ORGANIZATIONAL TARGETS IN GENERAL EQUILIBRIUM

By

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ABSTRACT

We build a general equilibrium model in which firms endogenously choose whether to target prices or quantities. We characterize how these choices of organizational targets depend on firms' uncertainty about microeconomic and macroeconomic factors. In equilibrium, the transmission of both nominal and real shocks hinges on firms' organizational targets. For example, under otherwise identical microfoundations, money is neutral under quantity targets and non-neutral under price targets. We further characterize how targets shape firms' strategic interactions and prove that the macroeconomic uncertainty that arises from each choice of targets reinforces incentives to choose that target. That is, choices of organizational targets are strategic complements. For this reason, monetary policy aimed at stabilization can backfire by inducing a regime shift that renders it ineffective. A simple quantification suggests that incentives over organizational targets can vary markedly at business-cycle frequencies and help explain the state-dependent pass-through of monetary shocks to prices and output.

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1 Introduction

Before making a choice, organizations must decide *what to choose*. Indeed, the seminal organizational analysis of Simon (1947) begins by emphasizing the importance of studying "the determining of what is to be done rather than [...] the actual doing." A classic instance of this general problem arises in the context of firms engaged in competition with the rest of the market. Should such firms target a desired price or a desired level of production? In practice, both approaches are prevalent. For example, in a survey of Austrian manufacturing firms, Aiginger (1999) found that two-thirds identified prices as their key decision variable while the remaining one-third identified quantities.

This choice of targets has significant implications for equilibrium outcomes. The classic example is the distinction between the oligopoly games of Bertrand (1883), which assumes price targets, and Cournot (1838), which assumes quantity targets. It is well understood that firms exercise some control over their choice of targets, except in some rare cases where technological feasibility makes one choice impossible. This problem of choosing targets has been studied extensively in the economics of industrial organization (*e.g.*, Klemperer and Meyer, 1986) and in operations research (*e.g.*, Olhager, 2003).

In macroeconomics, firms' strategic choices are central to modern theories of the business cycle. For example, models of monetary transmission often assume that firms engage in price competition (*e.g.,* Woodford, 2003b; Christiano et al., 2005), emphasize the role of strategic complementarity in price choices for generating inertia in the price level (*e.g.,* Ball and Romer, 1991; Woodford, 2003a; Basu, 2005; Chan et al., 2025), and draw normative conclusions about the optimal conduct of monetary policy (*e.g.,* Angeletos and La'O, 2020; La'O and Tahbaz-Salehi, 2022; McKay and Wolf, 2025). Models of real fluctuations often assume that firms engage in quantity competition and emphasize the role of strategic complementarity in quantity choices for amplifying the business cycle (*e.g.,* Angeletos and La'O, 2010, 2013; Benhabib et al., 2015). Nonetheless, despite the central role of these *opposite* strategic assumptions in the aforementioned literatures, prior work in macroeconomics does not consider the possibility that firms' organizational targets may themselves be choices that are endogenous to economic conditions (an important exception, discussed later, is Reis, 2006).

In this paper, we embed the endogenous choice of organizational targets in an otherwise canonical general equilibrium model of the business cycle (as in Woodford, 2003a; Hellwig and Venkateswaran, 2009, 2025). We characterize how firms' uncertainty shapes the decision of what to target and how firms' targets affect the transmission mechanisms of both nominal and real shocks. For example, under quantity targets, money is neutral in any equilibrium, while under price targets it is not. Moreover, we show that organizational target choice is one of strategic complements: if other firms target prices, the resulting nature of macroeconomic uncertainty increases the incentives of any particular firm to target prices. Because of this *meta-complementarity* in the choice of targets, the economy is prone to regime shifts in the nature of firm decision-making, leading to endogenous time-variation in the response of the economy to nominal and real shocks. From a monetary policy perspective, endogeneity of firms' targets can lead to a failure of the divine coincidence absent any cost-push shocks: while price stability and output gap stabilization are jointly possible if firms target prices, firms may prefer to target quantities given their resulting uncertainty. We finally provide suggestive evidence of these trade-offs in US data: empirical measures of uncertainty on average imply a failure of divine coincidence, changes in macroeconomic risk meaningfully affect firms' model-implied target-setting incentives, and the state-dependent transmission of monetary policy shocks lines up with the model's predictions.

The Organizational Targeting Problem. We first study the choice of targeting prices *vs.* quantities for a single firm. We study a textbook environment in which the firm operates a Cobb-Douglas production function and faces a constant price elasticity of demand. It maximizes dollar profits, deflated by the aggregate price, and multiplied by a real stochastic discount factor. It is uncertain about shocks to demand, input prices, productivity, the stochastic discount factor, and the aggregate price level. The firm can choose whether to set a price target or a quantity target. The underlying assumption is that the firm's attentional, contracting, or organizational frictions necessitate that it plan for one or the other *ex ante*.[1]

This notion that firms can design their organizational structure to implement a target is familiar from analyses of competition in industrial organization (*e.g.*, Singh and Vives, 1984; Cheng, 1985; Klemperer and Meyer, 1986). Far from being merely a theoretical curiosity, firms' target choices are central in the field of operations research, which studies firms' strategic choice of the *order penetration point* (Olhager, 2003). That is, should firms "produce-to-stock," determining prices *ex post* based on orders (as under quantity-setting), or "produce-to-order," meeting demand at a previously quoted price (as under price-setting)?

In our model, price and quantity targeting have different values to the firm because they expose the firm to different sources of risk. We derive a closed-form expression for the relative value of price versus quantity targets that depends on the elasticity of demand and the firm's uncertainty about demand shocks, the price level, and the co-movements between real marginal costs and both demand and the price level. The intuition is most easily understood by considering the scenarios under which price targeting is a relatively better or

[1] A natural question is what might happen if the firm made *ex ante* commitments to *both* strategic variables. Under uncertainty, this would generically lead to a scenario in which it is impossible for the market to clear. See Flynn et al. (2026a) for an analysis of such a non-Walrasian setting.

worse commitment. In our setting, the firm desires for its price to be a constant markup over nominal marginal costs. If the firm is uncertain primarily about product-level demand, but relatively confident about marginal costs, then the price target is safe. If instead the firm is uncertain about the price level itself, or fears that demand will be high for the product exactly when the product is most costly to produce, then price targeting exposes the firm to significant risks. Quantity targeting, by contrast, better shields the firm against the very same risks. In extensions, we show how these basic trade-offs continue to characterize firms' organizational choices in settings with other, purely technological reasons to favor price or quantity targets, such as adjustment costs or decreasing returns to scale.

Price and Quantity Targets in General Equilibrium. To understand the equilibrium implications of endogenous targets, we embed this mechanism in an otherwise entirely standard monetary business-cycle model with incomplete information, following Woodford (2003a) and Hellwig and Venkateswaran (2009). In addition to exogenous microeconomic and macroeconomic uncertainty, the model generates endogenous macroeconomic uncertainty about firms' demand, aggregate prices, and marginal costs.

We first study aggregate outcomes in *temporary equilibria* in which we fix that all firms target quantities or that all firms target prices. Under quantity targets, the game between firms can feature either strategic complementarity or substitutability depending on the relative size of aggregate demand externalities and factor price pressure, as in Angeletos and La'O (2010). Moreover, in this game, the aggregate demand state is a payoff-irrelevant shock. Thus, demand and monetary shocks are neutral for real output and affect the price level one-for-one. Under price targets, in an environment with otherwise *identical* microfoundations, price choices are strategically neutral in general equilibrium.

We next study the equilibrium incentives for targeting prices *vs.* quantities. There is a positive feedback loop in the equilibrium choice of organizational targets: the incentives to target prices as opposed to quantities are stronger when other firms target prices, and *vice versa*. When other firms target prices, demand and money shocks are non-neutral and the pass-through of these shocks into prices is less than one-for-one. Thus, when firms target prices, prices are less volatile than when firms target quantities. This reduced uncertainty about the aggregate price level makes price-targeting more attractive. We refer to this property as *meta-complementarity* in the choice of organizational targets. Thus, macroeconomic uncertainty can be self-fulfilling: price-setting generates less aggregate price volatility and greater aggregate output volatility, which in turn makes price targets more attractive.

We fully characterize the conditions under which meta-complementarity in organizational targets gives rise to a unique price-setting regime, a unique quantity-setting regime, or equilibrium multiplicity. The last possibility obtains under intermediate levels of uncertainty.

In such situations, the economy can fluctuate between price-setting and quantity-setting regimes, generating time-varying macroeconomic volatility even in the absence of extrinsic shocks to uncertainty. More generally, shocks to firms' uncertainty about idiosyncratic and aggregate demand shift the economy between price-setting and quantity-setting regimes, allowing the model to generate markedly different shock pass-through and aggregate volatility, even when the model features a unique equilibrium.

Monetary Policy with Endogenous Targets. We next study how these dynamics affect trade-offs for monetary policy. In particular, we consider a policymaker that can control how the money supply responds to the price level. Their objective is to minimize the output gap and to achieve price stability.

We first show that, depending on the targets that firms choose, systematic monetary policy has sharply different effects: in particular, policy can only affect the output gap when firms set price targets. Since firms' choice of targets depends on their uncertainty, and therefore on policy itself, this creates a novel trade-off for the policymaker.

Next, we characterize optimal policy in this setting. We identify a key condition on primitives under which the policymaker can achieve a "divine coincidence" of closing the output gap and achieving price stability. This condition characterizes the joint restrictions on uncertainty such that firms would be willing to target prices when monetary policy is extremely hawkish. When this condition fails, excessively hawkish policy can backfire by sending the macroeconomy into a quantity-targeting regime in which monetary policy loses all power to affect the real economy. Thus, our analysis reveals a novel justification for policymakers to face a meaningful inflation-output trade-off, even without adding additional frictions such as cost-push shocks (Clarida et al., 1999), wage rigidity (Blanchard and Galí, 2007), or real rigidities (Angeletos and La'O, 2020).

An Illustrative Quantification. The paper concludes with an illustrative calculation of the incentives firms may face for target choice in practice. First, we show how the endogenous choice of targets complicates the separate measurement of firm-level demand and productivity shocks, a distinction that is often immaterial in standard analyses of risk and the business cycle (*e.g.,* that of Bloom et al., 2018). Nonetheless, a calculation based on measurements of physical and revenue-based total factor productivity by Foster et al. (2008) suggests that firms may face strong microeconomic incentives to target quantities.

Second, using a simple stochastic volatility model estimated on US data, we calculate the time-varying incentives to target prices or quantities according to the model and show that this object fluctuates substantially. In particular, episodes in which inflation volatility spikes (*e.g.,* the 1970s and the 2020s) lead to higher incentives for quantity targeting.

Finally, we test the model's prediction that high quantity-targeting incentives lead monetary shocks to have weak real effects and high pass-through into prices. We do so by estimating rolling-window local-projection regressions of aggregate output and the price level on monetary shocks from Romer and Romer (2004). We find: (i) a negative relationship between the estimated pass-through of monetary shocks into output and the estimated quantity-setting incentives and (ii) a positive relationship between the pass-through of monetary shocks into prices and the estimated quantity-setting incentives. This provides empirical validation for one of the core macroeconomic predictions of the theory.

Related Literature. Our primary contribution is to characterize how firms choose organizational targets in a macroeconomic setting and analyze how this shapes shock transmission and optimal monetary policy. Our analysis builds upon previous studies of strategic interactions in macroeconomic models of price-setting (*e.g.*, Woodford, 2003a; Ball and Romer, 1991; Basu, 2005; Chan et al., 2025) and quantity-setting (*e.g.*, Angeletos and La'O, 2010; Benhabib et al., 2015) by introducing the choice of organizational targets. This reveals a new form of macroeconomic complementarity, in the choice of targets itself, and leads optimal policy to deviate from the "divine coincidence" outcome in which price stability is always optimal. This last point complements, but differs from, the finding of Angeletos and La'O (2020) that monetary policy in a setting with information frictions can deviate from the divine coincidence because of *real rigidities*, or frictions that prevent adjustment of fixed inputs: here, the reason is instead strategic choices of organizational targets.

The closest analysis to ours in the macroeconomics literature is that of Reis (2006), who derives a condition for whether a firm should plan in prices or quantities. When cost and demand shocks are independent, Reis (2006) shows that price-setting is *always* preferred. Our analysis differs in two key ways. First, we allow for uncertainty about multiple, correlated shocks, which arises because costs and demand are endogenously correlated in general equilibrium. Second, we characterize the prices *vs.* quantities choice in general equilibrium and study its implications for macroeconomic dynamics and policy.

Our work also relates closely to work in industrial organization by Klemperer and Meyer (1986, 1989), in which the authors study oligopoly games under uncertainty with, respectively, price *vs.* quantity choice and supply-function choice. Recent work in macroeconomics in this vein is by Flynn et al. (2026b), which adopts the supply-function methodology of Klemperer and Meyer (1989). By contrast, this paper analyzes firms' organizational target choices and provides a complete characterization of these strategic interactions in general equilibrium. In turn, our work allows us to further study the equilibrium effects of different policy rules and test the model's key mechanisms in the data.

Our work's macroeconomic predictions relate to the literature on how uncertainty matters for the business cycle and *vice versa*. Previous work emphasizes how macroeconomic uncertainty affects firms' *quantitative* decisions, such as how much to produce, consume, or invest (see, *e.g.,* Basu and Bundick, 2017; Bloom et al., 2018). By contrast, our analysis studies how the nature and extent of uncertainty about various factors affect the *qualitative* decision of what strategic variable to target. Moreover, our theory offers a novel mechanism for endogenous macroeconomic uncertainty, which is known to be highly cyclical (see *e.g.,* Jurado et al., 2015), through variations in the nature of firms' decision-making.

2 The Firm's Problem of Choosing Targets

It has long been understood in industrial economics that firms can either compete on prices or quantities by targeting one or the other as their main strategic variable (*e.g.*, Singh and Vives, 1984; Cheng, 1985; Klemperer and Meyer, 1986, 1989, see also the 1883 critique of Bertrand on Cournot). This literature emphasizes that organizational choices made at the managerial level determine whether firms compete using prices or quantities as their strategic variable and highlights that uncertainty is an economically important factor in this choice.

The notion that firms deliberately choose organizational structures so that they operate more like price-setters or quantity-setters has also long been acknowledged in operations research. This trade-off is referred to as the *customer-order decoupling problem* (Olhager, 2010). Concretely, this problem studies when in the production process a product should be "tied" to a given customer order. In produce-to-stock settings, the firm chooses a production quantity before observing realized orders and then sells whatever clears the market *ex post*, potentially through markdowns, dealer discounts, or spot negotiations. In produce-to-order settings, by contrast, the firm waits for a specific order or quote request, so the natural commitment is a quoted price and the quantity adjusts to realized demand at that quote. In operations terms, these correspond to different choices of the so-called *order penetration point*, with produce-to-stock settings resembling the economic metaphor of quantity-setting and produce-to-order settings resembling the metaphor of price-setting. Critically, the operations research literature emphasizes that a firm's positioning of the order penetration point is a strategic, organizational choice (Berry and Hill, 1992; Olhager, 2003).

Furthermore, as a practical matter, the choice of targets appears in the legal architecture of contracts. The Uniform Commercial Code (UCC) is a standardized set of rules governing transactions in the US (see White et al., 2022, for a summary). Under UCC §2-305, parties can form a binding sales contract either with a fixed price (resembling price-setting) or with the price left indeterminate (resembling quantity-setting). Thus, the choice between price or quantity commitments emerges as a choice between different forms of contracting.

In this section, we formalize these trade-offs under canonical microfoundations to evaluate when a firm should target prices or quantities. This decision will form the core new component of our subsequent general equilibrium model.

2.1 Framework

In order to formalize the trade-offs encompassing a firm's organizational choice, we begin by studying the problem of a single firm that must fix either a quantity $q \in \mathbb{R}_+$ or a price $p \in \mathbb{R}_+$. When doing so, the firm faces potential uncertainty about its costs, demand, the price level (*i.e.,* the prices of competitors), and the stochastic discount factor. Concretely, we assume that the firm faces a constant-price-elasticity-of-demand demand curve given by:

$$\frac{p}{P} = \left(\frac{q}{\Psi}\right)^{-\frac{1}{\eta}} \tag{1}$$

where the random variable $\Psi \in \mathbb{R}_{++}$ is a stochastic demand shifter, the random variable $P \in \mathbb{R}_{++}$ is the aggregate price level, and $\eta > 1$ is the price elasticity of demand. The firm purchases bundles of inputs $x \in \mathbb{R}_+^I$ at prices $p_x \in \mathbb{R}_{++}^I$ to produce according to a constant-returns-to-scale, Cobb-Douglas production function:

$$q = \Theta \prod_{i=1}^{I} x_i^{\alpha_i} \tag{2}$$

where the random variable $\Theta \in \mathbb{R}_{++}$ corresponds to the firm's Hicks-neutral productivity, and $\alpha_i \in \mathbb{R}_{++}$ is the input share of good i (with the property that $\sum_{i=1}^{I} \alpha_i = 1$). Finally, the firm's profits are priced according to a real stochastic discount factor represented by the random variable $\Lambda \in \mathbb{R}_{++}$.

The firm believes that the collection of random variables comprising demand, aggregate prices, productivity, input costs, and the stochastic discount factor $(\Psi, P, \Theta, \Lambda, p_x)$ is log-normal with mean μ and covariance matrix Σ with generic element $\sigma_{X,Y} = \text{Cov}(\ln X, \ln Y)$ for generic random variables X and Y. Given this uncertainty, the firm seeks to maximize the expected value of real profits under the given stochastic discount factor:

$$\mathbb{E}\left[\frac{\Lambda}{P}\left(pq - p_x x\right)\right] \tag{3}$$

The Optimal Price Target. We first consider the problem of price-targeting. If the firm targets a price p, it sells the quantity that clears markets *ex post*, or lies on the demand curve: $q = \Psi\left(\frac{p}{P}\right)^{-\eta}$. That is, the firm has committed to meeting demand at this price.

