.

The log-linearized first-order condition yields the Rotemberg Phillips curve in Equation (34) that shows current manufacturing inflation depends on the markup gap and expected future inflation, with $1/\kappa_M$ capturing the strength of price-adjustment frictions. Using the definition of the firm gross inflation as

$$\Pi_{j,t-1} \equiv \frac{P_{j,t}}{P_{j,t-1}}.$$

and using the markup / marginal-cost identity for firm j,

$$P_{j,\tau} = \mu_{j,\tau} MC_\tau, \quad (\text{for } \tau = t-1,\, t,\, t+1)$$

where $\mu_{j,t}$ denotes the firm-specific markup and MC_t denotes the aggregate (real) marginal cost in period t, and noting the useful relation that appears in the price FOC:

$$\frac{(P_{j,t})^2}{P_{j,t+1}} = \frac{P_{j,t}}{\Pi_{j,t+1}} = \frac{1}{\Pi_{j,t+1}}\,\mu_{j,t}\,MC_t,$$

and finally, dividing through by $-Y_{j,t}$ and expressing all price levels in terms of the time-varying markup $\mu_{j,t}$ and the marginal cost $MC_{j,t}$, yields the exact Euler condition for the optimal price

$$\begin{aligned} 0 \;=\; E_t\Bigg[& 1 - \theta + \frac{\theta}{\mu_{j,t}} \\ & -\;\kappa\left(\frac{\mu_{j,t}MC_t}{\mu_{j,t-1}MC_{t-1}} - 1\right)\frac{Y_t}{\mu_{j,t-1}MC_{t-1}Y_{j,t}} \\ & +\;\beta\kappa\left(\frac{\mu_{j,t+1}MC_{t+1}}{\mu_{j,t}MC_t} - 1\right)\frac{\mu_{j,t+1}MC_{t+1}}{(\mu_{j,t}MC_t)^2}\frac{Y_{t+1}}{Y_{j,t}}\Bigg]. \end{aligned} \tag{24}$$

If $\kappa = 0$ (no adjustment costs), the first-order condition collapses to

$$1 - \theta + \frac{\theta}{\mu_{j,t}} = 0,$$

which implies the familiar constant markup

$$\mu_{j,t} = \frac{\theta}{\theta - 1}, \qquad \theta > 1.$$

By contrast, when $\kappa > 0$, the condition is genuinely dynamic. The FOC no longer pins down a time-invariant markup but instead determines the optimal intertemporal path of $\mu_{j,t}$. The markup optimal path reflects the upstream monopolist's decision to price above marginal cost, but rather than relying on Calvo-style re-optimization probabilities, price changes now incur smooth, quadratic adjustment costs à la Rotemberg. In each period, any firm j that adjusts its price pays a cost proportional to the squared log-change in its price, which generates gradual price inertia without the binary "reset or not" decision.

Intuitively, with positive adjustment costs, a firm trades off the immediate marginal revenue gain from a higher markup against the contemporaneous and expected future real resource costs of changing its price. The resulting Euler-type condition selects the time-varying markup that optimally balances these forces.

Optimal Price-Setting: With a linear production technology in the upstream sector, each firm's output is directly proportional to the labor input. Hence, to produce one additional unit of output, the firm must hire an additional $\Delta L = \Delta Y^M / A_t^M$ units of labor. Since labor is the only variable input, the cost of that extra unit of output–i.e. the marginal cost–is simply the wage bill needed to generate it:

$$MC_t^M = W_t \cdot \frac{\Delta L}{\Delta Y^M} = W_t \cdot \frac{1}{A_t^M} = \frac{W_t}{A_t^M} \tag{25}$$

In other words, because the technology exhibits constant returns to labor, the marginal cost of producing one more unit is constant and equal to the wage per efficiency unit of labor, W_t/A_t^M. With market power, upstream firms price their output as a constant percentage above marginal cost. An upstream optimizing firm then chooses its price $P_{j,t}^M$ by balancing monopoly markups against quadratic adjustment costs.

Define the firm-level markup as a change of variables

$$\mu_{j,t}^M \equiv \frac{P_{j,t}^M}{MC_t^M}, \qquad \text{so} \qquad P_{j,t}^M = \mu_{j,t}^M \, MC_t^M.$$

The firm's Rotemberg Euler condition determines the optimal (generally time-varying) value or dynamics of $\mu_{j,t}^M$; it does *not* derive the identity above. In symmetric equilibrium, all upstream firms face the same marginal cost and choose the same optimal markup $\mu_{j,t}^M = \mu_t^M$ for all j, hence, each firm's optimal price under Rotemberg pricing is

$$P_{j,t}^M = \mu_t^M \, MC_t^M, \qquad \mu_t^M > 1 \tag{26}$$

Substituting this expression into the Dixit–Stiglitz price index

$$P_t^M \;=\; \Big(\int_0^1 (P_{j,t}^M)^{1-\theta}\,dj\Big)^{1/(1-\theta)}, \qquad \theta > 1. \tag{27}$$

and using the normalization $\int_0^1 dj = 1$ yields

$$P_t^M = \mu_t^M\, MC_t^M, \tag{28}$$

Here, the emphasis is that $P_t^M = \mu_t^M MC_t^M$ is a consequence of (i) the definition of μ and (ii) symmetric equilibrium plus the CES aggregator, while the FOC determines the equilibrium value (or path) of μ_t^M.

It follows that the entire distribution of firm-level prices is proportional to the common marginal cost. Therefore, when aggregated via the CES formula, the resulting P_t^M must also be proportional to MC_t^M. Thus, because there is no cross-firm dispersion in marginal costs or target markups, the aggregate price index P_t^M remains proportional to the common marginal cost MC_t^M via the time-varying markup μ_t^M. Therefore, the aggregate price index itself maintains the common markup ratio over marginal cost.

Upstream Aggregate Production

To obtain an economy-wide upstream (aggregate) production, we simply integrate or sum the firm-level outputs across all $j \in [0, 1]$. Because the upstream production function is linear in labor, summing over j gives:

$$Y_t^M = \int_0^1 Y_{j,t}^M\, dj = A_t^M \int_0^1 L_{j,t}^M\, dj = A_t^M\, L_t^M \tag{29}$$

where $L_t^M \equiv \int_0^1 L_{j,t}^M\, dj$ is total manufacturing-sector labor.

The CES aggregation of differentiated upstream varieties into the composite intermediate block X_t^M block (see Equation (16) makes explicit the channels through which an upstream shock (for example, a markup reduction) transmits to downstream production and ultimately to aggregate consumption and inflation. It therefore provides the necessary bridge between the firm-level FOCs above and the sectoral Phillips curves that follow.

iii. Antitrust Policy as a Structural Shock to Elasticities and Markups

I model antitrust intervention as a positive shock to the elasticity of substitution in the upstream manufacturing sector. In the baseline steady state, each upstream firm's desired markup is

$$\bar{\mu}^M = \frac{\bar{\theta}}{\bar{\theta} - 1}, \qquad \bar{\theta} > 1 \tag{30}$$

where $\bar{\theta}$ reflects the degree of substitutability across intermediate varieties. Antitrust policies implemented by the government are designed to reduce market power and compress price markups, particularly in key input-producing industries such as manufacturing.

These policies aim to make upstream goods more substitutable by enforcing competition laws, dismantling anti-competitive structures, or increasing price transparency.

In this framework, these reforms are not modeled through a standalone "Government" block, suggesting that I don't endogenously solve for taxes, subsidies, and public spending, instead, I embed antitrust directly into the markup process via ε_t^θ. Thus, I omit a full government budget constraint or policy optimization and capture the policy as a gradual increase in θ_t, modeled as:

$$\theta_t = \bar{\theta} + \varepsilon_t^\theta, \quad \varepsilon_t^\theta > 0 \tag{31}$$

where ε_t^θ is an exogenous antitrust shock. As θ_t rises, the desired markup decreases over time:

$$\bar{\mu}_t^M = \frac{\theta_t}{\theta_t - 1} = \frac{\bar{\theta} + \varepsilon_t^\theta}{\bar{\theta} + \varepsilon_t^\theta - 1} < \bar{\mu}^M \tag{32}$$

This gradual markup reduction reflects how antitrust enforcement interacts with the initial level of market power–industries with high baseline markups experience more pronounced effects from the same policy intervention.

As markups fall, upstream firms price their goods closer to marginal cost. This reduces the cost of intermediate inputs supplied to the downstream sector, leading to lower production costs and potential increases in downstream output. In this way, antitrust policy not only affects the targeted upstream industry but also generates economy-wide spillovers through input–output linkages.

To incorporate this into the dynamic model, I log-linearize around the steady-state markup:

$$\hat{\mu}_t^M = \ln(\bar{\mu}_t^M) - \ln(\bar{\mu}^M) \tag{33}$$

and treat ε_t^θ as the policy shock. Thus, $\hat{\mu}_t^M$ represents the markup gap that drives inflation dynamics in the Rotemberg Phillips curve. This specification endogenizes the effect of policy on both markups and downstream input–output linkages, allowing us to trace static and dynamic spillovers across the two-sector economy.

iv. Upstream Phillips Curve under Rotemberg Pricing

Under quadratic (Rotemberg) price-adjustment costs, each firm's optimality condition pins down the *change* in its own price rather than levels. Linearizing the FOC around a symmetric steady state (all firms identical, $P_{j,t}^M = P_t^M$) and rearranging yields the standard Rotemberg Phillips curve in difference form:

Upstream (Manufacturing) Inflation Dynamics

$$\left(\pi_t^M - \pi_{t-1}^M\right) = \beta\, E_t\left[\pi_{t+1}^M - \pi_t^M\right] + \frac{1}{\kappa_M}\left(\mu_t^M - \bar{\mu}^M\right), \tag{34}$$

or equivalently (after a slight rearrangement)

$$\hat{\pi}_t^M = \beta\, E_t[\hat{\pi}_{t+1}^M] + \kappa_M\, \hat{\mu}_t^M \tag{35}$$

where $\pi_t^M = \ln(P_t^M/P_{t-1}^M)$ is manufacturing inflation, $\mu_t^M = P_t^M/MC_t^M$ the time-varying markup, and $\kappa_M > 0$ governs the strength of the quadratic price-adjustment cost. The term $\mu_t^M - \bar{\mu}^M$ captures how deviations of the effective markup from its steady state value feed into upstream inflation dynamics. So, equation (34) reflects how continuous quadratic price adjustment costs, rather than a fixed reset probability, govern the response of inflation both to current markup deviations and to expected future price changes.

v. Rest-of-Economy (Downstream Sector)

A continuum of downstream firms indexed by $k \in [0,1]$ produces the final good $Y_{k,t}^D$ using labor $L_{k,t}^D$ and a CES composite of upstream intermediate inputs X_t^M:

$$Y_{k,t}^D = A_t^D \left[\alpha \left(L_{k,t}^D\right)^{\frac{\epsilon-1}{\epsilon}} + (1-\alpha)\left(X_t^M\right)^{\frac{\epsilon-1}{\epsilon}}\right]^{\frac{\epsilon}{\epsilon-1}}, \quad \epsilon > 1,\ \alpha \in (0,1). \tag{36}$$

where $\epsilon > 1$ governs the substitutability between labor and intermediates and $\alpha \in (0,1)$ is the labor share (value-added) in downstream production, while $(1-\alpha)$ is the share spent on upstream intermediates. Here, the assumption is that downstream varieties do not supply intermediate inputs to one another; each firm relies exclusively on the upstream composite X_t^M and labor to produce its final output.

Analogously, for the downstream sector, since each $Y_{k,t}^D$ shares the same functional form and depends on the common composite input X_t^M, summing over k yields the aggregate production

$$Y_t^D = \int_0^1 Y_{k,t}^D \, dk = A_t^D \left[\alpha \left(L_t^D\right)^{\frac{\epsilon-1}{\epsilon}} + (1-\alpha)\left(X_t^M\right)^{\frac{\epsilon-1}{\epsilon}}\right]^{\frac{\epsilon}{\epsilon-1}} \tag{37}$$

which in turn feeds into the household consumption bundle. Here $L_t^D = \int_0^1 L_{k,t}^D \, dk$ is total downstream labor, and X_t^M already aggregates across all upstream firms via its own CES formula given in Equation(16). Since $\epsilon > 1$, labor and intermediate inputs are imperfect substitutes–a higher ϵ makes them closer substitutes (a small relative price change induces a large reallocation of inputs). The sector-wide downstream TFP A_t^D scales the CES aggregate. At the firm level, real marginal costs in the downstream sector depend on the input price index for X_t^M and the real wage W_t.

The choice of modeling downstream production using a CES aggregator over labor and upstream intermediate inputs, rather than a Cobb–Douglas form allows for imperfect substitution and dynamic input adjustment in response to relative price changes–an essential feature in the presence of markup-reducing antitrust shocks.

When upstream markups fall, the price of intermediate inputs declines, reducing downstream production costs and raising output. These spillover effects operate through the input–output structure of the economy; the stronger the downstream sector's reliance on upstream intermediates, the greater the pass-through from markup reductions into cost savings. In this two-sector setting, the size of the downstream response is governed directly by the input share $1 - \alpha$, which serves as a Leontief-style IO weight.

Downstream firm: profit maximization (price-taking)

A representative downstream firm k takes P_t^D (its output price), W_t (the nominal wage) and P_t^M (the price of the composite intermediate) as given and chooses labor $L_{k,t}^D$ and the composite intermediate X_t^M to maximize one-period profits

$$\Pi_{k,t} = P_t^D Y_{k,t}^D - W_t L_{k,t}^D - P_t^M X_t^M. \tag{38}$$

Subject to the CES production function in Equation(36).

First-order conditions: Define

$$S_{k,t} \equiv \alpha\big(L_{k,t}^D\big)^{\frac{\epsilon-1}{\epsilon}} + (1-\alpha)\big(X_t^M\big)^{\frac{\epsilon-1}{\epsilon}}. \tag{39}$$

Then the production function can be written compactly as

$$Y_{k,t}^D = A_t^D\, S_{k,t}^{\frac{\epsilon}{\epsilon-1}}. \tag{40}$$

Using (40) and $\dfrac{dS}{dL} = \alpha\frac{\epsilon-1}{\epsilon}L_{k,t}^{-1/\epsilon}$, $\dfrac{dS}{dX} = (1-\alpha)\frac{\epsilon-1}{\epsilon}(X_t^M)^{-1/\epsilon}$, profit maximization yields the two FOCs for labor $L_{k,t}^D$ and the composite intermediate X_t^M in (41) and (42) respectively.

$$P_t^D A_t^D S_{k,t}^{\frac{1}{\epsilon-1}}\ \alpha\, L_{k,t}^{-\frac{1}{\epsilon}} = W_t, \tag{41}$$

$$P_t^D A_t^D S_{k,t}^{\frac{1}{\epsilon-1}}\ (1-\alpha)\,(X_t^M)^{-\frac{1}{\epsilon}} = P_t^M. \tag{42}$$

Combining (41) and (42) cancels the common factor $P_t^D A_t^D S_{k,t}^{\frac{1}{\epsilon-1}}$ and yields the ratio condition that pins the optimal input mix (the marginal rate of technical substitution equals the factor price ratio), and hence the aggregate composite X_t^M– and, in turn, its output $Y_{k,t}^D$:

$$\frac{1-\alpha}{\alpha}\left(\frac{X_t^M}{L_{k,t}^D}\right)^{-1/\epsilon} = \frac{P_t^M}{W_t}. \tag{43}$$

Downstream Input Demands: From the intratemporal first-order condition

$$\alpha\,(L_{k,t}^D)^{\frac{1}{\epsilon}} \;=\; (1-\alpha)\,(X_t^M)^{\frac{1}{\epsilon}}\,\frac{P_t^M}{W_t}, \tag{44}$$

we obtain

1. Labor demand:

$$L_{k,t}^D \;=\; \left(\frac{\alpha}{1-\alpha}\,\frac{P_t^M}{W_t}\right)^{\epsilon} X_t^M, \tag{45}$$

2. Composite intermediate–good demand:

$$X_t^M \;=\; \left(\frac{1-\alpha}{\alpha}\,\frac{P_t^M}{W_t}\right)^{\epsilon} L_{k,t}^D. \tag{46}$$

Finally, under Rotemberg-type price frictions and fixed markups, log-linearizing the firm's pricing first-order condition delivers the downstream Phillips curve in its "cost-push" form in Equation(49): inflation responds to changes in real marginal cost and to expected future inflation, but there is no endogenous markup gap since downstream firms are price-takers.

Downstream Real Marginal Cost: Using the primal cost-minimization problem and its dual representation via Shephard's Lemma, the downstream firm's real marginal cost coincides with the unit cost evaluated at the optimal input bundle. Specifically, solving the Lagrangian

$$\mathcal{L} = W_t L_{k,t}^D + P_t^M X_t^M + \lambda\Big(Y_{k,t}^D - A_t^D\big[\alpha(L_{k,t}^D)^{\frac{\epsilon-1}{\epsilon}} + (1-\alpha)(X_t^M)^{\frac{\epsilon-1}{\epsilon}}\big]^{\frac{\epsilon}{\epsilon-1}}\Big)$$

for the primal inputs and then invoking the envelope theorem (dual problem) yields

$$MC_t^D = \lambda^* = \frac{1}{A_t^D}\Big[\alpha^{\frac{1}{\epsilon}}\,W_t^{1-\epsilon} \;+\; (1-\alpha)^{\frac{1}{\epsilon}}\,(P_t^M)^{1-\epsilon}\Big]^{\frac{1}{1-\epsilon}}.$$

By substituting the optimal labor-to-intermediate ratio into this unit-cost expression and exploiting the CES structure, we recover the closed-form for downstream marginal cost. This real marginal cost enters the downstream Rotemberg Phillips curve, linking "cost-push" shocks in MC_t^D to inflation dynamics.