We now derive the optimal price. The cost of producing q is given by:

$$c(q; p_x, \Theta) = \min_{x \in \mathbb{R}_+^I} \sum_{i=1}^{I} p_{xi} x_i \quad \text{s.t.} \quad q = \Theta \prod_{i=1}^{I} x_i^{\alpha_i} \tag{4}$$

Taking first-order conditions, we obtain that the real cost function is given by $\frac{c(q;p_x,\Theta)}{P} = \mathcal{M}(P, \Theta, p_x) q$, with real marginal cost:

$$\mathcal{M}(P, \Theta, p_x) = P^{-1} \Theta^{-1} \prod_{i=1}^{I} \left(\frac{p_{xi}}{\alpha_i} \right)^{\alpha_i} \tag{5}$$

Thus, the problem of setting the optimal price reduces to:

$$V^P = \max_{p \in \mathbb{R}_+} \mathbb{E} \left[\Lambda \left(\frac{p}{P} - \mathcal{M} \right) \Psi \left(\frac{p}{P} \right)^{-\eta} \right] \tag{6}$$

Taking first-order conditions, the optimal price is given by:

$$p^* = \frac{\eta}{\eta - 1} \frac{\mathbb{E} \left[\Lambda \mathcal{M} P^{\eta} \Psi \right]}{\mathbb{E} \left[\Lambda P^{\eta - 1} \Psi \right]} \tag{7}$$

where the numerator is the expected marginal benefit of charging higher prices in reducing costs and the denominator is the expected marginal cost of charging higher prices in reducing revenue. In the absence of uncertainty, this reduces to the statement that the optimal relative price is a constant markup of $\frac{\eta}{\eta-1}$ on real marginal costs. Substituting the optimal price into the firm's payoff function and rearranging, we obtain that:

$$V^P = \frac{1}{\eta - 1} \left(\frac{\eta}{\eta - 1} \right)^{-\eta} \mathbb{E} \left[\Lambda \mathcal{M} P^{\eta} \Psi \right]^{1-\eta} \mathbb{E} \left[\Lambda P^{\eta - 1} \Psi \right]^{\eta} \tag{8}$$

The Optimal Quantity Target. We now study the problem of quantity targeting. If the firm targets a quantity q, it sells at the price that clears markets *ex post*: $p = P \left(\frac{q}{\Psi} \right)^{-\frac{1}{\eta}}$. Applying the earlier steps, the problem of setting the optimal quantity reduces to:

$$V^Q = \max_{q \in \mathbb{R}_+} \mathbb{E} \left[\Lambda \left(\left(\frac{q}{\Psi} \right)^{-\frac{1}{\eta}} - \mathcal{M} \right) q \right] \tag{9}$$

The optimal quantity is given by:

$$q^* = \left(\frac{\eta}{\eta - 1} \frac{\mathbb{E} \left[\Lambda \mathcal{M} \right]}{\mathbb{E} \left[\Lambda \Psi^{\frac{1}{\eta}} \right]} \right)^{-\eta} \tag{10}$$

where the numerator is the expected marginal cost of expanding production and the denominator is the expected marginal revenue from expanding production. In the absence of uncertainty, this is the quantity that the firm sells by setting its relative price equal to a constant markup on its real marginal cost. Substituting for q^* in the firm's payoff yields

$$V^Q = \frac{1}{\eta - 1}\left(\frac{\eta}{\eta - 1}\right)^{-\eta} \mathbb{E}\left[\Lambda \mathcal{M}\right]^{1-\eta} \mathbb{E}\left[\Lambda \Psi^{\frac{1}{\eta}}\right]^{\eta} \tag{11}$$

2.2 When to Target Prices *vs.* Quantities

A cursory inspection of the values of the price target and quantity target (Equations 8 and 11) reveals that they are not generally equal, precisely because of the uncertainty that the firm faces. We now characterize the trade-offs between price and quantity targets. We define the *comparative advantage of price setting* as the log difference between the values of price-setting and quantity-setting:

$$\Delta = \log V^P - \log V^Q \tag{12}$$

Under our log-normality assumption on the distribution of $(\Psi, P, \Theta, \Lambda, p_x)$, we have that $(\Psi, P, \Lambda, \mathcal{M})$ is also log-normal. Thus, we can analytically evaluate the expectations in Equations 8 and 11 and compute their differences. Performing these calculations, we obtain the following formula for the proportional benefit of prices over quantities:

Theorem 1 (Prices *vs.* Quantities)**.** *The comparative advantage of prices over quantities is given by:*

$$\Delta = \frac{1}{2}(\eta - 1)\left(\frac{1}{\eta}\sigma_\Psi^2 - \eta\sigma_P^2 - 2\sigma_{\Psi,\mathcal{M}} - 2\eta\sigma_{P,\mathcal{M}}\right) \tag{13}$$

Proof. See Appendix A.1. □

This formula expresses the relative benefit of prices over quantities in terms of a single structural parameter, the price elasticity of demand, and four uncertainties. Prices are preferred to quantities when, under the firm's beliefs, (i) the volatility of demand σ_Ψ^2 is high, (ii) the volatility of aggregate prices σ_P^2 is low, (iii) the covariance between demand and real marginal costs is low, and (iv) the covariance between aggregate prices and real marginal costs is low. In the absence of uncertainty, $\Delta = 0$ and the firm is indifferent between setting prices or quantities. Finally, note that Δ is in units of log expected real profits as the distribution of the stochastic discount factor drops out of the calculation.

The Four Relevant Uncertainties. We now describe the intuition for each of the four forces as well as their potential empirical relevance. First, in the presence of demand shocks alone, setting relative prices equal to a constant markup on marginal costs coincides with the full-information optimum. By contrast, fixing the quantity supplied induces losses. This rationalizes the common wisdom in the operations research literature that products with higher demand volatility should adopt organizational structures that resemble those of price-setting as opposed to quantity-setting (*e.g.*, produce-to-order, see Olhager, 2003).

Second, in the face of aggregate price shocks, fixing an optimal quantity allows relative prices to adjust perfectly, while fixing an optimal price leads the firm's price to diverge from the aggregate price and loses revenue. Thus, higher volatility of aggregate price shocks favors quantity targeting. We also note that the term related to price volatility is scaled by η^2 relative to the term related to demand volatility; thus, even if uncertainty about the latter is one or two orders of magnitude larger than uncertainty about the former, both forces may have a comparable effect on firms' planning incentives.

Third, if demand and real marginal costs positively covary, then a firm with a fixed price sells and produces more when costs are high, whereas a firm with a fixed quantity instead has its prices increase in those states. This force therefore favors quantity targeting. It arises naturally if firms face "quality shocks" that raise both demand and input requirements (Midrigan, 2011; Blanco et al., 2024), as has been argued in a suite of papers studying cost-price dynamics in menu costs models (see also, *e.g.,* Alvarez et al., 2016).

Fourth, a high covariance between aggregate prices and real marginal costs favors quantity targeting for the exact same reason. This may be natural if there are large supply-driven macroeconomic fluctuations (*e.g.,* shocks to aggregate productivity or oil prices).

What Doesn't Appear. As important as what does appear is what does not appear. First, no means of any variables appear. In Appendix B.2, we show that this is a robust feature of planning choices that extends beyond constant returns to scale technologies. Second, no moments involving the stochastic discount factor appear. This is somewhat surprising as price- and quantity-targets differentially expose the firm to priced risk (*i.e.,* risk that covaries with the stochastic discount factor). However, the stochastic discount factor has a symmetric effect on risk-adjusted profits in each case, and its properties are therefore immaterial for the comparison of price-setting and quantity-setting. Third, the variance of real marginal costs does not appear as both quantity and price-setting manage real marginal cost variation equally well under constant physical returns. An interesting implication is that uncertainty about shocks to the two primary components of revenue-based total factor productivity measures (Bloom et al., 2018), demand shocks and productivity shocks, have sharply different effects for firms' planning incentives. We return to this point in our quantitative analysis.

2.3 Extensions

While our baseline setting is canonical, two factors from which we have abstracted for expositional simplicity are: (i) costs of adjusting prices and quantities and (ii) the presence of real rigidities and decreasing returns to scale. We extend our framework to analyze these features in Appendix B and summarize the implications here.

Adjustment Costs. Our model assumes that there are no direct costs to *ex post* variation in prices or quantities, holding fixed their effects on (discounted) profits. However, in practice, adjusting quantities *ex post* could be costly because it is difficult to deploy (or hoard) factors, and adjusting prices *ex post* could be costly because it confuses or upsets consumers. To capture these forces, we pursue an extension in Appendix B.1 which allows for adjustment costs proportional to the unexpected variance of log quantities and log prices and provide the analogue to Theorem 1. Intuitively, quantity variance penalties favor quantity-setting and price variance penalties favor price-setting. The key considerations described in our main analysis remain identical otherwise. In this way, adjustment costs might tilt the balance toward either prices or quantities, but not upset the logic that prices become more favorable with high demand variance and low price-level variance. Thus, for the remainder of our analysis, to focus on the novel qualitative economics of endogenous target choice, we abstract from adjustment costs while acknowledging that they may matter quantitatively.

Decreasing Returns to Scale. We also consider how technology interacts with organizational target choice via decreasing returns to scale (DRS). Concretely, we assume that firm technology is given by $q = \Theta K^{\alpha} x^{1-\alpha}$, where $K \in \mathbb{R}_+$ is to be interpreted as a capital commitment that must be made *ex ante* at a potentially stochastic price $r \in \mathbb{R}_{++}$. The price-targeting and quantity-targeting problems of the firm are otherwise unchanged. This formulation captures settings in which firms might be technologically constrained to meet demand at posted prices because of pre-committed investments (*e.g.*, a car manufacturer installing machinery for a production line, a farmer sowing seeds for his crops, a chip manufacturer installing a new fabrication plant, *etc.*). Appendix B.2 contains further details.

In this environment, all of our qualitative results regarding target choice naturally extend to the case in which firms operate such technologies. However, DRS reduces the incentives of price-targeting because it is costlier for firms to expand production when demand is higher than anticipated. In Appendix B.2, we show that increasing α reduces the incentives of price-targeting if and only if $\sigma_d^2 > 2(\sigma_{\Theta,d} + \eta\sigma_{\Psi,P})$, where $d = P^{\eta}\Psi$. Intuitively, large demand fluctuations (as captured by σ_d^2) mean that a firm with DRS incurs large expected losses to meet demand when price-setting as it is more difficult to adjust output *ex-post*.

3 A Macroeconomic Model of Organizational Targets

We now study the macroeconomic implications of organizational choice. Our motivation for this exercise is threefold. First, as emphasized in industrial economics, a given firm's organizational choices can influence the organizational choices of other firms (Singh and Vives, 1984). Understanding these strategic interactions necessitates a general equilibrium model. Second, the transmission of macroeconomic shocks is likely to depend on how firms choose their organizational structures, as this ultimately determines which margin of adjustment is more flexible *ex-post*. Third, monetary policy, via its effects on uncertainty, can influence organizational choices and thus the business cycle. In order to study these questions, we construct a general equilibrium framework. We intentionally use standard microfoundations (see *e.g.,* Woodford, 2003b; Hellwig and Venkateswaran, 2009; Drenik and Perez, 2020) and deviate only in allowing firms to choose whether to commit to price or quantity choice. Importantly, motivated by our findings of Section 2, we allow firms to face rich sources of uncertainty in their technology, demand, costs, and the choices of their competitors.

3.1 Households

Time is discrete and infinite $t \in \mathbb{N}$. A representative household has expected discounted utility preferences with discount factor $\beta \in (0,1)$ and per-period utility defined over a consumption aggregate, C_t, holdings of real money balances, $\frac{M_t}{P_t}$, and labor effort supplied to each firm, N_{it}:

$$\mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t \left(\frac{C_t^{1-\gamma}}{1-\gamma} + \frac{1}{\xi_t} \ln \frac{M_t}{P_t} - \int_{[0,1]} \phi_{it} N_{it} \, \mathrm{d}i \right) \right] \tag{14}$$

In this expression, $\gamma \geq 0$ indexes income effects in both money demand and labor supply, $\phi_{it} > 0$ is the marginal disutility of labor supplied to firm i at time t, which is IID and follows $\log \phi_{it} \sim N(\mu_\phi, \sigma^2_{\phi,t})$, for some sequence of variances $(\sigma^2_{\phi,t})_{t\in\mathbb{N}}$, and ξ_t is a preference shock that follows a random walk in logarithms:

$$\log \xi_t = \mu_\xi + \log \xi_{t-1} + \sigma_{\xi,t} \varepsilon_t^\xi \tag{15}$$

where $\varepsilon_t^\xi \sim N(0,1)$ is an IID random variable, $(\sigma^2_{\xi,t})_{t\in\mathbb{N}}$ is a sequence of time-varying variances, and we assume $\mu_\xi \geq \frac{1}{2}\sigma^2_{\xi,t} > 0$ for all $t \in \mathbb{N}$ in order for inverse preference shocks to have a bounded long-run expectation. As will become clear in due course, we can interpret ε_t^ξ as an aggregate demand shock, and we therefore refer to ξ_t as the aggregate demand state. In particular, higher values of ξ_t will induce higher consumption as households substitute away from holding real money balances.

The consumption aggregate C_t is a constant-elasticity-of-substitution aggregate of the individual consumption varieties with elasticity of substitution given by $\eta > 1$. We define the consumption index and its corresponding ideal price index as

$$C_t = \left(\int_{[0,1]} \vartheta_{it}^{\frac{1}{\eta}} c_{it}^{\frac{\eta-1}{\eta}} \, \mathrm{d}i \right)^{\frac{\eta}{\eta-1}}, \qquad P_t = \left(\int_{[0,1]} \vartheta_{it} p_{it}^{1-\eta} \, \mathrm{d}i \right)^{\frac{1}{1-\eta}} \tag{16}$$

where ϑ_{it} is a preference shock that is independent over time with marginal distribution $\log \vartheta_{it} \sim N(\mu_\vartheta, \sigma_{\vartheta,t}^2)$, and where $(\sigma_{\vartheta,t}^2)_{t\in\mathbb{N}}$ is a sequence of variances. We allow the demand shock to be correlated with firm-level productivity shocks, which we introduce shortly.

Households can save in either money or risk-free one-period bonds B_t (in zero net supply) that pay an interest rate of $(1 + i_t)$. The household owns the firms in the economy, each of which has profits of Π_{it}. Thus, the household faces the following budget constraint at each time t:

$$M_t + B_t + \int_{[0,1]} p_{it} C_{it} \, \mathrm{d}i = M_{t-1} + (1 + i_{t-1}) B_{t-1} + \int_{[0,1]} w_{it} N_{it} \, \mathrm{d}i + \int_{[0,1]} \Pi_{it} \, \mathrm{d}i + T_t \tag{17}$$

where p_{it} is the price of variety i, w_t is the nominal wage, and T_t are transfers of money from the government.

The government controls the money supply and implements its monetary policy through the aforementioned transfers. In the baseline model, we assume the money supply is constant: $M_t \equiv M$ for all $t \in \mathbb{N}$. In Section 6, we revisit the case with meaningful monetary policy, whereby the money supply responds to economic conditions.

3.2 Firms

The production side of the model follows closely the setup from Section 2. Each consumption variety is produced by a separate monopolist, also indexed by $i \in [0, 1]$. The firm hires labor L_{it} at wage w_{it} to produce according to the constant returns-to-scale production technology:

$$q_{it} = z_{it} A_t L_{it} \tag{18}$$

The microeconomic shock z_{it} is independent across time with marginal distribution $\log z_{it} \sim N(\mu_z, \sigma_{z,t}^2)$, with variances $(\sigma_{z,t}^2)_{t\in\mathbb{N}}$ that can vary across time. We let this shock be correlated with the microeconomic demand shock ϑ_{it} with covariance $\sigma_{\vartheta,z,t}$ in each period $t \in \mathbb{N}$. The aggregate shock $\log A_t$ follows an AR(1) with time-varying variance $(\sigma_{A,t}^2)_{t\in\mathbb{N}}$:

$$\log A_t = \rho \log A_{t-1} + \sigma_{A,t} \varepsilon_t^A \tag{19}$$

where the productivity innovations are IID and follow $\varepsilon_t^A \sim N(0,1)$. As we will explain shortly, we can interpret ε_t^A as an aggregate supply shock.

Firms, which are owned by the representative household, choose their organizational structures, as in Section 2. In either case, their objective is to maximize expectations of real profits under a stochastic discount factor Λ_t:

$$\mathbb{E}_{it}\left[\frac{\Lambda_t}{P_t}\left(p_{it}q_{it} - w_{it}L_{it}\right)\right] \tag{20}$$

We finally describe the timing of firms' decisions and their information sets. At the beginning of time period t, each firm first observes A_{t-1} and ξ_{t-1}. Second, each firm receives a private signal about aggregate productivity and the aggregate demand state:

$$s_{it}^A = \log A_t + \sigma_{A,s}\varepsilon_{it}^{s,A}, \qquad s_{it}^{\xi} = \log \xi_t + \sigma_{\xi,s}\varepsilon_{it}^{s,\xi} \tag{21}$$

where the signal noise is IID and follows $\varepsilon_{it}^{s,A}, \varepsilon_{it}^{s,\xi} \sim N(0,1)$. These signals govern how much information about contemporaneous conditions is incorporated in firms' choices. Third, firms choose their organizational targets and make their production decisions. Fourth, the demand state, idiosyncratic demand shocks, and both aggregate and idiosyncratic productivity are realized. Finally, the household makes its consumption and savings decisions.