Downstream Input Cost Adjustment from Policy Shock

Although the current model focuses on a two-sector structure–upstream manufacturing and downstream final goods production–it preserves the essence of an input–output production network. The cost structure of the downstream sector reflects a fixed share $1-\alpha$ allocated to purchasing intermediate goods from the upstream sector. As upstream markups fall, these intermediate inputs become cheaper, lowering the downstream sector's total input cost. I model the post-shock input cost as

$$\zeta_t^D = \zeta_0^D \cdot (1 - \Delta\mu_t^M) \tag{47}$$

where ζ_t^D and ζ_0^D denote input cost at time t and the baseline (pre-shock) input cost, and $\Delta\mu_t^M$ is the effective percentage reduction in upstream markups, defined as:

$$\Delta\mu_t^M = \frac{\bar{\mu}^M - \mu_t^M}{\bar{\mu}^M} \tag{48}$$

This formulation captures how antitrust policies targeted at the upstream sector generate indirect cost reductions in the downstream industry. These effects operate through fixed input–output linkages and are proportional to the downstream sector's reliance on upstream intermediates. While the current model abstracts from inter-sectoral downstream trade, this setup can be extended to accommodate a richer network structure in future analysis.

Downstream (Final-Goods) Inflation Dynamics

With Rotemberg adjustment costs and constant markups, downstream firms' price-taking behavior implies quadratic price-adjustment frictions around their marginal cost. Log-linearizing the first-order condition yields the downstream Rotemberg Phillips curve:

$$\left(\pi_t^D - \pi_{t-1}^D\right) \;=\; \beta\, E_t\left[\pi_{t+1}^D - \pi_t^D\right] \;+\; \frac{1}{\kappa_D}\left(mc_t^D - mc_{t-1}^D\right) \tag{49}$$

or equivalently

$$\hat{\pi}_t^D = \beta\, E_t[\hat{\pi}_{t+1}^D] + \kappa_D \left(\hat{MC}_t^D - \overline{MC}^D\right) \tag{50}$$

where $\pi_t^D = \ln(P_t^D / P_{t-1}^D)$ is downstream inflation, $mc_t^D = \ln MC_t^D$ is real marginal cost, and and $\kappa_D > 0$ the downstream adjustment cost parameter. Because downstream firms set $P_{j,t}^D = \bar{\mu}^D\, MC_t^D$ with fixed $\bar{\mu}^D$, there is no markup gap term (thus, in contrast to the upstream curve, there is no $\mu_t^D - \bar{\mu}^D$ term because $\mu_t^D \equiv \bar{\mu}^D$ is constant); inflation is driven solely by "cost-push" shocks in marginal cost and by expected future inflation under smooth Rotemberg frictions.

Though the model assumes no direct household consumption of upstream varieties, upstream inflation π_t^M still matters, but only indirectly. Changes in upstream prices or markups affect downstream real marginal cost MC_t^D via the intermediate price P_t^M, and those marginal-cost changes feed into downstream inflation π_t^D. Thus upstream shocks enter aggregate inflation through pass-through to mc_t^D, not through direct consumption weights. Under this assumption, aggregate inflation follows the downstream Rotemberg NKPC in Equation(**??**), so that monetary–policy rules or welfare metrics that target aggregate (consumption) inflation effectively target downstream inflation in the model.

Input–Output Linkages

In the two-sector framework, only the downstream sector produces goods that enter the household's consumption bundle; the upstream sector supplies intermediate inputs. Downstream firms allocate a fraction $1 - \alpha$ of their total cost to purchasing these manufacturing intermediates and the remaining fraction α to labor. This cost-share $1 - \alpha$ functions analogously to a Leontief coefficient in a two-sector social accounting matrix (SAM)[2], capturing the direct dependence of downstream production on upstream outputs.

Economic Interpretation of Markup Spillovers

The reduction in upstream markups due to antitrust policy affects the downstream sector indirectly through lower input costs. In this setting, the spillover effect is governed by the

[2] In a SAM, each cell records the flow of payments from one account to another—firms to households, firms to firms, etc. Our downstream cost-share $1 - \alpha$ plays exactly the same role as the entry in a SAM that tells you "of every dollar spent by downstream firms, this fraction goes to upstream firms (intermediates), and that fraction goes to labor (value added)." Framing it as a SAM Leontief coefficient immediately signals "this is a fixed technical coefficient linking one sector's output to another's inputs."

fixed cost share $1-\alpha$, which represents the fraction of downstream production costs devoted to inputs sourced from the upstream manufacturing sector.

We can express the effective percentage reduction in downstream input costs as

$$\Delta\mu_t^D = \Delta\mu_t^M \cdot (1-\alpha) \tag{51}$$

where $\Delta\mu_t^M = \frac{\bar{\mu}^M - \mu_t^M}{\bar{\mu}^M}$ is the percentage reduction in the upstream markup. This formulation reflects the idea that sectors more reliant on high-markup upstream inputs experience greater cost savings when those markups fall. The strength of the spillover is thus tied to both the magnitude of the markup shock and the input-output structure.

Although our model abstracts from intra-downstream linkages, this setup can be extended to a network setting with multiple downstream sectors, where the size of the spillover for each sector would depend on the input share θ_i^U and its substitutability across sources.

C. Equilibrium Conditions

Equilibrium is given by the solution to the log-linearized system of expectational difference equations that characterizes the dynamic responses of the model. The system collects the New-Keynesian Phillips curves, the household Euler and labor-supply conditions, goods and labor market clearing, and a Taylor-type monetary policy rule. Antitrust shocks ε_t^θ enter the model through the markup-elasticity relationship in the price-setting block and thus affect inflation, sectoral costs, and output via the input–output network. Formally, I solve the linearized system in the vector of endogenous deviations $\{\hat{Y}_t^M, \hat{Y}_t^D, \hat{\pi}_t^M, \hat{\pi}_t^D, \hat{W}_t, \hat{C}_t, \hat{L}_t, \hat{R}_t\}$,

where:

- $\hat{Y}_t^M$, $\hat{Y}_t^D$ are the deviations of manufacturing and downstream output from steady state;
- $\hat{\pi}_t^M$, $\hat{\pi}_t^D$ are the sectoral inflation rates;
- $\hat{C}_t$ is consumption deviation;
- $\hat{L}_t$ is aggregate labor deviation;
- $\hat{R}_t$ is the nominal interest rate deviation.

i. Market Clearing Conditions

Labor Market Clearing

$$L_t \;=\; L_t^M \;+\; L_t^D \tag{52}$$

Here, total labor supply L_t is allocated between the upstream (manufacturing) sector L_t^M and the downstream sector L_t^D. This condition ensures that the household's labor endowment is exactly absorbed by firms in both sectors.

Final Goods Market Clearing

$$C_t \;=\; Y_t^D \tag{53}$$

Aggregate final demand–consumption C_t must equal total downstream output Y_t^D. Since only downstream firms produce the final good, all output goes to satisfy the consumption component of aggregate expenditure.

Intermediate Input (Upstream) Market Clearing

$$X_t^M \;=\; (1-\alpha)\, Y_t^D \tag{54}$$

Downstream production Y_t^D uses a fraction $(1-\alpha)$ of its total cost on upstream intermediates. Thus, the composite demand for manufacturing inputs X_t^M equals that share of downstream output. This condition links upstream supply and downstream demand in the two-sector IO network.

ii. Monetary policy

The central bank follows a standard Taylor rule that in general reads

$$\hat{R}_t \;=\; \rho_R\, \hat{R}_{t-1} \;+\; (1-\rho_R)\big[\phi_\pi\, \hat{\pi}_t^D + \phi_y\, \hat{y}_t^D\big] \;+\; \varepsilon_t^R, \tag{55}$$

where hats denote deviations from steady state, ϕ_π is the monetary-policy response coefficient to aggregate inflation; ensures an "active" policy stance when $\phi_\pi > 1$, and ϕ_y is the monetary-policy response coefficient to the output gap. $\rho_R \in [0, 1)$ captures interest-rate smoothing (fraction of last period's nominal rate carried into current policy), and ε_t^R is an (optional) unanticipated monetary policy disturbance.

For the deterministic perfect-foresight experiments reported in this paper I set $\varepsilon_t^R \equiv 0$ and therefore implement the policy mapping

$$\hat{R}_t \;=\; \rho_R\, \hat{R}_{t-1} \;+\; (1-\rho_R)\big[\phi_\pi\, \hat{\pi}_t^D + \phi_y\, \hat{y}_t^D\big], \tag{56}$$

so that policy reacts to deviations of the chosen aggregate inflation measure and aggregate output. Because households consume only downstream goods ($c = y^D$), the consumption price index coincides with downstream inflation π_t^D, hence the rule is written as a reaction to π_t^D; if stochastic monetary surprises are later desired, one can simply re-introduce the ε_t^R term.

iii. Aggregate inflation

Household consumption restricted to final (downstream) goods implies the consumption price index equals the downstream price index; hence aggregate consumption inflation is simply downstream inflation:

$$\hat{\pi}_t \;=\; \hat{\pi}_t^D, \qquad \text{equivalently} \qquad \pi_t \;=\; \pi_t^D, \tag{57}$$

because $P_t^C = P_t^D$ when the household bundle contains only downstream goods.