3.3 Equilibrium

We define equilibrium in two steps. We first fix firms' target choice at each date t to define a rational expectations *temporary equilibrium*:

Definition 1 (Temporary Equilibrium)**.** *A temporary equilibrium is a partition of* $\mathbb{N}$ *into two sets* $\mathcal{T}^P$ *and* $\mathcal{T}^Q$ *and a collection of variables*

$$\begin{aligned}\big\{&\{p_{it}, q_{it}, C_{it}, N_{it}, L_{it}, w_{it}, \phi_{it}, \vartheta_{it}, z_{it}, \Pi_{it}\}_{i\in[0,1]},\\ &C_t, P_t, \xi_t, M_t, A_t, B_t, N_t, \Lambda_t, \sigma_{A,t}, \sigma_{\xi,t}, \sigma_{\vartheta,t}, \sigma_{\phi,t}, \sigma_{z,t}, \sigma_{\vartheta,z,t}\big\}_{t\in\mathbb{N}}\end{aligned} \tag{22}$$

such that:

1. *In periods $t \in \mathcal{T}^P$, all firms choose their prices p_{it} to maximize expected real profits under the household's real stochastic discount factor.*
2. *In periods $t \in \mathcal{T}^Q$, all firms choose their quantities q_{it} to maximize expected real profits under the household's real stochastic discount factor.*
3. *In all periods, the household chooses consumption C_{it}, labor supply N_{it}, money holdings M_t, and bond holdings B_t to maximize their expected utility subject to their lifetime*

budget constraint, while Λ_t is the household's marginal utility of consumption.

4. *In all periods, the aggregate demand state ξ_t and productivity A_t evolve exogenously via Equations 15 and 19, and all markets clear.*
5. *In all periods, firms' and consumers' expectations are consistent with the equilibrium law of motion.*

In a temporary equilibrium, firms set either prices or quantities, but the choice between the two is not necessarily optimal. We define an *equilibrium* as a temporary equilibrium in which the choice between price and quantity-setting is optimal at all times:

Definition 2 (Equilibrium). *An equilibrium is a temporary equilibrium in which:*

1. *If $t \in \mathcal{T}^P$, then all firms find price-setting optimal. That is, expected real profits under the household's real stochastic discount factor are weakly higher under price-setting than quantity-setting.*
2. *If $t \in \mathcal{T}^Q$, then all firms find quantity-setting optimal. That is, expected real profits under the household's real stochastic discount factor are weakly higher under quantity-setting than price-setting.*

4 Outcomes Under Organizational Targets

We first characterize aggregate outcomes in temporary equilibria with either price targets or quantity targets. This analysis demonstrates the macroeconomic consequences of firms' organizational targets, and it will be a critical input to our full equilibrium analysis with endogenous choices in Section 5.

4.1 Demand and Costs in Equilibrium

We first describe several important equilibrium relationships that will assist in our derivations. First, household optimization implies that demand for each good $i \in [0, 1]$ is

$$\frac{p_{it}}{P_t} = \left(\frac{q_{it}}{\vartheta_{it} C_t}\right)^{-\frac{1}{\eta}} \tag{23}$$

This corresponds to the firm-level demand curve in Equation 1 with $\Psi_{it} = \vartheta_{it} C_t$. The role of aggregate real GDP, C_t, corresponds to the aggregate demand externality (Blanchard and Kiyotaki, 1987). Next, the household's stochastic discount factor is $\Lambda_t = C_t^{-\gamma}$. Third, from the household's intratemporal labor choice, labor supply for each variety i is completely elastic and determines the real wage, $w_{it}/P_t = \phi_{it} C_t^\gamma$. Thus, the firm's real marginal cost (see Equation 5) is the ratio of real wages to productivity, or

$$\mathcal{M}_{it} = \frac{\phi_{it} C_t^\gamma}{z_{it} A_t} \tag{24}$$

Finally, using the household's indifference between holding money and bonds and the Euler equation for bonds, we derive the money demand equation

$$\frac{M_t}{P_t} = \xi_t^{-1} C_t^\gamma (1 + i_t^{-1}) \tag{25}$$

Demand for real money balances decreases in the nominal interest rate, because that is the opportunity cost of holding money; it increases in real consumption, because of a wealth effect; and it decreases in the shock ξ_t, which reduces the payoff from holding real balances. Moreover, as shown in Appendix A.2, the nominal interest rate is *deterministic* and therefore unaffected by shock realizations.

4.2 Outcomes Under Price Targeting

We now derive aggregate outcomes under price targets. In this analysis, as well as the corresponding analysis under quantity targets, we will solve for *log-linear temporary equilibria*, or temporary equilibria in which $\log C_t$ is linear in $(\log A_t, \log \xi_t)$.

We begin by simplifying each firm's pricing policy in equilibrium. Exploiting the joint log-normality of the variables within each expectation, we can write the firm's optimal price (Equation 7) as

$$\log p_{it} = \mathbb{E}_{it}[\log P_t + \log \mathcal{M}_{it}] + \tilde{K}_{P,t} \tag{26}$$

for a constant $\tilde{K}_{P,t}$ that depends only on the desired markup and the firm's uncertainty about these variables. This equation is the familiar relationship that (up to a constant that is independent of shock realizations) a firm sets its price proportional to nominal marginal costs when engaging in price-setting. From this, we can see the standard fact that—conditional on real marginal costs—firms' pricing decisions are strategic complements. However, as is well known, once marginal costs are treated as endogenous, this apparent complementarity need not survive (see *e.g.,* Woodford, 2003a). To see this, we can substitute for real marginal costs using Equations 24 and 25 to write:

$$\begin{aligned} \log p_{it} &= \mathbb{E}_{it}[\log P_t + \gamma \log C_t - \log A_t + \log \phi_{it} - \log z_{it}] + \tilde{K}_{P,t} \\ &= \mathbb{E}_{it}[\log \xi_t - \log A_t] + K_{P,t} \end{aligned} \tag{27}$$

where the last line simplifies and defines $K_{P,t} = \tilde{K}_{P,t} + \log M_t - \log\left(1 + i_t^{-1}\right) + \mu_\phi - \mu_z$.

It follows that the price-setting problem implies that there are no strategic interactions in general equilibrium, as the firm needs only to forecast exogenous shocks: the demand state ξ_t and aggregate productivity A_t. To build an intuition for this, mirroring our derivations above, consider what happens if firms expect others' prices to increase by 1%, holding fixed exogenous variables. Real consumption is expected to go down by $1/\gamma\%$ because of substitution from consumption to real money balances. Real wages demanded by workers change by γ per percentage increase in real consumption, due to income effects, so the total change expected by firms is $-\gamma \times 1/\gamma = -1\%$. This cancels with the expected 1% change in the price level: that is, in light of Equation 26, firms expect the price level and *real* marginal costs to move in equal and opposite ways, leaving nominal marginal costs constant. Thus, firms do not respond by changing their price.

To solve for macroeconomic dynamics, we take the equilibrium pricing policy (Equation 27), combine the resulting expression for the price level with the money demand curve (Equation 25), and guess-and-verify that equilibrium aggregates are log-linear in the aggregate shocks. To this end, it is convenient to define the Kalman gain parameters

$$\kappa_t^A = \frac{1}{1 + \left(\frac{\sigma_{A,s}}{\sigma_t^A}\right)^2} \in (0,1)\,, \qquad \kappa_t^\xi = \frac{1}{1 + \left(\frac{\sigma_{\xi,s}}{\sigma_t^\xi}\right)^2} \in (0,1) \tag{28}$$

which are the posterior weights on the firms' signals of productivity and the aggregate demand state. This yields the following equilibrium characterization:

Proposition 1 (Outcomes under Price Targets)**.** *If all firms set price targets, real output and the price level in the unique log-linear temporary equilibrium follow:*

$$\begin{aligned} \log C_t &= \chi_{0,t}^P + \frac{1}{\gamma}\kappa_t^A \log A_t + \frac{1}{\gamma}\left(1 - \kappa_t^\xi\right)\log \xi_t \\ \log P_t &= \tilde{\chi}_{0,t}^P - \kappa_t^A \log A_t + \kappa_t^\xi \log \xi_t \end{aligned} \tag{29}$$

where $\chi_{0,t}^P$ and $\tilde{\chi}_{0,t}^P$ are constants that depend only on parameters and past shocks to the economy.

Proof. See Appendix A.3. □

The response of the price level to each aggregate shock is attenuated by the Kalman gains κ_t^A and κ_t^ξ, because firms imperfectly forecast these shocks (recall Equation 27). This dampens the economy's response to productivity shocks. Intuitively, decreased prices are the only market signal that induces consumers to spend more after a productivity improvement in this economy. For demand shocks, incomplete information dampens the response of the price level and *amplifies* the response of real income. Moreover, demand shocks are non-neutral under any amount of incomplete information ($\kappa_t^\xi < 1$) and otherwise neutral in the complete-information limit. The basic logic echoes Lucas (1972) and Woodford (2003a). When aggregate demand increases by 1%, firms desire to increase their prices by 1% (Equation 27). But, due to incomplete information, they increase prices by only $\kappa_t^\xi\% < 1\%$ on average. To accommodate this change, given that the money supply and nominal interest rate are fixed, consumption of goods must go up; and firms that have made price plans honor their commitment by producing more goods.

4.3 Outcomes Under Quantity Targeting

We next study temporary equilibrium under quantity targets. As before, we first derive firms' optimal quantity target in equilibrium by (i) expressing firms' optimal choice (Equation 10) in logarithms:

$$\log q_{it} = -\eta \mathbb{E}_{it}[\log \mathcal{M}_{it}] + \mathbb{E}_{it}[\log \Psi_{it}] + \tilde{K}_{Q,t} \tag{30}$$

where $\tilde{K}_{Q,t}$ is a constant that depends only on the desired markup and the firm's uncertainty about random variables. Substituting in the equilibrium determination of real marginal costs and product-level demand, and then simplifying, we obtain the policy function:

$$\begin{aligned} \log q_{it} &= -\eta \mathbb{E}_{it}\left[\gamma \log C_t - \log A_t + \log \phi_{it} - \log z_{it}\right] + \mathbb{E}_{it}\left[\log \vartheta_{it} + \log C_t\right] + \tilde{K}_{Q,t} \\ &= \eta \mathbb{E}_{it} \log A_t + (1 - \eta\gamma)\mathbb{E}_{it}[\log C_t] + K_{Q,t} \end{aligned} \tag{31}$$

where $K_{Q,t} = \tilde{K}_{Q,t} - \eta(\mu_\phi - \mu_z) + \mu_\vartheta$.

The quantity-planning decision requires forecasting one exogenous shock, aggregate productivity, and one endogenous object, real consumption. The coefficient $1 - \eta\gamma \gtrless 0$ on expected (log) real consumption reflects two forces. A 1% increase in consumption raises product demand by 1% and, holding fixed real marginal costs, the desired production quantity by the same amount. But it also raises real marginal costs by $\gamma\%$, due to income effects in labor supply, and therefore lowers the desired production quantity by $\eta \times \gamma\%$. The relative size of these effects determines whether higher expected output induces higher production (*strategic complementarity*, when $\eta\gamma < 1$) or lower production (*strategic substitutability*, when $\eta\gamma > 1$).

This prediction that strategic interactions in quantity-planning are shaped by the relative importance of aggregate demand externalities and factor price pressures is shared with the analysis of Angeletos and La'O (2010). But a crucial difference is that our analysis reveals that this qualitative feature of the economy hinges additionally on the assumption of planning through quantities: in the equivalent economy with price plans (Section 4.2), choices were neither complements nor substitutes. By employing the same strategy as in our previous analysis under price targets, we derive aggregate dynamics under quantity targets:

Proposition 2 (Outcomes under Quantity Targets)**.** *If all firms set quantity targets, real output and the price level in the unique log-linear temporary equilibrium follow:*

$$\begin{aligned}\log C_t &= \chi_{0,t}^Q + \frac{\eta\kappa_t^A}{1-\kappa_t^A(1-\eta\gamma)}\log A_t \\ \log P_t &= \tilde{\chi}_{0,t}^Q - \frac{\eta\gamma\kappa_t^A}{1-\kappa_t^A(1-\eta\gamma)}\log A_t + \log\xi_t\end{aligned} \tag{32}$$

where $\chi_{0,t}^Q$ *and* $\tilde{\chi}_{0,t}^Q$ *are constants that depend only on parameters and past shocks to the economy.*

Proof. See Appendix A.4. □

In a sharp contrast to the dynamics under price targets (Proposition 1), demand shocks are *neutral* under quantity targets: they transmit one-for-one into prices and have no effects on real variables. The reason is subtle and related to the previous discussion of strategic interactions. From Equation 31, we know that firms might want to condition production on their signal of aggregate demand only if this variable helped them predict real consumption (*i.e.,* if those shocks were non-neutral in equilibrium). That is, for production decisions, the aggregate demand shock is like a payoff-irrelevant "sunspot" that could only assist in coordination. Imagine, toward a contradiction, that firms did expect real consumption to increase by 1% due to a positive aggregate demand shock. Due to the net effects of aggregate demand externalities and factor price increases, the firm would want to increase its production by $1-\eta\gamma\%$. But, since $\eta\gamma > 0$, this can never be consistent with market clearing: firms would not produce enough for their expectations to be consistent.

In sharp contrast to the case in which firms choose prices as their organizational targets, the response of the economy to productivity shocks is shaped by multiplier effects. Concreteley, holding fixed their expectations of output, firms would respond to news of a 1% productivity increase by increasing production by $\eta\%$ (Equation 31). If all other firms increase production by $\eta\%$ in response to a productivity shock, then any given firm would perceive $\kappa_t^A \times \eta\%$ of this on average, and moreover change its own production by $(1-\eta\gamma)\times\kappa_t^A\times\eta\%$. The pass-through of productivity shocks to output can be computed as the "direct effect" plus the infinite sum of "indirect effects":[2]

$$\frac{\partial \log C_t}{\partial \log A_t} = \underbrace{\eta \kappa_t^A}_{\text{PE}} + \underbrace{\eta \kappa_t^A \sum_{k=1}^{\infty} \left[\kappa_t^A \times (1-\eta\gamma)\right]^k}_{\text{GE}} = \frac{\eta \kappa_t^A}{1-\kappa_t^A(1-\eta\gamma)} \tag{33}$$

Strategic Interactions and Organizational Targets. This analysis documents that firms' organizational targets give rise to distinct strategic interactions in general equilibrium. In turn, differences in firms' strategic interactions imply different macroeconomic dynamics. Of course, our predictions for strategic interactions will generally hinge on specific assumptions about production technologies, demand curves, and factor markets. If, for example, desired markups increased with market share (as in models of Kimball, 1995, demand) or marginal costs increased as firms produced more (as in Woodford, 2003a), then pricing decisions would feature strategic complementarity. It would be simple to extend our framework to capture these forces. Instead, what we emphasize in our analysis, especially through the contrast between the price-targeting and quantity-targeting cases, is that these microeconomic phenomena and their macroeconomic implications depend *jointly* on primitives and on firms' organizational targets.

4.4 Contrasting the Dynamics in Each Regime

We now summarize the key differences in how macroeconomic variables respond to shocks under the two regimes. To do this, we make use of the notation that Y_t^x for a generic variable Y_t under targeting variable $x \in \{P, Q\}$. We begin with the demand shock:

Corollary 1 (Differential Responses to Aggregate Demand Shocks)**.** *In the unique log-linear temporary equilibria under price targets and quantity targets, the responses of real output and the aggregate price to aggregate demand shocks satisfy:*

$$\frac{\partial \log C_t^P}{\partial \log \xi_t} > \frac{\partial \log C_t^Q}{\partial \log \xi_t} = 0 \quad \textit{and} \quad 1 = \frac{\partial \log P_t^Q}{\partial \log \xi_t} > \frac{\partial \log P_t^P}{\partial \log \xi_t} > 0 \tag{34}$$

Proof. Immediate from inspecting Propositions 1 and 2 and observing that $\kappa_t^\xi \in (0,1)$. □

For the reasons we have described, demand shocks have a higher pass-through into real consumption and a lower pass-through into prices in a price-setting economy versus

[2] We provide the summation of PE and GE effects only for exposition; this summation only converges when $|\kappa_t^A(1-\eta\gamma)| < 1$. As $\kappa_t^A(1-\eta\gamma) < 1$, the fixed point is nevertheless well-defined and given by the claimed formula even when $\kappa_t^A(1-\eta\gamma) \leq -1$.

a quantity-setting economy. We next summarize the differential response to productivity shocks:

Corollary 2 (Differential Responses to Productivity Shocks)**.** *In the unique log-linear temporary equilibria under price-targeting and quantity-targeting, the responses of real output and the aggregate price to productivity shocks satisfy, when* $\eta\gamma < 1$*:*

$$\frac{\partial \log C^P}{\partial \log A} > \frac{\partial \log C^Q}{\partial \log A} \quad \textit{and} \quad \frac{\partial \log P^P}{\partial \log A} < \frac{\partial \log P^Q}{\partial \log A} \tag{35}$$

with the reverse inequalities when $\eta\gamma > 1$ *and equality when* $\eta\gamma = 1$*. Moreover,* $\frac{\partial \log C}{\partial \log A} > 0$ *and* $\frac{\partial \log P}{\partial \log A} < 0$ *in all cases.*

Proof. See Appendix A.5. □

Whether responses to productivity shocks are larger under price-targeting or quantity-targeting depends on the composite parameter $\eta\gamma$, which determines whether quantity choices are strategic complements ($\eta\gamma < 1$) or substitutes ($\eta\gamma > 1$). In the special case where $\eta\gamma = 1$, equilibrium effects under quantity targeting are zero and, moreover, the partial equilibrium effects under both price- and quantity-targeting are the same. Therefore, in this special case, the models' predictions for the economy's response to productivity shocks coincide.

5 Targets in General Equilibrium

We now study general equilibrium with endogenous organizational targets. Whereas the previous section considered strategic interactions conditional on a given organizational target, we now analyze how strategic interactions shape organizational choices. Our first key result is that firms' organizational targets are strategic complements: if other firms target prices, any given firm has greater incentives to target prices, and *vice versa*. We characterize general equilibrium and show that it can feature endogenous switches of organizational choices with sharply different macroeconomic transmission.

5.1 Equilibrium Incentives for Organizational Choices

We first describe the firms' incentives to select price or quantity targets in general equilibrium. To start, we observe that if real output C_t and the price level P_t are log-normal in a temporary equilibrium, then so too is the full vector of states that the firm treats as exogenous, $(\Psi_{it}, P_t, \Lambda_t, \mathcal{M}_{it})$. Therefore, Theorem 1 can be directly applied to calculate the relative benefits of quantity-setting and price-setting in equilibrium without approximation.

To determine the equilibrium incentives for price-setting and quantity-setting, we first revisit Theorem 1, but substitute the general-equilibrium expressions for the demand shifter $\Psi_{it} = \vartheta_{it} C_t$ (Equation 23), real marginal costs $\mathcal{M}_{it} = \frac{\phi_{it} C_t^{\gamma}}{z_{it} A_t}$ (Equation 24), and the price level $P_t = \xi_t M_t C_t^{-\gamma}(1+i_t^{-1})^{-1}$ (from money demand, Equation 25). This allows us to express Δ_t, the payoff advantage of price targets, as a function of exogenous variances as well as the endogenous variance of $\log C_t$ and its endogenous covariance with $\log A_t$.

Lemma 1 (Prices *vs.* Quantities in General Equilibrium)**.** *The expected relative advantage of price plans over quantity plans is*

$$\Delta_t = \frac{1}{2}(\eta - 1)\left(\underbrace{\frac{1}{\eta}\sigma^2_{\vartheta,t} + 2\sigma_{\vartheta,z,t}}_{\text{“micro” uncertainty}} + \underbrace{\frac{1}{\eta}\left(1-\eta\gamma\right)^2\sigma^2_{C|s,t}}_{\text{consumption uncertainty}} - \underbrace{\eta\sigma^2_{\xi|s,t}}_{\substack{\text{price level}\\ \text{uncertainty}}} + \underbrace{2(1-\eta\gamma)\sigma_{C,A|s,t}}_{\substack{\text{cost-demand}\\ \text{co-movement}}}\right) \tag{36}$$

where $\sigma_{\cdot|s,t}$ denote the (co)variances of each firm i's beliefs after observing signals (s^A_{it}, s^{ξ}_{it}).

Holding fixed the dynamics of C_t, greater volatility in idiosyncratic demand always favors price targets, greater covariance between idiosyncratic demand and productivity shocks always favors price targets, and greater volatility in the aggregate demand shock always favors quantity targets by increasing the volatility of the price level. Finally, the endogenous terms play a more subtle role. Uncertainty about real consumption, $\sigma^2_{C|s,t}$, unambiguously increases price-setting incentives because it increases the volatility of demand faced by firms. The weight on $\sigma_{C,A|s,t}$ reflects that term's role in determining the cyclicality of real marginal costs. To understand this term and its coefficient, recall that the firm prefers price setting when states of high product demand turn out to be states in which real marginal costs are low. When a supply shock (increase in A_t) hits the economy, demand for a given product (fixing its price) expands by a factor of $C_t P_t^{\eta}$; holding fixed the money supply, this is proportional to $C_t^{1-\eta\gamma}$. Hence, if this aggregate term shifting product demand is pro-cyclical, or $1-\eta\gamma > 0$, then increased covariance between real consumption and productivity (*i.e.,* a more "supply-shock driven" business cycle) increases incentives for price setting; conversely, if $1-\eta\gamma < 0$, the same force increases incentives for quantity setting.

5.2 Meta-Complementarity in Targets

Does the fact that others set prices (quantities) increase or decrease a given firm's desire to target prices (quantities)? To formally study this, we define the object

$$\Delta_t^{P-Q} \equiv \Delta_t^P - \Delta_t^Q \tag{37}$$

which measures firms' incentives (in payoff terms) to plan prices conditional on a macroeconomic regime with price planning versus one with quantity planning. We refer to this object as the *meta-complementarity* in the economy, to distinguish from the complementarity in the choice of prices or quantities *given targets* studied earlier.

The economy always features meta-complementarity, and it is almost always strict:

Theorem 2 (Meta-Complementarity)**.** *The decision to target prices or quantities is one of meta-complementarity, i.e.,* $\Delta_t^{P-Q} \geq 0$*, with strict inequality whenever* $\eta\gamma \neq 1$*.*

Proof. See Appendix A.6. □

To build intuition for this result, and its tight connection to the standard notion of strategic complementarity, it is actually easiest to start with the knife-edge case where meta-complementarity limits to zero: $\eta\gamma = 1$. This is the exact same condition we encountered earlier under which standard strategic complementarity disappears in the choice of quantity targets—strategic complementarities in output markets and strategic substitutabilities in the input market exactly cancel out (Proposition 2). Furthermore, recall that such strategic complementarity in price choice was *always* zero, regardless of parameter values (Proposition 1). Thus, under the parameter restriction $\eta\gamma = 1$, there is no feedback loop whereby other firms' target choices affect endogenous macroeconomic uncertainty and, therefore, the incentives to favor one target over another. As a result, in this special case, firms' incentives in the choice of targets—while still responsive to changes in *exogenous* features of the environment, like the underlying volatility of shocks—do not depend on the *endogenous* transmission of shocks. Thus, when $\eta\gamma = 1$, there is no scope for strategic interactions in organizational choices, precisely because firms do not need to forecast the choices of their competitors.

This feedback loop emerges for any other values of parameters, which opens the door to meaningful general-equilibrium effects. We begin with the case where $\eta\gamma < 1$. In this case, consumption responds more to productivity shocks under price targets than under quantity targets (Corollary 2), because incomplete information attenuates positive general equilibrium effects in the latter regime. Moreover, regardless of the value of $\eta\gamma$, consumption responds more to demand shocks under price targets (Corollary 1). Therefore, others' targeting prices increases both the variance of consumption and the covariance of consumption with productivity. Both of these forces favor price targets, as shown in Equation 36. In summary, others setting prices induces aggregate volatility, which makes it more attractive for any given firm to also target a price.

In the case of $\eta\gamma > 1$, consumption is more responsive to demand shocks but less responsive to productivity shocks under price targets versus quantity targets. In the proof, we show how these effects net out in Equation 36 in the direction of making price-setting more attractive when other firms set prices. An immediate corollary of the strategic complementarity uncovered in Theorem 2 is that there always exists at least one "pure" price- or quantity-setting equilibrium:

Corollary 3 (Existence of Pure Equilibria)**.** *There exists an equilibrium.*

This result follows immediately from Theorem 2. In particular, there are two possible cases. First, suppose that firms prefer to target prices if others target quantities, or $\Delta_t^Q \geq 0$. In this case, they even more sharply prefer to target prices if others target prices, or $\Delta_t^P \geq \Delta_t^Q \geq 0$. Therefore, there exists a price-setting equilibrium. Conversely, suppose that firms prefer to target quantities when others target quantities, $\Delta_t^Q < 0$. In this case, a quantity-targets equilibrium trivially exists. As these cases are exhaustive, a pure equilibrium exists. We argue that this result is not obvious *ex ante*. In particular, if the decision to set prices was one of meta-substitutability, pure equilibria could fail to exist. Of course, a mixed equilibrium would always exist. We omit its characterization in the interests of space.

5.3 Uncertainty Shocks and the Choice of Targets

We next consider the effects of exogenous *uncertainty shocks*, or changes in the variance of exogenous microeconomic shocks (*i.e.*, those to product-level demand and productivity) and macroeconomic shocks (*i.e.*, those to aggregate demand and aggregate productivity). To do this, it is convenient to summarize these forces in three sufficient statistics. The first is a summary of uncertainty about product-level demand, $\sigma^2_{\vartheta,t}$, and the covariance between product-level demand and product-level productivity, $\sigma_{\vartheta,z,t}$ ("micro" uncertainty):

$$\Omega_t \equiv \frac{1}{\eta}\sigma^2_{\vartheta,t} + 2\sigma_{\vartheta,z,t} \tag{38}$$

The second two statistics are the volatilities of aggregate productivity and aggregate demand shocks, σ_t^A and σ_t^ξ.[3] The relevant comparative statics are summarized below:

[3]We consider variations in these parameters holding fixed the noise in signals.

Lemma 2. *The following statements are true:*

1. Δ^P *increases in* Ω_t*; increases in* σ_t^A *if* $\eta\gamma < 1$*, and decreases in* σ_t^A *if* $\eta\gamma > 1$*; and decreases in* σ_t^ξ *if* $\eta\gamma > \frac{1}{2}$*.*
2. Δ^Q *increases in* Ω_t*; increases in* σ_t^A *if* $\eta\gamma < 1$*, and decreases in* σ_t^A *if* $\eta\gamma > 1$*; and decreases in* σ_t^ξ*.*

Proof. See Appendix A.8. □

An increase in the composite parameter Ω_t unambiguously favors price-setting regardless of what other firms are doing: firms prefer price-setting when demand is uncertain and when states of high demand correspond with those of low marginal costs (recall Theorem 1). In what follows, we will focus on these microeconomic uncertainty shocks to further understand the implications for macroeconomic dynamics. The effects of changing macroeconomic shock volatility are more subtle. An increase in σ_t^A has opposite effects on firms' choices depending on parameters, because of simultaneous effects on uncertainty about product-level demand and the covariance between demand and marginal costs. An increase in σ_t^ξ tends to favor quantity setting by increasing price-level uncertainty, except in one parameter case in price-targeting regimes where these shocks have a dominant effect on consumption uncertainty.

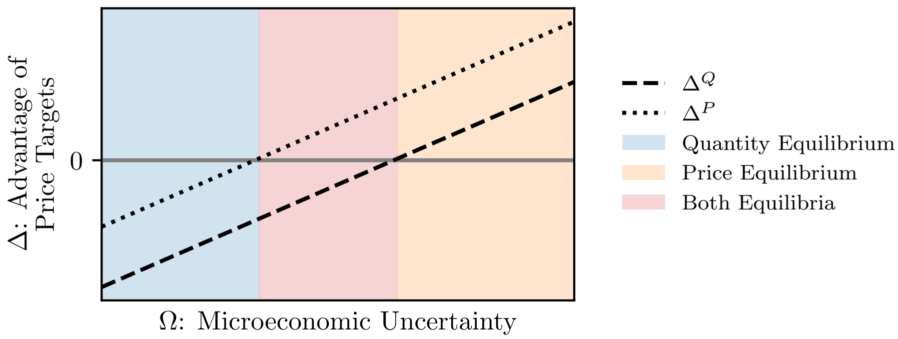
5.4 Uncertainty Propagation and Regime Switches

We have just established that changes to underlying exogenous uncertainty affect firms' incentives to choose price or quantity targets. This, in turn, affects the *endogenous* generation of macroeconomic uncertainty. We now characterize these dynamics and their implications for "uncertainty propagation": that is, how shocks to one primitive source of uncertainty can endogenously lead to changes in a different form of uncertainty.

We focus on "microeconomic uncertainty shocks" that shift Ω_t in the interests of brevity (Lemma 2 applies also for shocks to macroeconomic uncertainty). A literature stemming from Bloom et al. (2018) suggests that microeconomic uncertainty, in units of variance, may vary by as much as one order of magnitude between recessions and booms. We note that, for our analysis, a critical distinction is between uncertainty shocks to demand and to productivity: while these are often hard to distinguish using observational data on firms' revenue or revenue-based total factor productivity (TFPR; see Foster et al., 2008), they have starkly different effects on the parameter Ω_t and therefore on firms' incentives for target choice.

The result below formalizes how changes in microeconomic uncertainty can shift the economy between regimes of quantity- and price-targeting:

Figure 1: Microeconomic Uncertainty and Regime Switches



Note: This figure illustrates Proposition 3 under example parameter values. In each panel, we plot Δ^Q (dashed line) and Δ^P (dotted line) as a function of Ω, the index of microeconomic uncertainty (defined in Equation 38), holding fixed all other parameters. We shade the regions in which there are pure equilibria in quantity targets (blue), pure equilibria in price targets (orange), and both pure equilibria simultaneously (red).

Proposition 3. *Let $\eta\gamma \neq 1$. There exist thresholds $\underline{\Omega} < \bar{\Omega}$ such that:*

1. *For $\Omega_t \leq \underline{\Omega}$, $\Delta_t^Q < \Delta_t^P \leq 0$: the only pure equilibrium is in quantity targets.*
2. *For $\Omega_t \geq \bar{\Omega}$, $0 \leq \Delta_t^Q < \Delta_t^P$: the only pure equilibrium is in price targets.*
3. *For $\underline{\Omega} < \Omega_t < \bar{\Omega}$, $\Delta_t^Q < 0 < \Delta_t^P$: there is a pure equilibrium in price targets and a pure equilibrium in quantity targets.*

Proof. Immediate from Lemma 2 and Theorem 2. □

Figure 1 visualizes the implications of Proposition 3 by plotting both Δ^P and Δ^Q as a function of Ω_t. Because of meta-complementarity, $\Delta^P > \Delta^Q$ for all values of Ω_t (Theorem 2); because price targets better hedge the firm when Ω_t is high, both functions are increasing (Lemma 2). This splits the parameter space into three regimes. When Ω_t is sufficiently low, the only pure equilibrium is in quantity targets. When Ω_t is sufficiently high, the only pure equilibrium is in price targets. Thus, any shock to Ω_t that pushes the economy between these two regions of the parameter space would unambiguously lead to a significant qualitative change in macroeconomic dynamics, from a regime in which aggregate demand shocks have potentially very large real effects to one in which they are completely neutral.

For intermediate values of Ω_t, we have $\Delta^P \geq 0 \geq \Delta^Q$: firms would target prices if others target prices, but target quantities if others target quantities. This is because uncertainty is endogenous to the choice of organizational targets. Thus, the model could be consistent with entirely self-fulfilling switches between price- and quantity-targeting regimes.

Corollary 4 (Regime-Switching)**.** *Consider any partition of* $\mathbb{N}$ *into two sets* $\mathcal{T}^P$ *and* $\mathcal{T}^Q$*. If* $\Omega_t \in (\underline{\Omega}, \bar{\Omega})$ *for all* $t \in \mathbb{N}$*, there exists an equilibrium such that firms set quantities in all periods* $t \in \mathcal{T}^Q$ *and firms set prices in all periods* $t \in \mathcal{T}^P$*.*

This, in turn, could generate significant fluctuations in macroeconomic uncertainty and macroeconomic shock propagation without *any* underlying change in fundamentals. This is a potentially interesting candidate explanation for large and sudden changes in macroeconomic uncertainty driven by "small" underlying changes to the economy.

6 Monetary Policy and Organizational Targets

We now study monetary transmission and optimal monetary policy in our setting. To do so, we enrich the baseline model with a monetary rule. We show that, if firms always targeted prices, a "divine coincidence" would occur: the policymaker could achieve the frictionless allocation of output and complete price stability with sufficiently hawkish monetary policy. But if firms optimally choose quantity targets, hawkish monetary policy can backfire by moving the economy to a regime in which monetary policy cannot affect real outcomes.

6.1 The Model with a Monetary Authority

We augment the model (Section 3) to include a monetary authority that controls the growth of the money supply, M_t, via the following "Taylor-like" monetary rule:

$$\log M_t - \log M_{t-1} = \mu + \alpha \, \log P_t \tag{39}$$

The parameter $\mu \in \bar{\mathbb{R}}$ controls mean money growth and the parameter $\alpha \in \bar{\mathbb{R}}_-$ controls the responsiveness to the price level.

The monetary authority minimizes a reduced-form loss function that mimics the US Federal Reserve's dual mandate to achieve "maximum employment and stable prices." We interpret the former as a desire to center output around its frictionless level, which corresponds to the case where firms have complete information ($\kappa_t^A = \kappa_t^\xi = 1$ for all $t \in \mathbb{N}$). In this case,

$$\log C_t^* = \chi_0^* + \frac{1}{\gamma} \log A_t \tag{40}$$

for some constant χ_0^* that does not depend on shocks. This allocation is purely supply-driven: it responds to productivity shocks with elasticity $1/\gamma$ and does not respond to aggregate demand shocks. We interpret the authority's second goal, price stability, as removing all possible unanticipated fluctuations in the price level. The monetary authority's problem is:

$$\begin{aligned} &\inf_{\mu \in \bar{\mathbb{R}}, \alpha \in \bar{\mathbb{R}}_-} \left\{ \mathbb{E}\left[\mathrm{Var}_t[\log C_t - \log C_t^*] + \lambda \mathrm{Var}_t[\log P_t] \right] \right\} \\ &\text{s.t. } \log C_t, \log P_t \text{ are implementable in a log-linear equilibrium} \end{aligned} \tag{41}$$

where $\lambda > 0$ measures the relative weight on price stability, $\mathbb{E}[\cdot]$ denotes the unconditional expectation over realizations of all random variables, and $\mathrm{Var}_t[\cdot]$ denotes the conditional variance of a variable given aggregate shock realizations in the past, $(A_s, \xi_s)_{s<t}$.[4]

We make two technical remarks before proceeding. First, as we will soon show, the policy-rule intercept μ has no effect on real allocations or price stability: intuitively, because this level is common knowledge, it simply shifts the price level by a constant. Thus, we restrict attention to the choice of α and note that μ can simply be chosen to ensure a given allocation is implementable.[5] Second, because of the log normality of all variables, the outer expectation in Equation 41 is superfluous: uncertainty does not depend on the history of the economy, except through firms' *current* choice of targets.

6.2 Monetary Rules and Shock Transmission

To build an intuition for the role of monetary policy in the economy, we return to aggregate demand (Equation 25) and substitute the monetary rule:

$$P_t = \xi_t M_t (1 + i_t^{-1}) C_t^{-\gamma} = e^{\log M_{t-1} + \mu} (1 + i_t^{-1}) \xi_t P_t^{\alpha} C_t^{-\gamma} \tag{42}$$

The household chooses real money balances to equalize the marginal utility of consuming goods and holding money. When the central bank increases the money supply, this translates to a greater desire to consume goods and hence an expansion of aggregate demand. Making α more negative reduces aggregate demand when the price level expands. Thus, we refer to policies with lower α as more "hawkish" and those with greater α as more "dovish."