6 Calibration

6.1 Empirical Calibration and Solution Methods

Calibration parameters and sources: I calibrate a parsimonious two-sector IO–Rotemberg model to standard macro and input-output moments. Preferences and technology parameters (discount factor, risk aversion, Frisch elasticity, and value-added shares) follow common DSGE standard; sectoral shares and the downstream labor share α are taken from BEA input-output aggregates.

The upstream steady-state markup and the implied Dixit–Stiglitz elasticity θ are chosen to match evidence on gross margins, while Rotemberg adjustment coefficients are set to deliver plausible sectoral inflation persistence. Numerical values and precise data sources are reported in Table 1 (key parameters) and in Appendix A (full steady-state objects and data citations). Dynare solves the model's deterministic steady state under the normalization $Y^D = 1$; derived steady-state objects (e.g. $A^M = 0.84$, $W = 0.84$, $L^M = 0.47619$, $L^D = 0.52381$, $\chi = 0.84$, $Y^M = 0.40$) appear in Appendix A.

See also the model discussion for how the structural antitrust shock ε^θ is mapped into the Dynare markup gap `mup` via

$$\widehat{\mu}_t \approx \lambda_\theta \, \varepsilon_t^\theta.$$

Log-linearization: After assigning parameter values, the model is log-linearized around the non-stochastic steady state and solved using a first-order perturbation toolkit together with Dynare's perfect-foresight solver to generate impulse responses and welfare (consumption-equivalent variation) comparisons. The log-linearization yields a system of linear expectational difference equations that characterizes the dynamics of the endogenous variables in response to the antitrust shock.

Policy shock: The antitrust policy is introduced as a structural shock to the elasticity θ_t into the model and trace its dynamic effects. For small perturbations the induced markup gap satisfies $\widehat{\mu}_t \approx -\frac{1}{\bar{\theta}(\bar{\theta}-1)} \varepsilon_t^\theta$, so a positive antitrust shock ($\varepsilon_t^\theta > 0$) reduces the markup ($\widehat{\mu}_t < 0$).

In the Dynare experiments the model state `mup` is driven by the mapped structural shock (so $\texttt{mup} \equiv \widehat{\mu}_t$); numerical baseline values and robustness checks are reported in the Calibration section / Appendix. The analysis proceeds in three steps: (1) specification of the antitrust shock (timing and persistence); (2) log-linearization and solution of the dynamic system; and (3) impulse-response and channel-decomposition analysis.

Table 1: Baseline calibration: Two-sector IO–Rotemberg model (condensed)

Parameter	**Target / meaning**	**Data source / justification**	**Calibrated Value**
β	Discount factor (quarterly)	DSGE convention	0.99
σ	CRRA (inverse IES)	Macro DSGE literature	2.0
φ	Labor curvature (inverse Frisch)	Labour-supply estimates	1.0
χ	Labor disutility scale (ss)	Calibrated to match labor income share	0.84
$\bar{\mu}_M$	Upstream steady markup (gross margin)	Compustat / BEA industry margins	1.20 (20%)
θ	Dixit–Stiglitz elasticity (upstream)	Implied by $\bar{\mu}_M$	6.0
ϵ	Downstream CES elasticity (labor vs inputs)	Production / IO literature	6.0 (baseline)
α	Downstream labour (value-added) share	BEA IO aggregation	0.60
$1-\alpha$	Downstream intermediate share	BEA IO	0.40
κ_M	Rotemberg adj. cost (manufacturing)	Tuned to match inflation persistence	150
κ_D	Rotemberg adj. cost (downstream)	Tuned	200
ρ_μ	Persistence of markup gap (reduced form)	Experiment choice	1.0 (unit root; alt. 0.95)
λ_θ	Linear map: $\widehat{\mu} \approx \lambda_\theta \varepsilon^\theta$	$d\ln\mu/d\theta$ at $\bar{\theta}$	$-1/[\bar{\theta}(\bar{\theta}-1)] \approx -0.03333$
ρ_R	Interest-rate smoothing (Taylor)	Macro literature	0.80
ϕ_π	Taylor rule: inflation response	Standard Taylor	1.5
ϕ_y	Taylor rule: output response	Standard Taylor	0.5
T	Deterministic horizon for IRFs	Solver choice	40 quarters
$\Delta\bar{\mu}_M$	Antitrust shock (experiment)	Policy counterfactual	-10% (permanent)

Notes: Condensed core baseline parameters used for simulations and IRFs. The mapping coefficient λ_θ converts the structural antitrust impulse into the Dynare log-markup gap `mup` (see Appendix A). Values must match Dynare '.mod' files for reproducibility.

1. Specification of the Antitrust (Markup) Shock: I model the antitrust intervention as a reduction in the steady-state upstream markup $\bar{\mu}^M$. Concretely, let $\bar{\mu}^M$ denote the desired manufacturing markup in the absence of policy, and introduce a shock ε_t^θ that raises the elasticity of substitution $\theta_t = \bar{\theta} + \varepsilon_t^\theta$. Since

$$\bar{\mu}^M = \frac{\bar{\theta}}{\bar{\theta}-1} \quad \Longrightarrow \quad \bar{\mu}_t^M = \frac{\theta_t}{\theta_t - 1} < \bar{\mu}^M \tag{58}$$

the upward shift in θ_t compresses the upstream markup. For a one-time shock I set $\varepsilon_t^\theta > 0$ at $t = 1$ and $\varepsilon_t^\theta = 0$ for all $t > 1$. In a more persistent specification, ε_t^θ follows the AR(1) process $\varepsilon_t^\theta = \rho_\theta \varepsilon_{t-1}^\theta + \eta_t^\theta$. In either case, this specification captures how antitrust policy directly compresses the market power of upstream firms, lowering the markup wedge P_t^M/MC_t^M that enters the upstream NKPC.

Caveat: Because I run a deterministic perfect-foresight experiment with the nonzero innovation placed at $t = 1$, the shock path is taken as known to the solver (i.e. anticipated in the simulation); if instead one wishes to model an unanticipated surprise one should use a stochastic unexpected innovation. Additionally, since I employ the first-order mapping $\widehat{\mu}_t \approx \lambda_\theta \varepsilon_t^\theta$, the numerical mapping is a local approximation, so I report robustness checks using smaller/persistent shocks and comparative steady-state exercises (see Appendix A).

2. Linearization and solution of the dynamic system: I log-linearize all equilibrium conditions (household Euler and labor-supply equations, firm price-setting (Phillips curves), market-clearing conditions, and the Taylor-type monetary policy rule) around the nonstochastic steady state and treat the resulting markup gap as an exogenous driving force in the upstream NKPC. In particular, log-linearizing $\mu(\theta) = \theta/(\theta - 1)$ around $\bar{\theta}$ yields the first-order approximation

$$\widehat{\mu}_t \;=\; \ln \mu(\theta_t) - \ln \bar{\mu} \;=\; \ln \mu(\bar{\theta} + \varepsilon_t^{\theta}) - \ln \mu(\bar{\theta}) \;\approx\; \lambda_\theta \, \varepsilon_t^{\theta}, \tag{59}$$

where

$$\lambda_\theta \;=\; \frac{d \ln \mu}{d\theta}\Big|_{\bar{\theta}} \;=\; -\frac{1}{\bar{\theta}(\bar{\theta} - 1)}.$$

Hence the markup gap $\widehat{\mu}_t$ enters the upstream Rotemberg Phillips curve as the exogenous shock term. Note that the sign is negative, implies, a positive antitrust shock $\varepsilon_t^{\theta} > 0$ (more substitutability) reduces the desired markup $\widehat{\mu}_t < 0$.

Defining log-deviations around steady-state and linearizing around this point using a first-order Taylor expansion also gives the log-linearized Euler equation

$$-\sigma \, c_t \;\approx\; -\sigma \, E_t[c_{t+1}] \;+\; (r_t - E_t[\pi_{t+1}^D]). \tag{60}$$

Setting $\sigma = 1$ (or absorbing $1/\sigma$ into parameter calibration), and finally, dividing through by $-\sigma$ and, for simplicity, yields the familiar log-linear Euler equation:

$$c_t \;=\; E_t[c_{t+1}] \;-\; (r_t - \pi_{t+1}^D), \tag{61}$$

with $\pi_{t+1}^D = \dfrac{P_{t+1}^D}{P_t^D}$. By normalizing the consumption price index $P_t^D \equiv 1$, we have $\pi_{t+1}^D = 1$ in steady state, so that the real rate term R_t/π_{t+1}^D simplifies to R_t.