Price Targets. We next derive how monetary rules affect macro dynamics under each target regime, starting with price targets. As derived in Section 4.2, firms set prices equal to a mark-up over expected nominal costs: $\log p_{it} = \mathbb{E}_{it}[\log P_t + \log \mathcal{M}_{it}] + \tilde{K}_{P,t}$, up to some

[4]This choice of information set is inessential; using the information set of firms would lead to qualitatively the same conclusions below. Moreover, our definition allows the policymaker to pick the most advantageous equilibrium when multiple are implementable given (μ, α).

[5]In particular, for the transversality condition to hold, it is necessary that $\mu \geq \frac{1}{2}\mathrm{Var}_t[\log P_t]$ for all t. For any given value of α, if the maximum value of the right-hand-side is finite, the allocation can be implemented with sufficiently high μ; if the right-hand-side is infinite, then we observe that the allocation is never preferred by the policymaker with $\lambda > 0$, and we can ignore it.

constant $\tilde{K}_{P,t}$. As earlier (see Equation 27), we substitute in the equilibrium expression for real marginal costs and for aggregate demand to derive the equilibrium policy function:

$$\begin{aligned}\log p_{it} &= \mathbb{E}_{it}[\log P_t + \gamma \log C_t - \log A_t + \log \phi_{it} - \log z_{it}] + \tilde{K}_{P,t} \\ &= \mathbb{E}_{it}[\log \xi_t - \log A_t + \alpha \log P_t] + K_{P,t}\end{aligned} \tag{43}$$

With the monetary rule, price choices are no longer strategically neutral. Because of stabilization policy ($\alpha < 0$), there is strategic substitutability in pricing: when prices increase, the monetary authority offsets their effects on aggregate demand and wages by reducing the money supply, leading firms to expect lower marginal costs and decrease their prices. Taking this into account, equilibrium dynamics are as follows:

Corollary 5 (Outcomes under Price Targets with the Monetary Rule)**.** *If all firms set price targets, and the monetary authority implements a rule with reaction coefficient α, real output and the price level in the unique log-linear temporary equilibrium follow:*

$$\begin{aligned}\log C_t &= \chi_{0,t}^P + \frac{1}{\gamma}\frac{(1-\alpha)\kappa_t^A}{1-\alpha\kappa_t^A}\log A_t + \frac{1}{\gamma}\frac{1-\kappa_t^\xi}{1-\alpha\kappa_t^\xi}\log \xi_t \\ \log P_t &= \tilde{\chi}_{0,t}^P - \frac{\kappa_t^A}{1-\alpha\kappa_t^A}\log A_t + \frac{\kappa_t^\xi}{1-\alpha\kappa_t^\xi}\log \xi_t\end{aligned} \tag{44}$$

where $\chi_{0,t}^P$ and $\tilde{\chi}_{0,t}^P$ are constants that depend only on parameters and past shocks.

Proof. See Appendix A.3. □

Active monetary policy creates new general equilibrium interactions in the economy, which in turn shape shock transmission. As policy becomes more hawkish, the central bank responds to positive aggregate demand shocks and negative aggregate supply shocks by deflating aggregate demand. This induces firms to expect lower marginal costs and set lower prices, with additional higher-order effects in equilibrium due to the anticipation of this behavior. As a result, this reins in the response of real output to aggregate demand shocks, but *amplifies* the response of real output to supply shocks. We summarize these lessons below:

Corollary 6. *Under price targets, more dovish policies (higher α):*

1. *Increase the responsiveness of the price level to shocks, or*

$$\frac{\partial}{\partial \alpha}\left(\frac{\partial \log P_t}{\partial \log A_t}\right) < 0, \qquad \frac{\partial}{\partial \alpha}\left(\frac{\partial \log P_t}{\partial \log \xi_t}\right) > 0 \tag{45}$$

2. Decrease the responsiveness of real output to productivity shocks, but increase its responsiveness to aggregate demand shocks:

$$\frac{\partial}{\partial \alpha}\left(\frac{\partial \log C_t}{\partial \log A_t}\right) < 0, \qquad \frac{\partial}{\partial \alpha}\left(\frac{\partial \log C_t}{\partial \log \xi_t}\right) > 0 \tag{46}$$

Proof. Immediate from direct calculations using Equation 44. □

A particularly interesting monetary rule is the infinitely hawkish one with $\alpha = -\infty$. This induces unbounded strategic substitutability in firms' choice of prices: if they received news of a shock increase in the aggregate price level, they would aggressively (in the limit, infinitely) reduce their own price. This supports an equilibrium in which the price level indeed does not respond to shocks. Moreover, in this equilibrium, it is easily computed that, up to constants,

$$\log C_t = \log C_t^* \tag{47}$$

That is, output responds to productivity shocks as in the frictionless economy, and does not respond to aggregate demand shocks at all.

Dynamics Under Quantity Targets. Under quantity targets, firms want to produce more when they forecast higher demand and less when they forecast higher marginal costs (Equation 30). We showed in Section 4.3 that, given the structure of product-level demand and wage determination in the economy, production decisions follow

$$\log q_{it} = \eta \mathbb{E}_{it} \log A_t + (1 - \eta\gamma)\mathbb{E}_{it}[\log C_t] + K_{Q,t} \tag{48}$$

up to some constant $K_{Q,t}$. Crucially, this condition does not rely on (forecasted) aggregate demand or on the conduct of monetary policy. Thus, for *any* monetary rule, incentives for producers are the same. Thus, real output dynamics are unaffected by monetary policy:

Corollary 7 (Outcomes under Quantity Targets with the Monetary Rule)**.** *If all firms set quantity targets, and the monetary authority implements a rule with reaction coefficient α, real output and the price level in the unique log-linear temporary equilibrium follow:*

$$\begin{aligned} \log C_t &= \chi_{0,t}^Q + \frac{\eta \kappa_t^A}{1 - \kappa_t^A(1 - \eta\gamma)} \log A_t \\ \log P_t &= \tilde{\chi}_{0,t}^Q - \frac{1}{1-\alpha}\frac{\eta\gamma\kappa_t^A}{1 - \kappa_t^A(1 - \eta\gamma)} \log A_t + \frac{1}{1-\alpha} \log \xi_t \end{aligned} \tag{49}$$

where $\chi_{0,t}^Q$ and $\tilde{\chi}_{0,t}^Q$ are constants that depend only on parameters and past shocks.

Proof. See Appendix A.4. □

In particular, the neutrality of money under quantity targets is a robust result under any monetary rule. The rule affects only how the price level responds to shocks. Moreover, while it is in principle possible to stabilize the price level via the policies described earlier with $\alpha = -\infty$, these policies under quantity targets do not affect the dynamics of real output or, by implication, achieve the "divine coincidence" of full employment and price stability. We summarize these lessons below:

Corollary 8. *Under quantity targets, more dovish policies (higher α):*

1. *Increase the responsiveness of the price level to shocks, or*

$$\frac{\partial}{\partial \alpha}\left(\frac{\partial \log P_t}{\partial \log A_t}\right) < 0, \qquad \frac{\partial}{\partial \alpha}\left(\frac{\partial \log P_t}{\partial \log \xi_t}\right) > 0 \tag{50}$$

2. *Do not affect the responsiveness of real output to shocks.*

Proof. Immediate from direct calculations using Equation 49. □

6.3 Optimal Policy With and Without the Divine Coincidence

Under a price-targeting regime, the monetary authority can, in principle, achieve a "divine coincidence" of maximum employment and price stability. But can it actually implement this equilibrium, given that firms might not want to target prices?

We first revisit firms' incentives to target prices as described in Theorem 1. Hawkish monetary policy unambiguously stabilizes the price level, regardless of the regime, which makes price targets more appealing for firms. On the other hand, the same policies make the business cycle more responsive to supply shocks under price-setting. This can increase the co-movement between real marginal costs and consumption, thus favoring quantity-setting. Finally, there remain microeconomic incentives for firms to favor prices over quantities or *vice versa* depending on the variance of idiosyncratic demand shocks and their covariance with productivity shocks.

To describe optimal policy in this setting, we first define some important objects. First, we define the sets of policy rules such that price-setting equilibria and quantity-setting equilibria exist:

$$\mathcal{A}^P = \{\alpha \in \bar{\mathbb{R}}_- : \Delta^P(\alpha) \geq 0\} \quad \text{and} \quad \mathcal{A}^Q = \{\alpha \in \bar{\mathbb{R}}_- : \Delta^Q(\alpha) \leq 0\} \tag{51}$$

If these sets are non-empty, *i.e.,* there exists some policy rule under which each targeting regime can arise, then we define:

$$\alpha_P^* = \min \mathcal{A}^P \quad \text{and} \quad \alpha_Q^* = \min \mathcal{A}^Q \tag{52}$$

That is, α_P^* and α_Q^* are the most hawkish monetary rules that are compatible with firms setting prices and quantities, respectively. We also define $\mathcal{L}^P(\alpha)$ and $\mathcal{L}^Q(\alpha)$ as the authority's loss under price-setting and quantity-setting equilibria when the slope of the policy rule is α. The result below summarizes the optimal policy in our setting, taking the endogenous choice of organizational targets into account. In particular, it characterizes exactly when the "divine coincidence" occurs and describes how policymakers navigate their trade-offs otherwise.

Theorem 3 (Optimal Policy)**.** *Optimal policy is described by the following exhaustive cases:*

1. *If $\mathcal{A}^P$ is empty, then optimal policy is $\alpha = \alpha_Q^*$.*
2. *If $\mathcal{A}^Q$ is empty, then optimal policy is $\alpha = \alpha_P^*$.*
3. *If neither $\mathcal{A}^Q$ nor $\mathcal{A}^P$ is empty, then the optimal policy is:*

$$\alpha = \begin{cases} \alpha_P^*, & \mathcal{L}^P(\alpha_P^*) < \mathcal{L}^Q(\alpha_Q^*), \\ \alpha_Q^*, & \text{otherwise.} \end{cases} \tag{53}$$

Moreover, the authority can achieve zero loss for any value of $\lambda \in (0, \infty]$ if and only if:

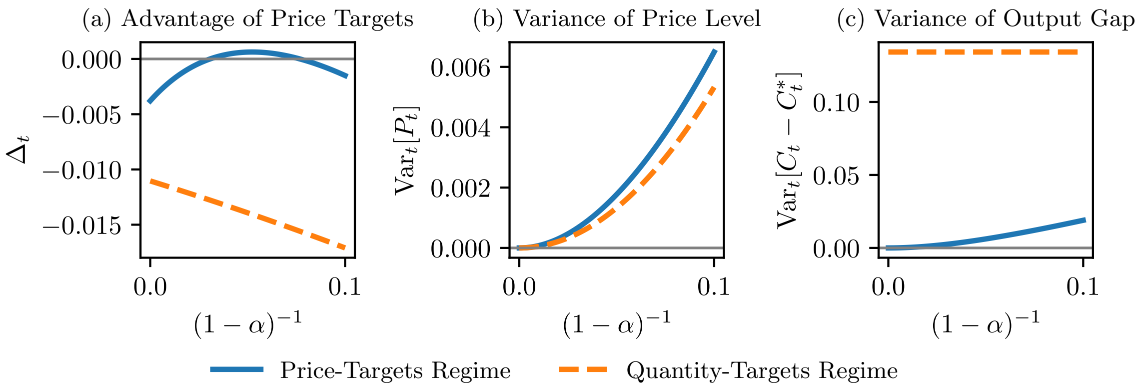
$$\frac{1}{\eta}\sigma_{\vartheta,t}^2 + 2\sigma_{\vartheta,z,t} + \frac{\sigma_{A|s,t}^2}{\eta\gamma^2} \geq 0 \tag{D}$$

Under Condition D, the authority achieves zero loss with infinitely hawkish monetary policy, $\alpha = \alpha_P^* = -\infty$. Further, under this policy, there is an equilibrium in which firms target prices.

Proof. See Appendix A.9, which also provides formulas for Δ, $\mathcal{L}^P$, and $\mathcal{L}^Q$. □

A classic argument in the literature on economies with nominal rigidities (see, *e.g.*, Clarida et al., 1999) is that, absent other time-varying distortions (markup shocks) or factor-market imperfections, the monetary authority faces no meaningful trade-off between stabilizing inflation and the output gap. That is, the robust optimal policy is one that simultaneously achieves price stability and a zero output gap (the "divine coincidence"). Theorem 3 demonstrates that this conclusion is sensitive to firms' organizational choices. Concretely, this result says that the central bank always wishes to implement either the most hawkish policy that it can sustain while ensuring that firms wish to target prices (α_P^*) or the most hawkish policy

Figure 2: Monetary Trade-offs Without the Divine Coincidence



Note: This figure shows policy trade-offs when the divine coincidence does not hold, using an illustrative numerical calibration. In each panel, we show outcomes under price targets as the blue solid line and outcomes under quantity targets as the orange dashed line. We parametrize changes in policy by the monotone transformation $(1-\alpha)^{-1}$, and observe that infinite hawkishness $\alpha = -\infty$ coincides with $(1-\alpha)^{-1} = 0$. Panel (a) shows the equilibrium incentives for price targets. Panels (b) and (c) show the one-period-ahead variance of the price level and output gap, the two components of the policymaker's loss in Equation 41.

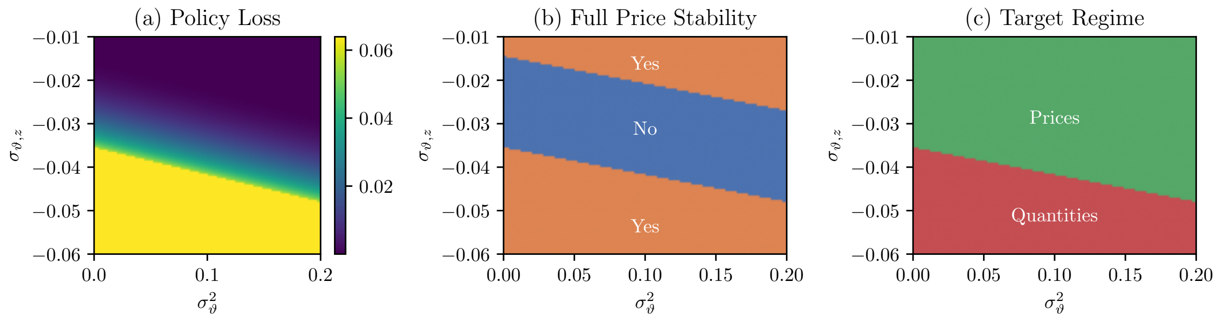
that it can sustain while ensuring that firms wish to target quantities (α_Q^*). Condition D characterizes when infinitely hawkish policy is compatible with firms targeting prices. When this is not possible, the divine coincidence fails: the central bank cannot implement the full-information efficient consumption allocation with complete price stability.[6]

Economically, the possibility of divine coincidence (Condition D) hinges on the uncertainties firms face and whether they are compatible with favoring price targets under aggregate price stability. We note that the first and third terms in this calculation, corresponding to uncertainty about idiosyncratic demand and uncertainty about aggregate productivity, are always positive. Hence, failure of the divine coincidence rests on the second term: in particular, that microeconomic demand and productivity shocks are negatively correlated. In Section 7, we discuss one approach through which these covariances can be estimated using observational data.

Policy Trade-offs Without the Divine. When the divine coincidence is not possible, the policymaker faces a trade-off between two policies, neither of which implements the first-best: the most hawkish policy that implements quantity-targeting and the most hawkish policy

[6] On a more technical level, we observe that Theorem 3 covers all cases of the policy problem even if, at first glance, it does not explicitly consider the case in which both $\mathcal{A}^P$ and $\mathcal{A}^Q$ are empty. The reason why this is not an issue is that the presence of meta-complementarity at $\alpha = 0$ (Theorem 2), ensures that $0 \in \mathcal{A}^P \cup \mathcal{A}^Q$ and thus that at least one of these sets is non-empty.

Figure 3: How Uncertainty Shapes Optimal Policy



Note: This figure illustrates how optimal policy depends on underlying microeconomic uncertainty in the economy in an illustrative calibration. In each panel, the horizontal and vertical axes respectively vary σ^2_ϑ (the variance of idiosyncratic demand shocks) and $\sigma_{\vartheta,z}$ (the covariance between idiosyncratic demand and productivity shocks), two of the primitives in Condition D. Panel (a) shows the loss for the policymaker as a heat map. Panel (b) identifies the regions of the parameter space where the policymaker chooses to implement full price stability ($\alpha = -\infty$). Panel (c) identifies the regions of the parameter space where the policymaker chooses to implement a price-targets or quantity-targets regime.

that implements price targets. We illustrate an example of this trade-off in a numerical example in Figure 2. In this example, the former allocation actually coincides with complete hawkishness and perfect price stability; but, in this case, the policymaker must tolerate a positive variance in the output gap, generated by the economy's suboptimal response to productivity shocks. The latter allocation, by contrast, involves lower variance in the output gap but higher variance in the price level. The policymaker's preference between the two depends on their relative weight on these two terms of the objective. Note further that the variance of the output gap under quantity-targeting is independent of monetary policy in light of Corollary 7.

How Uncertainty Shapes Optimal Policy. Putting this together with the earlier discussion about Condition D, we observe that optimal policies can be sensitive to private agents' underlying uncertainty. We illustrate this in a numerical example in Figure 3, varying the two terms corresponding to microeconomic uncertainty in the divine condition. As uncertainty about idiosyncratic demand shocks becomes larger and the covariance between idiosyncratic demand and productivity shocks becomes more positive, Condition D becomes more likely to hold. In the top right part of the parameter space, the divine coincidence obtains: the loss is zero (panel (a)), the policy implements price stability (panel (b)), and the economy is in a price-targets regime (panel (c)). As we move to the bottom left of the parameter space, the policymaker becomes unable to implement the divine coincidence, but nonetheless prefers to implement the price-targets regime: this region is colored blue in panel (b) and green in panel (c), and the loss is positive. However, at some point, this allocation ceases to be implementable, and the optimal policy switches to one that implements price stability under quantity targets (the region that is orange in panel (b) but red in panel (c)). The loss for the policymaker jumps up at this point. In summary, this simple example illustrates the cases of Theorem 3 and reveals how changes in underlying uncertainty can have significant effects on the optimal policy.