I then assemble the full system of linear expectational difference equations in the vector of state and control variables

$$\{\hat{Y}_t^M, \, \hat{Y}_t^D, \, \hat{\pi}_t^M, \, \hat{\pi}_t^D, \, \hat{C}_t, \, \hat{R}_t, \; \hat{L}_t^M, \hat{L}_t^D, \hat{W}_t, \hat{P}^M\}$$

and solve for a first-order accurate policy function using a perturbation toolkit (e.g. Dynare). This yields the law of motion for all endogenous variables as linear functions of their own lags, the markup shock $\hat{\mu}_t^M$, and any exogenous disturbances.

3. Computation Impulse-Response Functions (IRFs): Using the solved linear rational-expectations system, I IRFs for a one-off structural antitrust shock ε_t^{θ} implemented as a permanent step at $t = 1$, mapped into the log-markup gap by $\widehat{\mu}_t = \lambda_\theta \varepsilon_t^{\theta}$; responses are generated with Dynare's perfect-foresight solver over a T-quarter horizon. Specifically, I examine the dynamic responses of:

$$\{Y_t^M, \; Y_t^D, \; \pi_t^M, \; \pi_t^D, \; C_t, \; R_t, \; L_t^M, \; L_t^D, \; W_t, \; P_t^M\}$$

to a sudden compression in the upstream markup.

To aid interpretation, I report both signed quarterly *peak* responses and *cumulative* responses (sums of IRFs up to a chosen horizon). Peak responses summarize short-run intensity (the largest quarter-by-quarter move); cumulative responses measure the total effect over the horizon (for inflation, the cumulative sum equals the implied log price-level change). Because the experiment uses a permanent (unit-root) shock, cumulative sums grow with horizon and therefore should not be read as the long-run steady-state percent change. For long-run level comparisons, interpret the price-level panels (constructed as cumulative sums of π_t^M, π_t^D) together with the comparative steady-state calculations in Appendix A.[3]

Caveat: All IRFs are computed at first order (log-linearized system); non-linear or second-order effects are not captured here.

- *Upstream Output and Inflation (Y_t^M, π_t^M):* The initial markup cut lowers upstream firms' profit-maximizing price markups. As a result, P_t^M falls relative to MC_t^M, which reduces μ_t^M. Through the Phillips curve, Equation(35), upstream inflation π_t^M declines, and the lower effective price increases real demand for intermediate goods, thereby boosting Y_t^M in the short run (provided the markup effect on quantity outweighs the negative-profit incentive).

- *Downstream Output and Inflation (Y_t^D, π_t^D):* The reduction in P_t^M translates into a lower price index for upstream inputs, reducing downstream marginal cost MC_t^D. In the downstream Phillips curve, Equation(50), downstream inflation π_t^D also falls. Meanwhile, with cheaper intermediates, real downstream output Y_t^D rises. This "cost-push" channel is a key spillover effect from upstream market power reduction to final goods production.

- *Aggregate Consumption and Labor (C_t, L_t):* Households reap partially higher real income from lower intermediate prices, but lose some income due to reduced upstream profit distributions. And the labor-supply condition, Equation(10), consumption C_t and aggregate labor L_t adjust endogenously. The net effect on C_t typically depends on the relative strength of the positive input-cost channel versus the negative profit-income channel.

- *Nominal Interest Rate (R_t):* The central bank's Taylor rule, Equation(56), reacts to changes in inflation (i.e. inflation in downstream π_t^D) and the downstream output gap $\hat{y}_t^D$. A decline in inflation following the markup shock typically prompts monetary easing (a lower $\hat{R}_t$), which further influences consumption and downstream output.

- *Spillover Channel and Sectoral Feedbacks:* By lowering upstream prices, the markup shock reduces downstream input costs and raises Y_t^D. In turn, increased downstream activity raises labor demand (higher L_t^D) and wages W_t. Higher labor income partially offsets the loss in upstream profits, softening the impact on aggregate consumption. These sectoral feedback loops encoded in the IO linkages and price-setting equations are what distinguish the IO-NK model from a standard one-sector NK framework.

By tracing out these IRFs, I quantify both the direct upstream effects of antitrust policy and the economy-wide spillovers that propagate through the two-sector structure. In the next subsection, I discuss the quantitative calibration and interpret key results in terms of welfare and sectoral output dynamics.

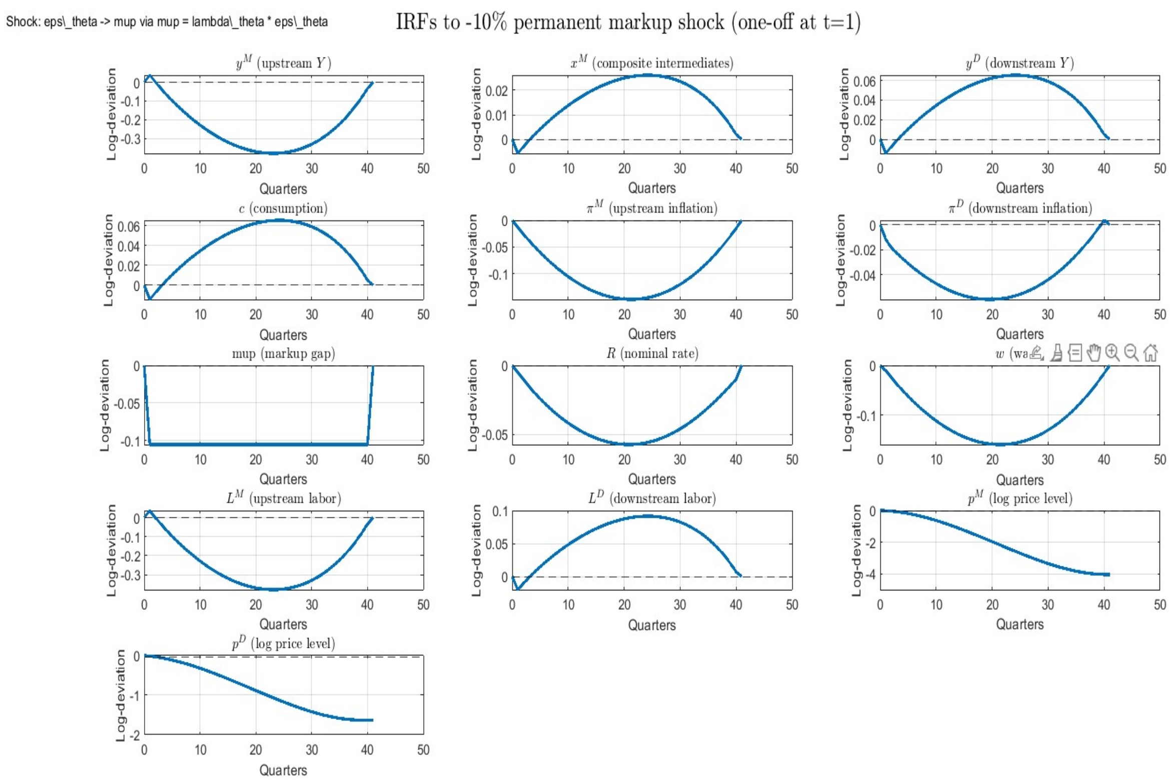
[3]Use the Appendix table, not cumulative IRF sums alone, to read off long-run level differences.

7 Results and Analysis

7.1 IRF Results: Permanent 10% Markup Reduction via IO Channel

In this experiment, I simulate a one-off 10% permanent reduction in the upstream markup such that the Dynare log-markup gap $\widehat{\mu}_t$ jumps to $\ln(0.9) \approx -0.10536$ at $t = 1$ and stays there. The resulting IRF graphics of the the structural antitrust shock ε_t^θ are presented in Figure 2. Each panel in Figure 2 plots log-deviations from the pre-policy steady state for upstream value added y^M, composite intermediates x^M, downstream output y^D, consumption c, upstream and downstream inflation π^M, π^D, the markup gap $\widehat{\mu}$, the nominal rate R, the wage w, upstream and downstream labor L^M, L^D, and the implied log price levels p^M, p^D (constructed as cumulative sums of π^M, π^D).

Figure 2: Antitrust Markup shock and Impulse Response Functions



Note: the IRFs plot responses of the endogenous markup gap $\widehat{\mu}_t$ (Dynare variable `mup`) which is driven by the structural antitrust shock ε_t^θ; I map the shock into the log-markup gap via $\widehat{\mu}_t \approx \lambda_\theta \varepsilon_t^\theta$ with $\lambda_\theta = -1/(\bar{\theta}(\bar{\theta}-1))$ (here $\bar{\theta} = 6$), so $\varepsilon_1^\theta \approx 3.1608 \Rightarrow \widehat{\mu}_1 = \ln(0.9) \approx -0.10536$. Price-level panels plot $\ln P_t^M - \ln P_0^M = \sum_{s=1}^t \pi_s^M$ and $\ln P_t^D - \ln P_0^D = \sum_{s=1}^t \pi_s^D$ (variables `pM_level` and `pD_level`), representing log-deviations of sectoral price levels. These are cumulative sums of sectoral inflation IRFs and illustrate the persistent level shift after a markup reduction; see Appendix A (comparative steady-state table) for exact long-run level changes.