7 The Relevance of Organizational Targets

We conclude by providing a simple empirical illustration of firms' macroeconomic and microeconomic incentives to target prices versus quantities and how the propagation of monetary shocks depends on these incentives. Given the many caveats with mapping theory to data, we interpret this evidence as merely suggestive. We also stress new challenges for measurement that are raised by considering the endogenous choice of targets.

7.1 The "Divine Condition" in the Data

As discussed in Section 6.3, the failure of divine coincidence is tied to the kind of microeconomic uncertainty that firms face. In particular, if microeconomic incentives sufficiently favored quantity targets, or

$$\Delta_t^{\text{Mic}} \equiv \frac{1}{2}(\eta - 1)\left(\frac{1}{\eta}\sigma_{\vartheta,t}^2 + 2\sigma_{\vartheta,z,t}\right) \leq -\frac{1}{2}(\eta - 1)\frac{\kappa_t^A \sigma_{A,s}^2}{\eta\gamma^2} \leq 0 \tag{54}$$

then the divine coincidence cannot be achieved. We note that, as defined, Δ_t^{Mic} is in units of the comparative advantage of price-targeting in log points of profits.

However, empirically measuring this uncertainty is challenging for two reasons. First, it is difficult to separate components pertaining to physical productivity versus product demand, a distinction that is crucial in our theory.[7] In practice, researchers often resort to measuring revenue-based TFP measures that conflate the two (see, *e.g.,* Bloom et al., 2018). Second, our model implies that the statistical content of revenue-based TFP *itself* depends on firms' choice of targets.

To see this, we derive *revenue-based* TFP ("TFPR") in our model. Since firms' production

[7] This is *not* crucial for positive analysis of the business cycle; see, for example, Bloom et al. (2018), whose proposed macroeconomic mechanism is agnostic to whether fluctuations in firms' revenue productivity are due to physical efficiency or demand.

is constant returns to scale in one input, labor, TFPR for firm i in period t is

$$\log \text{TFPR}_{it} = \log \frac{p_{it} q_{it}}{L_{it}} = \log p_{it} + \log z_{it} + \log A_t \tag{55}$$

i.e., the product of prices and physical productivity. How does this depend on the shocks that hit the firm?

If firms target prices, then prices depend only on lagged, forecastable information. Therefore, the unforecastable, idiosyncratic variations in TFPR arise only from idiosyncratic TFP shocks, or

$$\log \text{TFPR}^P_{it} = \log \bar{p}_{it} + \log z_{it} + \log A_t = \log z_{it} + K^P_{it} \tag{56}$$

where $\log \bar{p}_{it}$ is the price the firm sets in advance and therefore the constant $K^P_{it} = \log \bar{p}_{it} + \log A_t$ depends only on aggregate shocks and lagged firm-level variables. An econometrician who projects out lagged firm variables and non-parametric aggregate trends would measure the idiosyncratic variance in TFPR, or $\sigma^2_{\text{TFPR}^P,t} = \text{Var}\left[\log \text{TFPR}^P_{it} - K^P_{it}\right]$, as:

$$\sigma^2_{\text{TFPR}^P,t} = \sigma^2_{z,t} \tag{57}$$

Therefore, when firms are price-setters in our model, this measurement is uninformative about the two microeconomic terms that *do* matter for firms' target incentives: uncertainty about demand shocks or the covariance between demand and productivity shocks.

If instead firms' target quantities, then observed prices are market-clearing and do incorporate variance from demand shocks. In this case, it is straightforward to show that

$$\begin{aligned} \log \text{TFPR}^Q_{it} &= \left(\log P_t + \frac{1}{\eta}(\log C_t + \log \vartheta_{it} - \log \bar{q}_{it})\right) + \log z_{it} + \log A_t \\ &= \frac{1}{\eta} \log \vartheta_{it} + \log z_{it} + K^Q_{it} \end{aligned} \tag{58}$$

where $\log \bar{q}_{it}$ is the quantity the firm sets in advance and therefore the constant $K^Q_{it} = \log P_t + \eta^{-1}(\log C_t - \log q_{it}) + \log A_t$ depends only on aggregate shocks and lagged firm-level variables. The measured idiosyncratic variance in TFPR, or $\sigma^2_{\text{TFPR}^Q,t} = \text{Var}[\log \text{TFPR}^Q_{it} - K^Q_{it}]$ is instead

$$\sigma^2_{\text{TFPR}^Q,t} = \frac{1}{\eta^2}\sigma^2_{\vartheta,t} + \sigma^2_{z,t} + \frac{2}{\eta}\sigma_{\vartheta,z,t} \tag{59}$$

Thus, this moment is informative about demand volatility, productivity volatility, and their covariance. In this way, common moments used by economic researchers to measure uncertainty or volatility (*e.g.*, Foster et al., 2008; Bloom et al., 2018) can be sensitive to firms' organizational choices.

To proceed, we observe that the volatility of TFPR for quantity targeting firms is informative about the relevant incentives for target choice, but is conflated by the variance of physical productivity. Following standard practice, we define *quantity-based TFP* (TFPQ) as $\log \mathrm{TFPQ}_{it} = \log q_{it} - \log L_{it} = \log z_{it} + \log A_t$, and we observe that this can be measured in any setting with data on physical outputs and inputs, regardless of whether firms target prices or quantities. We define its idiosyncratic variance as $\sigma^2_{\mathrm{TFPQ},t} = \mathrm{Var}[\log \mathrm{TFPQ}_{it} - \log A_t]$. Moreover, we observe that

$$\sigma^2_{\mathrm{TFPR}^Q,t} - \sigma^2_{\mathrm{TFPQ},t} = \frac{1}{\eta^2}\sigma^2_{\vartheta,t} + \frac{2}{\eta}\sigma_{\vartheta,z,t} = \frac{2}{\eta(\eta-1)}\,\Delta^{\mathrm{Mic}}_t \tag{60}$$

If firms have incentives to target quantities in our theory, then the variance of TFPQ exceeds that of TFPR. Intuitively, in this case, demand is high exactly when productivity is low, which makes quantity targets preferable to price targets.[8] If instead firms have incentives to target prices, then unforecastable idiosyncratic variation in TFPR and TFPQ must exactly coincide, because quantities rather than prices absorb all the variation from demand shocks.

We can thus measure the microeconomic incentives for price *vs.* quantity-setting using the empirical results of Foster et al. (2008), who are able to separately measure revenue- and quantity-based TFP for a subset of manufacturing firms in the US that produce physically homogeneous products and for which reliable physical quantity measurements are therefore possible. In these data, physical TFP has a higher volatility than revenue TFP and the two variables have an imperfect correlation of 0.75. These observations are consistent with the conjecture that the firms in this study target quantities. Moreover, if indeed firms are targeting quantities in the data, then we can compute their incentives to do so versus switching to price targeting (in units of percent profits, at the quarterly frequency):[9]

$$\Delta^{\mathrm{Mic}} = \underbrace{\frac{1}{2}\eta(\eta-1)}_{28,\text{ if }\eta=8} \times \left(\underbrace{\sigma^2_{\mathrm{TFPR}^Q,t}}_{=0.11^2} - \underbrace{\sigma^2_{\mathrm{TFPQ},t}}_{=0.13^2}\right) = -13\% \tag{61}$$

That is, microeconomic incentives favor quantity-setting to an extent equivalent to 13% of these firms' profits. If *all* firms faced a profile of volatility similar to that of the firms in the Foster et al. (2008) study, then the "divine condition" of Theorem 3 would fail under

[8] We note that this is also the maintained assumption of models in which firms are hit by "quality shocks" that simultaneously raise demand and lower productivity (*e.g.* Midrigan, 2011; Blanco et al., 2024).

[9] We take estimates of TFPR and TFPQ volatility from Table I, p. 404, of Foster et al. (2008). We divide the standard deviation by two (variance by four) to translate these estimates from the annual to the quarterly frequency.

essentially any plausible calibration for the volatility of aggregate productivity. That is, microeconomic incentives to target quantities rather than prices would be strong enough to prevail under price stability. We take this as a first indication that the policy trade-offs identified in our model could be empirically relevant.

7.2 Organizational Targets and Shock Propagation in the Data

We next study how time-varying incentives for organizational targets shape the transmission of shocks. A prediction that emerges from the theory is that aggregate demand shocks should have a larger impact on prices when firms target quantities relative to when they target prices (Corollary 1). Conversely, the impact of aggregate demand on output should be larger when firms target prices relative to when they target quantities.

To test this prediction, we proxy for firms' time-varying incentives in making their organizational choices and interact them with plausibly identified aggregate demand shocks. To proceed, we first observe that, up to scale, the comparative advantage of price targets can be written as the weighted sum of uncertainty about several macroeconomic variables plus the microeconomic component studied earlier:

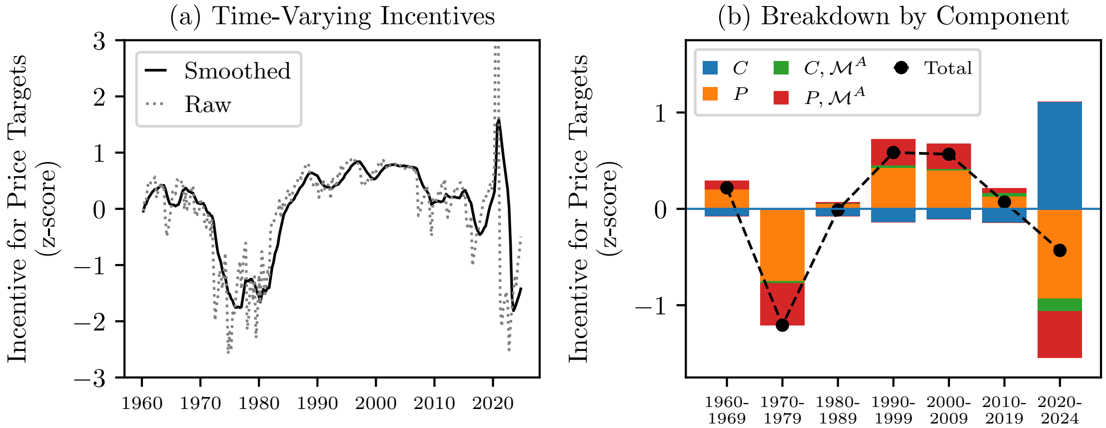
$$\Delta_t = \frac{1}{2}(\eta - 1)\left(\frac{1}{\eta}\sigma^2_{C,t} - \eta\sigma^2_{P,t} - 2\sigma_{C,\mathcal{M}^A,t} - 2\eta\sigma_{P,\mathcal{M}^A,t}\right) + \Delta^{\text{Mic}}_t \tag{62}$$

where C is aggregate real output, P is the aggregate price level, $\mathcal{M}^A = \frac{C^\gamma}{A}$ is the aggregate component of real marginal costs, and A is aggregate total factor productivity. Absent reliable data on how microeconomic incentives vary over the business cycle, we calculate a proxy for time variation in Δ_t using the macroeconomic terms in Equation 62.

To do this, we estimate a statistical model for time-varying uncertainty in macroeconomic aggregates using data on real GDP growth, GDP deflator growth, and capacity-utilization adjusted TFP growth (Fernald, 2014) from 1960Q1 to 2024Q4. We estimate a multivariate GARCH model and, from the maximum likelihood estimate, extract one-quarter-ahead uncertainty about each macroeconomic variable. Finally, we use an estimate of $\eta = 8$, in line with estimates from US retail scanner data (Hottman et al., 2016). Appendix C contains more details about the methods.

Time-Varying Incentives. Figure 4 shows our estimated time series for the macroeconomic incentives to target prices. In the time series, we see two key instances where quantity targets become more attractive: the inflation surges of the 1970s and the 2020s. In both cases, the key terms that change in the calculation are uncertainty about inflation and its covariance with real marginal costs. This can be seen most clearly in Panel (b), which breaks

Figure 4: Time-Varying Incentives to Target Prices *vs.* Quantities



Note: This figure shows the macroeconomic incentives for price targeting as defined in Equation 62. We report this in z-score units. The underlying calculations are based on an estimated stochastic volatility model of the US economy (see Section 7.2). Panel (a) shows the raw estimate (dotted line) and a smoothed estimate, the average over the last 10 quarters (solid line). The raw estimate exceeds the axis in one quarter, 2020:4. Panel (b) breaks down the calculation into the four terms in Equation 62, showing average values over decades.

down the calculation by each component of macroeconomic uncertainty.

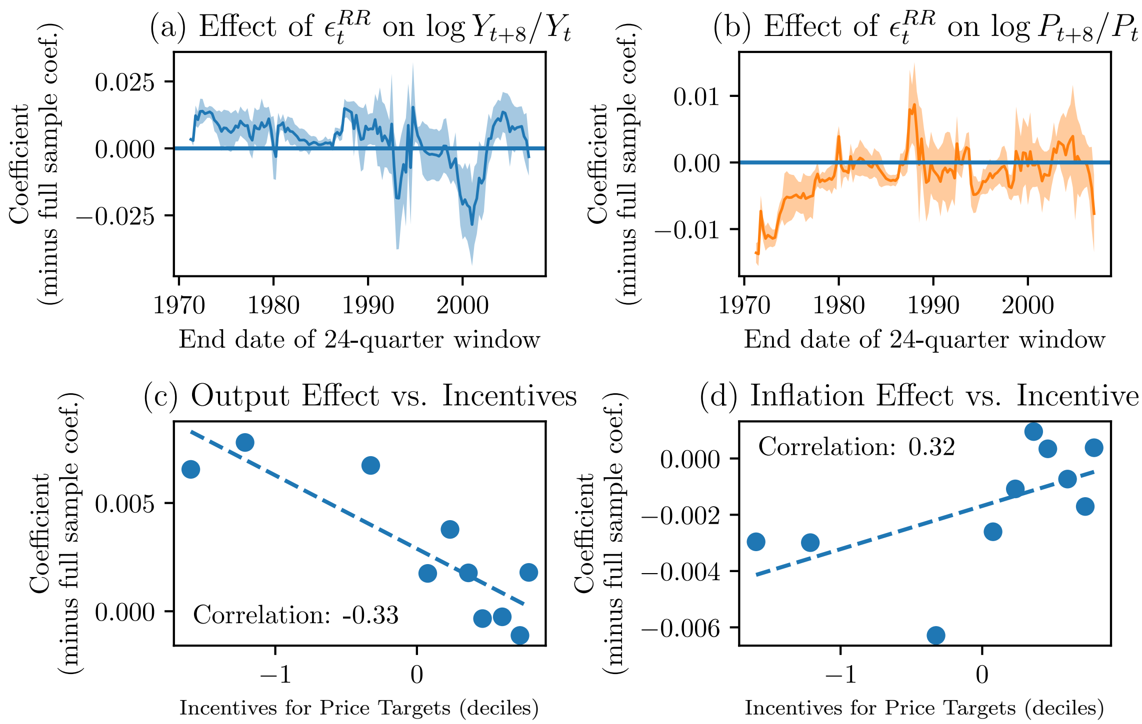
Testing the Effects on Shock Propagation. We now test whether the propagation of identified monetary policy shocks varies with our estimated incentives for organizational targets. We use the identified monetary shock of Romer and Romer (2004) and consider the local projection model

$$\log X_{t+8} - \log X_t = \beta \cdot \epsilon_t^{RR} + \gamma' Z_t + \varepsilon_t \tag{63}$$

where the outcome is the 8-quarter growth rate of either Real GDP or GDP deflator, ϵ_t^{RR} is the identified monetary policy shock, scaled to represent a surprise contraction, and the controls Z_t include the contemporaneous and lagged value of real GDP, GDP deflator, and total factor productivity (all in logarithms). The coefficient of interest, β, measures the economic effects of monetary contractions. We estimate each model in 24-quarter rolling windows throughout the sample to measure time- and state-varying propagation. We use Romer and Romer (2004) shocks instead of high-frequency shocks as these shocks are only available from the 1990s, greatly limiting our ability to detect state-dependence in monetary transmission.

Our findings, shown in Figure 5, suggest state-dependent shock propagation consistent

Figure 5: State-Dependent Effects of Monetary Contractions



Note: This figure summarizes our test for state-dependent propagation of monetary policy shocks. The top row shows estimates from local projection models for the effect of identified contractionary monetary policy shocks (Romer and Romer, 2004) in 24-quarter rolling windows. The outcomes are eight-quarter growth in real GDP (panel (a)) and GDP deflator (panel (b)), and we report the difference between the rolling-window estimates and the full-sample estimates. Error bars are 90% confidence intervals based on HAC-corrected standard errors with a bandwidth of six quarters. The second row relates these estimates to the smoothed and standardized estimate of firms' macroeconomic incentives for price targets (see Section 7.2 and Figure 4). Higher values indicate relative incentives toward price targets. The dashed line is the best-fit from a least-squares regression.

with the predictions of our theory. The negative real effects of shocks are largest precisely when the incentives for price-setting are largest (panel (c)), and the negative effects on inflation are highest when the incentives for price-setting are lowest (panel (d)). Together, these results imply that firms' endogenous targeting choices can be empirically relevant for the transmission of shocks to aggregate outcomes. In particular, as implied by the theory, the same monetary contraction can primarily move output or primarily move inflation depending on whether firms target prices or quantities.

8 Conclusion

The strategic choice of targeting prices or quantities is a long-standing problem in industrial organization and operations research and is, moreover, ingrained in the legal architecture of contracts. This paper is a first study in embedding firms' organizational choices in a general equilibrium macroeconomic context. Our contributions have been fivefold. First, we have illustrated how firm-level uncertainty and technology shapes organizational choices. Second, we have documented that organizational choices shape the transmission of shocks to macroeconomic aggregates in important qualitative ways via their effect on firms' strategic interactions. Third, we have illustrated that organizational choices feature meta-complementarities: a firm's incentives to target prices are highest when its competitors target prices as well. Fourth, the endogenous choice of organizational targets gives rise to new tradeoffs for monetary policy: excessive stabilization can backfire by inducing adverse incentives for price targeting and rendering monetary policy neutral. Fifth, we have documented suggestive empirical evidence of the relevance of organizational targets and the new challenges it raises for measurement.

In order to analyze the strategic choice of organizational targeting and its general equilibrium implications, we have intentionally constructed a simple, static model of firm behavior. In practice, firms face a multitude of choices that may interact with their organizational choices, including how they choose to manage their inventories, ration their products, engage in investment, and purchase inputs. Analyzing how these choices interact with the strategic nature of organizational behavior strikes us as a valuable avenue for future research. Moreover, it would be very interesting to use further empirical methods and data to uncover the nature of organizational decision-making and how it varies across time and macroeconomic conditions.

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Supplemental Appendix to *Organizational Targets in General Equilibrium*
by Flynn, Nikolakoudis, and Sastry

A Omitted Derivations and Proofs

A.1 Proof of Theorem 1

Proof. We first derive the cost function c. By the first-order condition of Equation 4, we have that $p_{xi} = \lambda \alpha_i \frac{q}{x_i}$ where λ is the Lagrange multiplier on the constraint. Multiplying both sides by z_i and summing, we obtain that:

$$c(q; p_x, \Theta) = \sum_{i=1}^{N} p_{xi} x_i = \lambda q \tag{64}$$

Moreover, setting $q = 1$, and substituting the first-order condition into the constraint, we obtain that:

$$\lambda = \Theta^{-1} \prod_{i=1}^{I} \left(\frac{p_{xi}}{\alpha_i} \right)^{\alpha_i} \tag{65}$$

Thus, real marginal costs are given by $\mathcal{M} = P^{-1}\lambda$, as claimed in Equation 5.

We next derive the optimal price under price targeting. To do so, we take the first-order condition of Equation 6. This yields:

$$\eta {p^*}^{-\eta-1} \mathbb{E}\left[\Lambda \mathcal{M} P^{\eta} \Psi\right] = (\eta - 1) {p^*}^{-\eta} \mathbb{E}\left[\Lambda P^{\eta-1} \Psi\right] \tag{66}$$

which rearranges to Equation 7.

We next derive the value under price targeting. To economize notation in the proof, we define

$$\xi^P = \mathbb{E}\left[\Lambda \mathcal{M} P^{\eta} \Psi\right], \qquad \zeta^P = \mathbb{E}\left[\Lambda P^{\eta-1} \Psi\right] \tag{67}$$

Substituting p^* into Equation 6, we derive

$$\begin{aligned}
V^P &= \mathbb{E}\left[\Lambda \left(\frac{p^*}{P} - \mathcal{M}\right) \Psi \left(\frac{p^*}{P}\right)^{-\eta}\right] \\
&= \mathbb{E}\left[\Lambda \left(\frac{1}{P}\frac{\eta}{\eta-1}\frac{\xi^P}{\zeta^P} - \mathcal{M}\right) \Psi P^{\eta} \left(\frac{\eta}{\eta-1}\right)^{-\eta} \left(\frac{\xi^P}{\zeta^P}\right)^{-\eta}\right] \\
&= \left(\frac{\eta}{\eta-1}\right)^{-\eta} \left(\frac{\eta}{\eta-1} - 1\right) \left(\xi^P\right)^{1-\eta} \left(\zeta^P\right)^{\eta}
\end{aligned} \tag{68}$$

which re-arranges to Equation 8 using the definitions of ξ^P and ζ^P.

We next derive the optimal quantity under quantity targeting. To do so, we take the first-order condition of Equation 9. This yields:

$$\mathbb{E}\left[\Lambda \mathcal{M}\right] = \frac{\eta - 1}{\eta} {q^*}^{-\frac{1}{\eta}} \mathbb{E}[\Lambda \Psi^{\frac{1}{\eta}}] \tag{69}$$

which rearranges to Equation 10.

To derive the value under quantity targeting, we first define

$$\xi^Q = \mathbb{E}\left[\Lambda \mathcal{M}\right], \qquad \zeta^Q = \mathbb{E}[\Lambda \Psi^{\frac{1}{\eta}}] \tag{70}$$

Substituting q^* into Equation 9, we obtain Equation 11:

$$\begin{aligned} V^Q &= \mathbb{E}\left[\Lambda \left(\left(\frac{q}{\Psi}\right)^{-\frac{1}{\eta}} - \mathcal{M} \right) q \right] \\ &= \mathbb{E}\left[\Lambda \left(\frac{\eta}{\eta - 1} \frac{\xi^Q}{\zeta^Q} \Psi^{\frac{1}{\eta}} - \mathcal{M} \right) \left(\frac{\eta}{\eta - 1} \right)^{-\eta} \left(\frac{\xi^Q}{\zeta^Q} \right)^{-\eta} \right] \\ &= \left(\frac{\eta}{\eta - 1} \right)^{-\eta} \left[\frac{\eta}{\eta - 1} - 1 \right] \left(\xi^Q\right)^{1-\eta} \left(\zeta^Q\right)^{\eta} \end{aligned} \tag{71}$$

We finally derive the log difference in value under price- and quantity targeting, Δ. We first combine the expressions for V^P and V^Q to write

$$\begin{aligned} \Delta &= \eta \Bigg(\log \mathbb{E}\left[\Lambda P^{\eta - 1} \Psi\right] - \log \mathbb{E}\left[\Lambda \Psi^{\frac{1}{\eta}}\right] \Bigg) - (\eta - 1) \Bigg(\mathbb{E}\left[\Lambda \mathcal{M} P^{\eta} \Psi\right] - \mathbb{E}\left[\Lambda \mathcal{M}\right] \Bigg) \\ &= \eta (\log \zeta^P - \log \zeta^Q) - (\eta - 1)(\log \xi^P - \log \xi^Q) \end{aligned} \tag{72}$$

Thus, it suffices to compute $(\zeta^P, \zeta^Q, \xi^P, \xi^Q)$.

To this end, we first establish that $(\Psi, P, \Lambda, \mathcal{M})$ is log-normal. We assumed that $(\Psi, P, \Theta, \Lambda, p_x)$ is log-normal. Moreover, we have that:

$$\log \mathcal{M} = -\log \Theta + \sum_{i=1}^{I} \alpha_i \log p_{xi} - \sum_{i=1}^{I} \alpha_i \log \alpha_i \tag{73}$$

which is an affine combination of jointly normal random variables, and is therefore jointly normal with (Ψ, P, Λ). Given log-normality of $(\Psi, P, \Lambda, \mathcal{M})$, we compute the first term of

Equation 72, which we call the "cost-hedging" component, we compute:

$$\begin{aligned}
\log \xi^P &= \log \mathbb{E}\left[\Lambda \mathcal{M} P^\eta \Psi\right] = \log \mathbb{E}\left[\exp\{\log \Lambda + \log \mathcal{M} + \eta \log P + \log \Psi\}\right] \\
&= \mu_\Lambda + \mu_\mathcal{M} + \eta \mu_P + \mu_\Psi + \frac{1}{2}\left(\sigma_\Lambda^2 + \sigma_\mathcal{M}^2 + \eta^2 \sigma_P^2 + \sigma_\Psi^2\right) \\
&\qquad + \sigma_{\Lambda,\mathcal{M}} + \eta \sigma_{\Lambda,P} + \sigma_{\Lambda,\Psi} + \eta \sigma_{\mathcal{M},P} + \sigma_{\mathcal{M},\Psi} + \eta \sigma_{P,\Psi} \qquad (74) \\
\log \xi^Q &= \log \mathbb{E}[\Lambda \mathcal{M}] = \log \mathbb{E}[\exp\{\log \Lambda + \log \mathcal{M}\}] \\
&= \mu_\Lambda + \mu_\mathcal{M} + \frac{1}{2}\left(\sigma_\Lambda^2 + \sigma_\mathcal{M}^2\right) + \sigma_{\Lambda,\mathcal{M}}
\end{aligned}$$

Thus, the cost-hedging cost of prices is given by:

$$\begin{aligned}
(\eta - 1)(\log \xi^P - \log \xi^Q) = (\eta - 1)\Bigg[&\eta \mu_P + \mu_\Psi + \frac{1}{2}\left(\eta^2 \sigma_P^2 + \sigma_\Psi^2\right) \\
&+ \eta \sigma_{\Lambda,P} + \sigma_{\Lambda,\Psi} + \eta \sigma_{\mathcal{M},P} + \sigma_{\mathcal{M},\Psi} + \eta \sigma_{P,\Psi}\Bigg]
\end{aligned} \qquad (75)$$

To compute the second term of Equation 72, which we call the "revenue-hedging" component, we compute:

$$\begin{aligned}
\log \zeta^P &= \log \mathbb{E}\left[\Lambda P^{\eta-1} \Psi\right] = \log \mathbb{E}[\exp\{\log \Lambda + (\eta - 1)\log P + \log \Psi\}] \\
&= \mu_\Lambda + (\eta - 1)\mu_P + \mu_\Psi + \frac{1}{2}\left(\sigma_\Lambda^2 + (\eta - 1)^2 \sigma_P^2 + \sigma_\Psi^2\right) \\
&\quad + (\eta - 1)\sigma_{\Lambda,P} + \sigma_{\Lambda,\Psi} + (\eta - 1)\sigma_{P,\Psi}
\end{aligned} \qquad (76)$$

and

$$\begin{aligned}
\log \zeta^Q &= \log \mathbb{E}\left[\Lambda \Psi^{\frac{1}{\eta}}\right] = \log \mathbb{E}\left[\exp\left\{\log \Lambda + \frac{1}{\eta}\log \Psi\right\}\right] \\
&= \mu_\Lambda + \frac{1}{\eta}\mu_\Psi + \frac{1}{2}\left(\sigma_\Lambda^2 + \frac{1}{\eta^2}\sigma_\Psi^2\right) + \frac{1}{\eta}\sigma_{\Lambda,\Psi}
\end{aligned} \qquad (77)$$

Thus, the revenue-hedging benefit of prices is given by:

$$\begin{aligned}
\eta(\log \zeta^P - \log \zeta^Q) = \eta\Bigg[&(\eta - 1)\mu_P + \frac{\eta - 1}{\eta}\mu_\Psi + \frac{1}{2}\left((\eta - 1)^2 \sigma_P^2 + \left(1 - \frac{1}{\eta^2}\right)\sigma_\Psi^2\right) \\
&+ (\eta - 1)\sigma_{\Lambda,P} + \frac{\eta - 1}{\eta}\sigma_{\Lambda,\Psi} + (\eta - 1)\sigma_{P,\Psi}\Bigg]
\end{aligned} \qquad (78)$$

Taking the difference between the cost-hedging and revenue-hedging terms, we obtain Equation 13:

$$\Delta = \frac{1}{2}\left[\left(\eta(\eta-1)^2 - \eta^2(\eta-1)\right)\sigma_P^2 + \left(\eta\left(1-\frac{1}{\eta^2}\right)-(\eta-1)\right)\sigma_\Psi^2\right] - \eta(\eta-1)\sigma_{\mathcal{M},P} - (\eta-1)\sigma_{\mathcal{M},\Psi} = \frac{1}{2}\left(\frac{\eta-1}{\eta}\sigma_\Psi^2 - \eta(\eta-1)\sigma_P^2 - 2(\eta-1)\sigma_{\mathcal{M},\Psi} - 2\eta(\eta-1)\sigma_{\mathcal{M},P}\right) \quad (79)$$

□

A.2 Calculations of Equilibrium Relationships

Here, we derive the equilibrium relationships that are claimed in Section 4.1. We first derive Equation 25. The household must be indifferent between three things: spending a dollar on consumption, holding the dollar (conferring utility today and a dollar tomorrow), and investing in the bond (giving interest tomorrow). These conditions can be written as

$$C_t^{-\gamma}P_t^{-1} = \xi_t^{-1}M_t^{-1} + \beta\mathbb{E}_t\left[C_{t+1}^{-\gamma}P_{t+1}^{-1}\right] = \beta(1+i_t)\mathbb{E}_t\left[C_{t+1}^{-\gamma}P_{t+1}^{-1}\right] \quad (80)$$

Combining these expressions, we have that:

$$\xi_t^{-1}M_t^{-1} = \beta i_t\mathbb{E}_t\left[C_{t+1}^{-\gamma}P_{t+1}^{-1}\right] = \frac{i_t}{1+i_t}C_t^{-\gamma}P_t^{-1} \quad (81)$$

This rearranges to Equation 25 by isolating M_t/P_t on one side of the equation.

We next solve for the nominal interest rate and, in particular, establish that it is deterministic. Substituting Equation 81 into the Euler equation for bonds,

$$\frac{1+i_t}{i_t}\frac{1}{\xi_t M_t} = \beta(1+i_t)\mathbb{E}_t\left[\frac{1+i_{t+1}}{i_{t+1}}\frac{1}{\xi_{t+1}M_{t+1}}\right] \quad (82)$$

Dividing both sides by $(1+i_t)$, multiplying by $M_t\xi_t$, and then adding one, we obtain:

$$\frac{1+i_t}{i_t} = 1 + \beta\mathbb{E}_t\left[\frac{1+i_{t+1}}{i_{t+1}}\frac{M_t\xi_t}{M_{t+1}\xi_{t+1}}\right] = 1 + \beta\mathbb{E}_t\left[\exp\left(-\mu_\xi - \sigma_{\xi,t+1}\varepsilon_{t+1}^\xi\right)\frac{1+i_{t+1}}{i_{t+1}}\right] \quad (83)$$

where the second equality uses the fact that M_t is constant, and ξ_t follows a random walk with drift in logarithms, with increments $\sigma_{\xi,t}\varepsilon_t^\xi$, or $\xi_{t+1}/\xi_t = \exp\Big(\mu_\xi + \sigma_{\xi,t+1}\varepsilon_{t+1}^\xi\Big)$.

We guess that i_t is deterministic and define $x_t = \frac{1+i_t}{i_t}$, then we obtain that:

$$x_t = 1 + \delta_t x_{t+1} \quad (84)$$

where:

$$\delta_t = \beta \exp\left\{-\mu_\xi + \frac{1}{2}\sigma^2_{\xi,t+1}\right\} \tag{85}$$

Solving this equation forward, we obtain that:

$$x_t = 1 + \delta_t + \delta_t \sum_{i=1}^{T-1} \prod_{j=1}^{i} \delta_{t+j} + \delta_t \left(\prod_{j=1}^{T} \delta_{t+j}\right) x_{t+T+1} \tag{86}$$

Taking the limit $T \to \infty$, this becomes:

$$x_t = 1 + \delta_t + \delta_t \sum_{i=1}^{\infty} \prod_{j=1}^{i} \delta_{t+j} + \delta_t \lim_{T\to\infty} \left(\prod_{j=1}^{T} \delta_{t+j}\right) x_{t+T+1} \tag{87}$$

The household's transversality condition ensures that this final term is zero. Formally, the transversality condition (necessary for the optimality of the household's choices) is that:

$$\lim_{T\to\infty} \mathbb{E}_0 \left[\beta^T \frac{C_T^{-\gamma}}{P_T}(M_T + (1+i_T)B_T)\right] = 0 \tag{88}$$

where $\mathbb{E}_0$ denotes the household's expectation at $t = 0$. Moreover, as $B_t = 0$ for all $t \in \mathbb{N}$, this reduces to $\lim_{T\to\infty} \beta^T \mathbb{E}_0 \left[\frac{C_T^{-\gamma}}{P_T} M_T\right] = 0$. By Equation 81, we have that $\frac{x_t}{\xi_t M_t} = \frac{C_t^{-\gamma}}{P_t}$ for all t. Thus, the transversality condition reduces to

$$0 = \lim_{T\to\infty} \left(\beta^T x_T \mathbb{E}_0[\xi_T^{-1}]\right) = \lim_{T\to\infty} \left(\xi_0^{-1} x_T \left[\prod_{j=1}^{T} \delta_j\right]\right) \tag{89}$$

Thus, $\lim_{T\to\infty} \left(\prod_{j=1}^{T} \delta_{t+j}\right) x_{t+T+1} = 0$. It follows that

$$\frac{1+i_t}{i_t} = 1 + \beta \exp\left\{-\mu_\xi + \frac{1}{2}\sigma^2_{\xi,t}\right\} \left(1 + \sum_{i=1}^{\infty} \prod_{j=1}^{i} \beta \exp\left\{-\mu_\xi + \frac{1}{2}\sigma^2_{\xi,t+j}\right\}\right) \tag{90}$$

A.3 Proof of Proposition 1

We prove this result in a modified environment in which the money demand equation is

$$\frac{M_t}{P_t^\theta} = \xi_t^{-1} C_t^\gamma (1 + i_t^{-1}) \tag{91}$$

for some $\theta \in \mathbb{R}$. Proposition 1 corresponds to the case in which $\theta = 1$. Corollary 5 corresponds to the case in which $\theta = 1 - \alpha$ and where M_t is replaced with $M_{t-1}e^\mu$.