Short summary of IRFs: The experiment produces immediate disinflation in the upstream sector (peak $\Delta\pi^M \approx -0.0132$) and a slightly smaller initial fall in downstream inflation ($\Delta\pi^D \approx -0.0118$). Monetary policy eases modestly (nominal rate drops ≈ -0.005 at impact), and downstream output/consumption exhibit a small short-run dip (peak ≈ -0.0143) before recovering as lower intermediate prices propagate. Composite intermediate demand x^M falls slightly on impact but turns positive over the transition. Wages and labor reallocate (small immediate movement in L^M, L^D, and w). By contrast, upstream cumulative value-added falls because lower per-unit margins shrink upstream firm's receipts and producer surplus; see Appendix A for cumulative IRFs and comparative steady-state levels for long-run interpretation.

Long-run (comparative steady-state) changes: The permanent markup reduction lowers the upstream price and raises downstream real activity in the new steady state. Table 3 in Appendix A reports full steady-state levels; the main exercise implies a reduction in P^M, an increase in Y^D and c, a rise in $A^M = W$, and a reallocation of labor toward the downstream sector (see Appendix A for exact numbers).

Key steady-state differences (brief)

Variable	Baseline	New (after $\bar{\mu}_M$ fall)
P^M	1.20	1.08
Y^D	1.07	1.14
c	1.073	1.144
L^M	0.495	0.484
L^D	0.505	0.516
$W = A^M$	0.867	0.947

Brief summary of Peak responses: The mapped antitrust shock opens a large markup gap at impact ($\widehat{\mu}_1 \approx -0.105$). Sectoral prices fall immediately- upstream inflation drops by about 0.013 in quarter 1 and downstream inflation by about 0.012. Monetary policy responds with a mild easing (nominal rate $\downarrow\approx 0.005$ at impact). Real activity registers a small short-run contraction in the downstream sector (consumption and $y^D \approx -0.014$ at impact), while composite intermediate demand x^M falls only slightly on impact (≈ -0.006) and then turns positive during the transition as lower input costs raise downstream demand. Wages and labor reallocate modestly at impact (real wage $\downarrow\approx 0.011$; L^M moves up briefly while L^D falls), but these short-run reallocations unwind over subsequent quarters. For cumulative and long-run level changes see the price-level panels and the comparative steady-state table in Appendix A.

Table 2: Condensed peak responses to a permanent 10% upstream-markup shock

Variable	1 quarter (peak)	4 quarters (peak)
$\widehat{\mu}$ (markup gap)	-0.105361	-0.105361
π^M (upstream inflation)	-0.013194	-0.049297
π^D (downstream inflation)	-0.011768	-0.027185
R (nominal rate)	-0.004957	-0.019857
y^D (downstream output / c)	-0.014265	-0.014265
x^M (composite intermediates)	-0.005706	-0.005706
w (real wage)	-0.010817	-0.050110
L^M (upstream labor)	$+0.037684$	-0.066689
L^D (downstream labor)	-0.019971	-0.019971
p^M (price level, cumulative)	-0.013194	-0.126153
p^D (price level, cumulative)	-0.011768	-0.080527

Notes: Entries are signed peak log-deviations (Dynare output). 1-quarter = impact; 4-quarter = signed peak within first 4 quarters (min or max depending on sign). For cumulative sums, long-run/level comparisons use the comparative steady-state table in Appendix A.

7.2 Interpretation of IRFs

7.2.1 Impulse response to a -10% permanent upstream markup cut

I consider a permanent 10% reduction in upstream markups (mapped so $\widehat{\mu}_1 = \ln(0.9) \approx -0.10536$). Responses are computed with Dynare's perfect-foresight solver over a T-quarter horizon.

Aggregate output and consumption

On impact (quarter 1), the responses are small but economically visible and somewhat asymmetric across sectors. Manufacturing value added rises on impact, while downstream output and aggregate consumption fall modestly:

$$y_1^M \approx +0.03768 \quad (\approx +3.77\%), \qquad y_1^D = c_1 \approx -0.01427 \quad (\approx -1.43\%).$$

The immediate downstream output and consumption drop is driven by a short-run reduction in aggregate real income and demand following the upstream markup compression (model abstract from an explicit dividend/ownership channel), while upstream output increases on impact because of an intra-period reallocation of labor and input-demand adjustments. Over the transition the cumulative downstream response turns positive (the cumulative sum is ≈ 0.2004 at 12 quarters and ≈ 1.6258 at 40 quarters) as lower upstream markups reduce intermediate input costs, downstream firms expand production, and looser monetary policy reinforces demand. The short-run negative effect reflects the dominance of the income/demand channel, while the long-run positive effect arises as the cost pass-through channel and monetary easing dominate.

Manufacturing inflation

Manufacturing inflation falls immediately:

$$\pi_1^M \approx -0.01319 \ (\approx -1.32 \text{ pp}),$$

and remains negative at longer horizons ($\pi_4^M \approx -0.0493$, $\pi_{12}^M \approx -0.1190$, $\pi_{40}^M \approx -0.1480$). This persistent disinflation reflects the permanent reduction in upstream markups (mup $= \ln(0.9) = -0.10536$), which lowers target price levels. With Rotemberg adjustment costs, firms smooth their price changes, implying prolonged negative inflation rates until convergence to the new steady-state markup.

Downstream inflation

Downstream inflation also falls on impact, but by slightly less:

$$\pi_1^D \approx -0.01177 \ (\approx -1.18 \text{ pp}),$$

and declines further over time (e.g. $\pi_4^D \approx -0.02719$, $\pi_{12}^D \approx -0.05189$, $\pi_{40}^D \approx -0.05986$). The smaller initial effect reflects downstream marginal costs, combine with wages (share α) and intermediate inputs (share $1-\alpha$). Downstream firms are price takers and respond to both wage and input costs. Thus, the inflation reduction is substantial but weighted by input composition.

Markup deviation

The Dynare state `mup` equals the mapped log-markup gap and is constant across horizons

$$\text{mup}_t \equiv \widehat{\mu}_t = \ln(0.9) \approx -0.10536.$$

reflecting the permanent nature of the shock.

Nominal Interest Rate

The nominal policy rate eases on impact: $R_1 \approx -0.00496$ ($\approx -0.5\%$), with larger cumulative reductions at longer horizons as inflation remains suppressed (cumulative R falls grow because of the permanent component). The Taylor rule mechanism lowers policy rates in response to sustained disinflation, generating further demand stimulus and amplifying the reversal of output from negative to positive.

Labor, wages and intermediates

Real wages decline on impact ($w_1 \approx -0.01082$, $\approx -1.08\%$), and labor reallocates slightly between sectors. L^M shows an immediate uptick ($\approx +0.03768$ at impact) while L^D moves down modestly (≈ -0.01997). Composite intermediate demand x^M falls a little on impact ($x_1^M \approx -0.00571$) but turns positive in cumulative terms as downstream output expands during the transition.

Interpretation note: Rely on short-horizon (impact and 1–4 quarter) IRF magnitudes for interpreting the dynamic channels, and use the comparative steady-state table in Appendix A (price-level panels and level comparisons) for long-run level conclusions.

7.2.2 Mechanisms

The simulated responses are explained by four interacting channels.

Income or producer-surplus channel: A reduction in upstream markups mechanically lowers the upstream sector's nominal receipts and producer surplus[4]. Given the model's resource constraint and endogenous factor prices, this fall in upstream nominal income shows up in equilibrium allocations (wages, labor shares, and hence household real income) and produces the small immediate decline in downstream output and consumption (See the short-run drops in y^D and c in Figure 2).

Cost pass-through or IO channel (medium and long run): Permanent lower upstream prices reduce downstream marginal costs. Over time downstream firms expand input use and output, so cost savings propagate through the input–output network and generate positive cumulative gains (See the gradual rise in x^M, y^D, and cumulative gains in Figure 2 and Table 3).

Price adjustment and monetary policy: Rotemberg adjustment costs slow price reoptimization, producing persistent disinflation as sectoral prices converge to the new markup. The central bank eases in response to lower inflation, reducing real rates and partially offsetting the initial demand loss (See π^M, π^D and R in Figure 2).

Dynamic interaction or network amplification: Because intermediates enter many production processes, cheaper upstream inputs diffuse economy-wide. This transmission amplifies the positive medium-run effects on aggregate output and consumption and eventually reverses the short-run contraction (See the joint evolution of p^M, p^D, x^M and y^D in Figure 2 and the comparative steady-state changes in Appendix A).

7.2.3 Short-run Effects and Interpretation

Small initial output response: The short-run contraction is modest (order-of-magnitude: $\approx$ 1.42% on impact under the baseline calibration). This indicates the firms' nominal receipts/producer-surplus channel is present but limited relative to the size of the markup shock. The quantitative magnitude depends strongly on (i) the fraction of upstream income that accrues to households through factor payments, (ii) the indirect role of manufacturing in aggregate demand through changes in wages and labor reallocation and via lower intermediate input costs that affect downstream production and income, and (iii) the labor-income share; hence the short-run effect is sensitive to calibration choices (see Appendix A for sensitivity checks).

Monetary policy matters: A responsive Taylor rule materially cushions the initial demand loss: monetary easing following falling inflation contributes substantially to the recovery. Turning off policy responses (e.g. setting $\phi_\pi = 0$ or $\phi_y = 0$) alters transitional dynamics and welfare results in economically meaningful ways; we report these counterfactuals in the robustness section.

[4]The model does not incorporate explicit dividend pay-outs to households; the effect operates through changes in value-added and equilibrium factor payments in the closure.

7.2.4 Immediate robustness checks

Conclusion

This paper develops a parsimonious two-sector IO–New Keynesian DSGE model with Rotemberg price-adjustment frictions to study how antitrust interventions that compress upstream markups propagate through input–output linkages, affect sectoral inflation and output, and interact with monetary policy. I model antitrust as a structural increase in the Dixit–Stiglitz elasticity θ_t that maps linearly into a log-markup gap (the Dynare state `mup`). Calibrated to standard macro and BEA/Compustat moments and solved with a perfect-foresight perturbation routine, the model delivers transparent quantitative predictions about the static and dynamic consequences of markup-reducing policy.

Two central results emerge. First, a permanent compression of upstream markups generates immediate sectoral disinflation (upstream $\Delta\pi^M$ and downstream $\Delta\pi^D$ fall on impact) and a modest short-run contraction in downstream output and consumption (e.g. y^D and c fall by roughly 1.4% at impact in the baseline experiment), while upstream value added rises on impact (labor reallocates transiently toward manufacturing). Second, over the transition, the cost-pass-through and IO channels, amplified by monetary easing in response to lower inflation, more than offset the initial income/demand drag, downstream output and consumption recover and display positive cumulative gains (the model shows positive cumulative y^D by the 12–40 quarter horizons), and the comparative steady-state exercise documents a lasting expansion in downstream real activity following a permanent markup reduction. In short, an antitrust policy that lowers input markups produces short-run redistribution and modest contraction, but generates persistent, economy-wide gains through cheaper inputs and policy accommodation.

The mechanism is intuitive and policy-relevant. Three interacting channels drive the transitional and long-run responses: (i) A short-run producer-surplus channel associated with the immediate reduction in upstream margins; through the resource constraint and endogenous factor-price adjustments, this shows up as a transitory compression of real income and demand; (ii) a cost-pass-through / IO channel by which cheaper intermediates lower downstream marginal costs and raise real activity; and (iii) monetary policy, which conditionally amplifies the downstream recovery by lowering nominal rates when inflation falls. These channels imply nontrivial tradeoffs- the timing and magnitude of benefits depend on the size and persistence of the antitrust change, the structure of consumption and production shares, and the monetary rule.

The paper also highlights important caveats and extensions. I abstract from endogenous government enforcement costs, firm heterogeneity, and an explicit dividend/ownership channel in the household budget; I normalize downstream productivity and abstract from investment and open-economy transmission. These simplifications make the model tractable and sharpen the IO–pricing mechanism, but they leave scope for richer exercises: incorporating heterogeneous firms and produced capital, modeling enforcement costs and fiscal interactions, or calibrating sectorally to firm-level markup series would sharpen quantitative policy guidance. Finally, welfare implications depend on specification details (preferences, market structure, and monetary policy) and merit careful, model-based CEV calculations in future work.

Overall, the analysis provides a clear theoretical and quantitative argument that well-targeted antitrust interventions in upstream industries can generate substantial economy-wide gains through input-cost channels, while also producing short-run distributional and demand effects that policymakers should anticipate and, where appropriate, mitigate. I hope this framework and the accompanying quantitative results help inform both the academic debate and practical policy design on antitrust and market-structure reform.

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Appendix A: Calibration details and steady-state objects

7.2.5 Comparative steady-state levels (baseline calibration)

Table 3: Steady-state comparison: $\bar{\mu}_M = 1.20$ (baseline) vs. $\bar{\mu}_M = 1.08$

Variable	Baseline	New	Δ : (new − baseline)
A^M (upstream productivity / wage)	0.866667	0.946667	+0.080000
W (wage)	0.866667	0.946667	+0.080000
L^M (upstream labor)	0.495050	0.483559	−0.011491
L^D (downstream labor)	0.504950	0.516441	+0.011491
Y^M (upstream output)	0.429043	0.457769	+0.028726
A^D (downstream productivity)	1.000000	1.000000	0.000000
Y^D (downstream output)	1.072610	1.144420	+0.071816
c (consumption)	1.072610	1.144420	+0.071816
P^M (upstream price)	1.200000	1.080000	−0.120000
P^D (downstream price)	1.000000	1.000000	0.000000
R (nominal interest rate)	1.0101	1.010100	0.000000
B^* (steady bond holdings)	-20.38810	-19.57790	+0.810246

Notes: Values come from the Dynare comparative-steady-state routine (see Appendix A). All levels computed under the normalization $P^C = 1$. "Delta" equals new steady state ($\bar{\mu}_M = 1.08$) minus baseline ($\bar{\mu}_M = 1.20$).

Table 3 reports model steady-state levels under the baseline calibration and the computed comparative steady-state changes following a counterfactual reduction in the upstream markup (baseline $\bar{\mu}_M = 1.20 \rightarrow$ alternative $\bar{\mu}_M = 1.08$).

All levels are reported under the normalization $P^C = 1$. The markup reduction mechanically lowers the upstream price P^M and raises upstream productivity/wage, $A^M = W^M$ (marginal product normalization). Labor shifts toward downstream production (L^D increases), expanding downstream value added Y^D and consumption c, as lower input costs boost downstream real activity. The steady-state gross nominal interest rate R is pinned down by the household Euler equation, hence $R = \frac{1}{\beta}$. Since β is unchanged between the baseline and counterfactual, R remains constant across steady states.

The change in steady-state bond holdings B^* reflects the change in the economy's net real surplus, $WL - P^C C$. See Appendix A for detailed equations and parameter mappings used to generate these levels.

The key quantitative facts from the IRFs (peaks and cumulative sums reported by Dynare) in terms of variable-by-variable evidence are below. All reported numbers are log-deviations from baseline (approximate percent changes for small magnitudes):

- y_M **(manufacturing output):** Peak response is +0.02707 at impact ($\approx +2.7\%$), then −0.06325 at 4q, −0.24405 at 12q, and −0.34118 at 40q. Cumulative responses become increasingly negative (e.g., cumulative ≈ -8.90 at 40q). Interpretation: a small initial uptick at impact is followed by a persistent contraction and large negative integrated effect.

- x_M **(demand for manufacturing intermediates):** Signed peak ≈ -0.01342 (minor immediate drop). Cumulative responses turn positive and grow over time (e.g. +0.197 at 12q, +1.618 at 40q). Interpretation: after initial adjustment, downstream increases its use of cheaper intermediates.

- y_D **(downstream output) and** c **(consumption):** Peak responses ≈ -0.01342 at impact; cumulative responses are negative short-run but positive by 12–40 quarters (same cumulative values as x_M). Interpretation: modest initial dip in downstream output/consumption followed by positive cumulative gains as input-cost savings propagate.

- π_M **(manufacturing inflation):** Persistent negative inflation: π_M falls by -0.01319 (1q), -0.04930 (4q), -0.11899 (12q), -0.14797 (40q). Cumulative sums are large and negative.

- π_D **(downstream inflation):** Smaller disinflation than manufacturing (e.g. -0.01319 at 1q, -0.05971 at 40q). Interpretation: pass-through from upstream drives downstream disinflation, attenuated by wage (value-added) share.

- mup **(markup gap):** Constant at -0.10536 every period (the imposed permanent shock). Its cumulative value over T quarters equals $-0.10536 \times T$.

- R **(nominal interest rate):** Small negative response (e.g. -0.00530 at 1q, -0.05712 at 40q). Interpretation: the central bank eases in response to disinflation, supporting later recovery.

Table 4: Peak responses to a permanent -10% markup shock (log-deviations)

Variable	1 quarter	4 quarters	12 quarters	40 quarters
y_M	0.037684	-0.066689	-0.269525	-0.378916
x_M	-0.005706	-0.005706	0.016882	0.026125
y_D	-0.014265	-0.014265	0.042205	0.065313
c	-0.014265	-0.014265	0.042205	0.065313
π_M	-0.013194	-0.049297	-0.118993	-0.147972
π_D	-0.011768	-0.027185	-0.051887	-0.059859
$\widehat{\mu}$ (mup)	-0.105361	-0.105361	-0.105361	-0.105361
R	-0.004957	-0.019857	-0.046872	-0.057260
w (wage)	-0.010817	-0.050110	-0.126027	-0.158570
L^M (lm)	0.037684	-0.066689	-0.269525	-0.378916
L^D (ld)	-0.019971	-0.019971	0.059087	0.091438
p^M (level)	-0.013194	-0.126153	-0.860132	-4.040662
p^D (level)	-0.011768	-0.080527	-0.419669	-1.629178

Table 5: Cumulative responses (sum of log-deviations) to a permanent -10% markup shock

Variable	1 quarter	4 quarters	12 quarters	40 quarters
y_M	0.037684	−0.062161	−1.574783	−9.839403
x_M	−0.005706	−0.007177	0.080148	0.650326
y_D	−0.014265	−0.017942	0.200369	1.625815
c	−0.014265	−0.017942	0.200369	1.625815
π_M	−0.013194	−0.126153	−0.860132	−4.040662
π_D	−0.011768	−0.080527	−0.419669	−1.625789
$\widehat{\mu}$ (mup)	−0.105361	−0.421442	−1.264326	−4.214421
R	−0.004957	−0.050334	−0.341833	−1.585491
w (wage)	−0.010817	−0.123163	−0.893527	−4.311631
L^M (lm)	0.037684	−0.062161	−1.574783	−9.839403
L^D (ld)	−0.019971	−0.025119	0.280517	2.276141
p^M (level)	−0.013194	−0.255211	−4.214165	−81.699904
p^D (level)	−0.011768	−0.175982	−2.221782	−35.266940

Peak signed responses at horizons 1, 4, 12, and 40 quarters are reported in Table 4, and for cumulative responses in Table 5 in Appendix A. Peak responses report the maximum (signed) quarter-by-quarter impact, while cumulative responses sum the IRF up to horizon H (for inflation, this equals the implied log price-level change). For example, in the case of downstream output y^D, the peak impact is about -0.014 (a 1.4 percent log-deviation) on impact, capturing the maximum short-run contraction. By contrast, the cumulative response of y^D over 12 quarters is $+0.200$, meaning that despite the short-run dip, the economy experiences a net gain of roughly 20 log-points in downstream output once cheaper intermediates feed through. Similarly, for upstream inflation π^M, the peak response at 4 quarters is -0.049, but the cumulative sum at 12 quarters reaches -0.860, which corresponds directly to an 86 log-point reduction in the upstream price level over that horizon.

Because the shock specification includes a permanent component (unit root), cumulative sums grow with horizon and can be misleading as a long-run measure, for long-run/level comparisons, I therefore complement the IRFs with a separate comparative steady-state exercise reported in Table3 in Appendix A, such that the interpretation of the bottom panels plot p^M and p^D should read jointly with comparative steady-state results.

A.1. Calibration and Linearization

Calibration chooses a small set of structural parameters so the model reproduces economically meaningful steady-state moments and standard New Keynesian targets (steady-state markups, BEA input–output shares, sectoral inflation persistence, and conventional Taylor-rule responses). Baseline numerical values used for all experiments are reported in Table 1; full data sources, derived steady-state objects (e.g. A^M, B^*), and the analytic mapping from the structural antitrust shock to the log-markup gap are given in Appendix A.

Parameter definitions: The key calibrated parameters are:

- σ**:** CRRA (coefficient of relative risk aversion); inverse of the IES for consumption.
- φ**:** Inverse Frisch elasticity (determines the labor-supply curvature).

β: Subjective discount factor (pins down the steady real rate via $\beta R = 1$ in a zero-inflation steady state).

θ: Dixit–Stiglitz elasticity across upstream varieties; $\bar{\mu}_M = \theta/(\theta - 1)$.

ε: CES elasticity between labour and intermediate inputs in downstream production (shapes downstream cost shares).

α: Downstream value-added (labour) share (from BEA IO aggregation).

ϕ_π, ϕ_y: Taylor-rule coefficients on inflation and output; $\phi_\pi > 1$ signals an "active" policy.

ρ_R: Interest-rate smoothing in the Taylor rule (policy inertia).

$\rho_\mu,\ \lambda_\theta$: Reduced-form markup persistence and the linear mapping coefficient that converts a structural ε^θ shock into the log-markup gap used in the NKPC (numerical values and derivation: Table 1 and Appendix A).

A.2. Steady-state derivations used in calibration

Table 6: Derived steady-state quantities and data/source notes

Quantity	Definition / formula	Value (Model)	Source / notes
Downstream output	Normalization	$Y^D = 1.00$	Normalization (no investment)
Consumption	$C = Y^D$ (no investment)	$C = 1.00$	Model normalization
Upstream output	IO identity: $Y^M = (1-\alpha)Y^D$	$Y^M = 0.40$	$1-\alpha = 0.40$ (BEA two-sector aggregation)
Upstream labor L^M	Steady-state solution	$L^M = 0.47619$	Calibrated (Dynare)
Downstream labor L^D	$L^{tot} - L^M$ (with $L^{tot} = 1$)	$L^D = 0.52381$	Normalization ($L^{tot} = 1$)
Upstream productivity	$A^M = Y^M/L^M$ (linear tech)	$A^M \approx 0.84$	Computed steady-state
Downstream prod. A^D	Normalization	$A^D = 1.00$	Model normalization (scale)
Wage	Marginal product	$W = 0.84$	Endogenous (Dynare)
Upstream markup	Target $\bar{\mu}_M$	$\bar{\mu}_M = 1.20$	Compustat/De Loecker & Warzynski; BEA industry margins
Dixit–Stiglitz $\bar{\theta}$	$\bar{\theta} = \bar{\mu}_M/(\bar{\mu}_M - 1)$	$\bar{\theta}_M = 6.0$	Implied from $\bar{\mu}_M$
Mapping coeff. λ_θ	$\lambda_\theta = \left.\dfrac{d\ln\mu}{d\theta}\right\rvert_{\bar{\theta}} = -\dfrac{1}{\bar{\theta}(\bar{\theta}-1)}$	$\lambda_\theta = -1/30$	Analytical derivative (used to map eps_theta→mup)
Antitrust shock ε^θ	$\varepsilon_1^\theta = \widehat{\mu}_1/\lambda_\theta$, $\widehat{\mu}_1 = \ln(0.9)$	$\varepsilon_1^\theta \approx 3.1608$	Used in Dynare shocks
Markup gap $\widehat{\mu}_1$	$\ln(0.9)$ (10% level fall)	$\widehat{\mu}_1 \approx -0.1053605$	Target experiment
Bond holdings B^*	$\frac{\beta(W^*L^* - p^C C^*)}{1-\beta}$, (with $P^C = 1$)	$B^* = -15.84$	Closed form (depends on normalization)
Rotemberg costs	Calibration inputs	$\kappa_M = 150$, $\kappa_D = 200$	Tuned to inflation persistence (NK Literature)
Monetary policy	Taylor rule params	$\rho_R = 0.8$, $\phi_\pi = 1.5$, $\phi_y = 0.5$	Standard DSGE values
Horizon T	Deterministic perf.-foresight IRF horizon	$T = 40$ qtrs	Solver choice

Notes: "Value (model)" reports numbers produced by the `dynare.mod script` and used in the experiments (Dynare 5.2). Data citations: BEA Input–Output Accounts (Industry-by-Industry tables, most recent year), BLS / NIPA for labor income shares, and Compustat / De Loecker et al. for firm-level gross margins. The closed-form B^* is sensitive to the normalizations $C = 1$, $Y^D = 1$, $A^D = 1$ and $L^{tot} = 1$; I will report comparative-steady-state values when presenting counterfactuals.

I report the algebra used to compute the steady-state scalars that enter the dynamic experiments. The model is calibrated so that downstream output is normalized to $Y^D = 1$ and consumption equals downstream output $C = Y^D = 1$ (no investment). The downstream production function is the CES aggregator (log-linearized in the dynamics), with downstream labor share α and intermediate (manufacturing) share $1 - \alpha$. The two-sector IO identity in steady state implies

$$X^M = (1-\alpha)Y^D,$$

and, under market clearing, upstream manufacturing output supplies intermediates:

$$Y^M = X^M = (1-\alpha)Y^D.$$

With the linear technology $Y^M = A^M L^M$ we recover the upstream productivity as

$$A^M = \frac{Y^M}{L^M}.$$

The household labor-supply condition (steady state) is obtained from the first-order condition

$$\chi(L^*)^\varphi = W^*(C^*)^{-\sigma},$$

which for our normalizations $C^* = 1$ and $\varphi = 1$ reduces to

$$\chi L^* = W^*.$$

I compute the steady-state (closed-form) risk-free bond holdings B^* from the period budget constraint and the fact that in steady-state $R^* = 1/\beta$. Starting from

$$P_C C^* + B^* = W^* L^* + R^* B^*,$$

and rearranging, I obtain

$$B^* = \frac{\beta\big(W^* L^* - P_C C^*\big)}{1-\beta},$$

which is the expression used to compute B^* below (we set $P_C = 1$ under our normalization).