By taking logarithms of Equation 7, we observe that

$$\begin{aligned}\log p_{it} &= \log\left(\frac{\eta}{\eta-1}\right) + \log \mathbb{E}_{it}[\Lambda \mathcal{M}_{it} P_t^{\eta} \Psi_{it}] - \log \mathbb{E}_{it}[\Lambda_t P_t^{\eta-1}\Psi_{it}] \\ &= \log\left(\frac{\eta}{\eta-1}\right) + \log \mathbb{E}_{it}[\phi_{it}(z_{it}A_t)^{-1} P_t^{\eta} \vartheta_{it} C_t] - \log \mathbb{E}_{it}[C_t^{1-\gamma} P_t^{\eta-1}\vartheta_{it}] \\ &= \log\left(\frac{\eta}{\eta-1}\frac{i_t}{1+i_t}M_t\right) + \log \mathbb{E}_{it}[\phi_{it}(z_{it}A_t)^{-1} \xi_t^{\frac{1}{\gamma}} \vartheta_{it} P_t^{\eta-\frac{\theta}{\gamma}}] - \log \mathbb{E}_{it}[\xi_t^{\frac{1}{\gamma}-1} P_t^{-\frac{\theta}{\gamma}+\theta+\eta-1}\vartheta_{it}]\end{aligned} \tag{92}$$

where, in the second line, we use the expressions: $\Lambda_t = C_t^{-\gamma}$ (calculation of marginal utility), $\mathcal{M}_{it} = \frac{\phi_{it}C_t^{\gamma}}{z_{it}A_t}$ (Equation 24), and $\Psi_{it} = C_t\vartheta_{it}$ (Equation 23); and, in the third equation, we use the money demand equation to solve for real consumption (Equation 25), and we observe that the money supply and nominal interest rate are deterministic. We now proceed under the conjecture that

$$\log P_t = \tilde{\chi}_{0,t}^P + \tilde{\chi}_{A,t}^P \log A_t + \tilde{\chi}_{\xi,t}^P \log \xi_t \tag{93}$$

Under this conjecture, all variables in both conditional expectations of Equation 92 are jointly log normal. Since ϕ_{it}/z_{it} and ϑ_{it} are independent from the others, we can rewrite this condition as

$$\begin{aligned}\log p_{it} = &\log\left(\frac{\eta}{\eta-1}\frac{i_t}{1+i_t}M_t\right) + \log \mathbb{E}_{it}[\phi_{it} z_{it}^{-1}] \\ &+ \underbrace{\log \mathbb{E}_{it}[A_t^{-1}\xi_t^{\frac{1}{\gamma}} P_t^{\eta-\frac{\theta}{\gamma}}]}_{\text{Term 1}} - \underbrace{\log \mathbb{E}_{it}[\xi_t^{\frac{1}{\gamma}-1} P_t^{-\frac{\theta}{\gamma}+\theta+\eta-1}]}_{\text{Term 2}}\end{aligned} \tag{94}$$

We now calculate the two terms.

We start with Term 1, first collecting terms that load on $\log A_t$ and $\log \xi_t$:

$$\begin{aligned}\log \mathbb{E}_{it}\left[A_t^{-1}\xi_t^{\frac{1}{\gamma}} P_t^{\eta-\frac{\theta}{\gamma}}\right] &= \log \mathbb{E}_{it}\left[\exp\left\{-\log A_t + \frac{1}{\gamma}\log \xi_t + \left(\eta - \frac{\theta}{\gamma}\right)\log P_t\right\}\right] \\ &= \log \mathbb{E}_{it}\left[\exp\left\{-\log A_t + \frac{1}{\gamma}\log \xi_t + \left(\eta - \frac{\theta}{\gamma}\right)\left(\tilde{\chi}_{0,t}^P + \tilde{\chi}_{A,t}^P \log A_t + \tilde{\chi}_{\xi,t}^P \log \xi_t\right)\right\}\right] \\ &= \left(\eta - \frac{\theta}{\gamma}\right)\tilde{\chi}_{0,t}^P + \log \mathbb{E}_{it}\left[\exp\left\{\left(\tilde{\chi}_{A,t}^P\left(\eta - \frac{\theta}{\gamma}\right) - 1\right)\log A_t + \left(\gamma^{-1}(1-\theta\tilde{\chi}_{\xi,t}^P) + \eta\tilde{\chi}_{\xi,t}^P\right)\log \xi_t\right\}\right]\end{aligned} \tag{95}$$

We next use the fact that, for each variable $Z \in \{A, \xi\}$, $\log \mathbb{E}_{it}[Z_t] = (1-\kappa_t^Z)\mu_{t-1}^Z + \kappa_t^Z s_{it}^Z + \frac{1}{2}\sigma_{Z|s,t}^2$, where κ_t^Z is the posterior weight defined in Equation 28, μ_{t-1}^Z is short-hand notation for the prior mean (based on observing the history of the variables: $\mu_{t-1}^A = \rho \log A_{t-1}$, $\mu_{t-1}^{\xi} = \log \xi_{t-1}$); and $\sigma_{Z|s,t}^2$ denotes the posterior variance. Using these simplifications,

$$\log \mathbb{E}_{it}\left[A_t^{-1}\xi_t^{\frac{1}{\gamma}} P_t^{\eta-\frac{\theta}{\gamma}}\right] = K_1 + \left(\tilde{\chi}_{A,t}^P\left(\eta - \frac{\theta}{\gamma}\right) - 1\right)\kappa_t^A s_{it}^A + \left(\gamma^{-1}(1-\theta\tilde{\chi}_{\xi,t}^P) + \eta\tilde{\chi}_{\xi,t}^P\right)\kappa_t^{\xi} s_{it}^{\xi} \tag{96}$$

where the constant is

$$
\begin{aligned}
K_1 = &\left(\eta - \frac{\theta}{\gamma}\right) \tilde{\chi}^P_{\xi,t} + \\
&\left(\left(\tilde{\chi}^P_{A,t}\left(\eta - \frac{\theta}{\gamma}\right) - 1\right)((1-\kappa^A_t)\mu^A_{t-1}) + \frac{1}{2}\left(\left(\tilde{\chi}^P_{A,t}\left(\eta - \frac{\theta}{\gamma}\right) - 1\right)^2 \sigma^2_{A|s,t}\right)\right) \\
&+ \left(\left(\gamma^{-1}(1-\theta\tilde{\chi}^P_{\xi,t}) + \eta\tilde{\chi}^P_{\xi,t}\right)((1-\kappa^\xi_t)\mu^\xi_{t-1}) + \frac{1}{2}\left(\gamma^{-1}(1-\theta\tilde{\chi}^P_{\xi,t}) + \eta\tilde{\chi}^P_{\xi,t}\right)^2 \sigma^2_{\xi|s,t}\right)
\end{aligned}
\tag{97}
$$

We next consider Term 2. Performing the same operations, we determine

$$
\begin{aligned}
\log \mathbb{E}_{it}\left[\xi_t^{\frac{1}{\gamma}-1} P_t^{-\frac{\theta}{\gamma}+\theta+\eta-1}\right] = K_2 &+ \left((\theta(1-\gamma^{-1}) + \eta - 1)\tilde{\chi}^P_{A,t}\right)\kappa^A_t s^A_{it} \\
&+ \left(\gamma^{-1}(1-\gamma-\theta\tilde{\chi}^P_{\xi,t}) + (\theta+\eta-1)\tilde{\chi}^P_{\xi,t}\right)\kappa^\xi_t s^\xi_{it}
\end{aligned}
\tag{98}
$$

where the constant is

$$
\begin{aligned}
K_2 = &\left(-\frac{\theta}{\gamma} + \theta + \eta - 1\right)\tilde{\chi}^P_{\xi,t} + \left((\theta(1-\gamma^{-1}) + \eta - 1)\tilde{\chi}^P_{A,t}\right)((1-\kappa^A_t)\mu^A_{t-1}) \\
&+ \frac{1}{2}\left((\theta(1-\gamma^{-1}) + \eta - 1)\tilde{\chi}^P_{A,t}\right)^2 \sigma^2_{A|s,t} \\
&+ \left(\gamma^{-1}(1-\gamma-\theta\tilde{\chi}^P_{\xi,t}) + (\theta+\eta-1)\tilde{\chi}^P_{\xi,t}\right)((1-\kappa^\xi_t)\mu^\xi_{t-1}) \\
&+ \frac{1}{2}\left(\gamma^{-1}(1-\gamma-\theta\tilde{\chi}^P_{\xi,t}) + (\theta+\eta-1)\tilde{\chi}^P_{\xi,t}\right)^2 \sigma^2_{\xi|s,t}
\end{aligned}
\tag{99}
$$

Therefore, turning back to Equation 94,

$$
p_{it} = K_3 + \kappa^A_t\left(\tilde{\chi}^P_{A,t}(1-\theta) - 1\right)s^A_{it} + \kappa^\xi_t\left(1 + (1-\theta)\tilde{\chi}^P_{\xi,t}\right)s^\xi_{it}
\tag{100}
$$

where

$$
K_3 = K_1 - K_2 + \log\left(\frac{\eta}{\eta-1}\frac{i_t}{1+i_t}M_t\right) + \left(\mu_\phi - \mu_z + \frac{1}{2}\left(\sigma^2_{\phi,t} + \sigma^2_{z,t}\right)\right)
\tag{101}
$$

Thus $\log p_{it}$ is a normal random variable.

Under these normal best replies, the aggregate price level is given by the ideal price index. Simplifying and applying the law of large numbers,

$$
\begin{aligned}
\log P_t &= \frac{1}{1-\eta}\log \mathbb{E}_t\left[\exp\left\{\log\vartheta_{it} + (1-\eta)\log p_{it}\right\}\right] \\
&= \frac{1}{1-\eta}\left(\mu_\vartheta + \frac{1}{2}\sigma^2_{\vartheta,t}\right) + \mathbb{E}_t[\log p_{it}] + \frac{1-\eta}{2}\mathbb{V}_t[\log p_{it}]
\end{aligned}
\tag{102}
$$

where $\mathbb{E}_t$ and $\mathbb{V}_t$ are across the cross-sectional distribution of signals. Since $\mathbb{E}_t[s^Z_{it}] = \log Z_t$

for each variable $Z \in \{A, \xi\}$, we proceed to solve for the coefficients in Equation 93 by guess and verify. For $\log A_t$,

$$\tilde{\chi}^P_{A,t} = \kappa^A_t \left(\tilde{\chi}^P_{A,t}(1-\theta) - 1\right) \implies \tilde{\chi}^P_{A,t} = -\frac{\kappa^A_t}{1-\kappa^A_t(1-\theta)} \tag{103}$$

For $\log \xi_t$,

$$\tilde{\chi}^P_{\xi,t} = \kappa^\xi_t \left(\tilde{\chi}^P_{\xi,t}(1-\theta) + 1\right) \implies \tilde{\chi}^P_{\xi,t} = \frac{\kappa^\xi_t}{1-\kappa^\xi_t(1-\theta)} \tag{104}$$

And the constant solves

$$\tilde{\chi}^P_{0,t} = K_1 - K_2 + \log\left(\frac{\eta}{\eta-1}\frac{i_t}{1+i_t}M_t\right) + \frac{1}{1-\eta}\left(\mu_\vartheta + \frac{1}{2}\sigma^2_{\vartheta,t}\right) + \frac{1-\eta}{2}\mathbb{V}_t[\log p_{it}] \tag{105}$$

To derive the dynamics of output, we inspect Equation 91 and observe that

$$\log C_t = \chi^P_{0,t} + \chi^P_{A,t}\log A_t + \chi^P_{\xi,t}\log \xi_t \tag{106}$$

where

$$\begin{aligned}
\chi^P_{0,t} &= \frac{1}{\gamma}\log M_t - \frac{\theta}{\gamma}\tilde{\chi}^P_{0,t} - \frac{1}{\gamma}\log\frac{1+i_t}{i_t} \\
\chi^P_{A,t} &= -\frac{\theta}{\gamma}\tilde{\chi}^P_{A,t} = \frac{\theta}{\gamma}\frac{\kappa^A_t}{1-\kappa^A_t(1-\theta)} \\
\chi^P_{\xi,t} &= \frac{1}{\gamma}\left(1-\theta\tilde{\chi}^P_{\xi,t}\right) = \frac{1}{\gamma}\left(\frac{1-\kappa^\xi_t}{1-\kappa^\xi_t(1-\theta)}\right)
\end{aligned} \tag{107}$$

A.4 Proof of Proposition 2

Proof. We prove this result in the modified environment in which the money demand equation is Equation 91 for some $\theta \in \mathbb{R}$. Proposition 2 corresponds to the case in which $\theta = 1$. Corollary 7 corresponds to the case in which $\theta = 1 - \alpha$.

Taking logarithms of the optimal quantity plan in Equation 10, and simplifying, we obtain:

$$\begin{aligned}
\log q_{it} &= -\eta\left(\log\frac{\eta}{\eta-1} + \log\mathbb{E}_{it}[\Lambda_t\mathcal{M}_{it}] - \log\mathbb{E}_{it}[\Lambda_t\Psi^{\frac{1}{\eta}}_{it}]\right) \\
&= -\eta\left[\log\left(\frac{\eta}{\eta-1}\right) + \underbrace{\log\mathbb{E}_{it}\left[\phi_{it}(z_{it}A_t)^{-1}\right]}_{\text{Term 1}} - \underbrace{\log\mathbb{E}_{it}\left[\vartheta^{\frac{1}{\eta}}_{it}C_t^{-\gamma+\frac{1}{\eta}}\right]}_{\text{Term 2}}\right]
\end{aligned} \tag{108}$$

where, in the second line, we use the expressions: $\Lambda_t = C_t^{-\gamma}$ (calculation of marginal utility),

$\mathcal{M}_{it} = \frac{\phi_{it} C_t^{\gamma}}{z_{it} A_t}$ (Equation 24), and $\Psi_{it} = C_t \vartheta_{it}$ (Equation 23). We now compute this as a function of primitives under the conjecture that

$$\log C_t = \chi_{0,t}^Q + \chi_{A,t}^Q \log A_t + \chi_{\xi,t}^Q \log \xi_t \tag{109}$$

We begin with "Term 1," exploiting the independence of ϕ_{it}, z_{it} and A_t:

$$\begin{aligned} \log \mathbb{E}_{it}\left[\phi_{it}(z_{it}A_t)^{-1}\right] &= \log \mathbb{E}_{it}\left[\exp\left\{\log \phi_{it} - \log z_{it} - \log A_t\right\}\right] \\ &= \mu_\phi + \frac{1}{2}\sigma_{\phi,t}^2 - \mu_z + \frac{1}{2}\sigma_{z,t}^2 - (1-\kappa_t^A)\mu_{t-1}^A + \frac{1}{2}\sigma_{A|s,t}^2 - \kappa_t^A s_{it}^A \end{aligned} \tag{110}$$

We next calculate "Term 2":

$$\begin{aligned} \mathbb{E}_{it}\left[\vartheta_{it}^{\frac{1}{\eta}} C_t^{-\gamma+\frac{1}{\eta}}\right] &= \log \mathbb{E}_{it}\left[\exp\left\{\frac{1}{\eta}\log \vartheta_{it} + \left(-\gamma + \frac{1}{\eta}\right)\log C_t\right\}\right] \\ &= \frac{\mu_\vartheta}{\eta} + \frac{1}{2\eta^2}\sigma_{\vartheta,t}^2 \\ &\quad + \log \mathbb{E}_{it}\left[\exp\left\{\left(-\gamma + \frac{1}{\eta}\right)\left(\chi_{0,t}^Q + \chi_{A,t}^Q \log A_t + \chi_{\xi,t}^Q \log \xi_t\right)\right\}\right] \\ &= \frac{\mu_\vartheta}{\eta} + \frac{1}{2\eta^2}\sigma_{\vartheta,t}^2 + \left(-\gamma + \frac{1}{\eta}\right)\left(\chi_{0,t}^Q + \chi_{A,t}^Q(1-\kappa_t^A)\mu_{t-1}^A + \chi_{\xi,t}^Q(1-\kappa_t^\xi)\mu_{t-1}^\xi\right) \\ &\quad + \frac{1}{2}\left(-\gamma + \frac{1}{\eta}\right)^2\left((\chi_{A,t}^Q)^2\sigma_{A|s,t}^2 + (\chi_{\xi,t}^Q)^2\sigma_{\xi|s,t}^2\right) \\ &\quad + \left(-\gamma + \frac{1}{\eta}\right)\kappa_t^A \chi_{A,t}^Q s_{it}^A + \left(-\gamma + \frac{1}{\eta}\right)\kappa_t^\xi \chi_{\xi,t}^Q s_{it}^\xi \end{aligned} \tag{111}$$

Putting these together, we write:

$$\log q_{it} = -\eta\left(a_t + b_t s_{it}^A + c_t s_{it}^\xi\right) \tag{112}$$

where

$$\begin{aligned} a_t &= \log\frac{\eta}{\eta-1} + \mu_\phi + \frac{1}{2}\sigma_\phi^2 - \mu_z + \frac{1}{2}\sigma_z^2 - (1-\kappa_t^A)\mu_{t-1}^A + \frac{1}{2}\sigma_{A|s,t} \\ &\quad - \left(\frac{\mu_\vartheta}{\eta} + \frac{1}{2\eta^2}\sigma_{\vartheta,t}^2 + \left(-\gamma + \frac{1}{\eta}\right)\left(\chi_{0,t}^Q + \chi_{A,t}^Q(1-\kappa_t^A)\mu_{t-1}^A + \chi_{\xi,t}^Q(1-\kappa_t^\xi)\mu_{t-1}^\xi\right)\right. \\ &\quad \left. + \frac{1}{2}\left(-\gamma + \frac{1}{\eta}\right)^2\left((\chi_{A,t}^Q)^2\sigma_{A|s,t}^2 + (\chi_{\xi,t}^Q)^2\sigma_{\xi|s,t}^2\right)\right) \\ b_t &= -\kappa_t^A - \left(-\gamma + \frac{1}{\eta}\right)\kappa_t^A \chi_{A,t}^Q \\ c_t &= -\left(-\gamma + \frac{1}{\eta}\right)\kappa_t^\xi \chi_{\xi,t}^Q \end{aligned} \tag{113}$$

We next re-express the consumption aggregator,

$$C_t = \left[\int \vartheta_{it}^{\frac{1}{\eta}} q_{it}^{\frac{\eta-1}{\eta}} \, \mathrm{d}i \right]^{\frac{\eta}{\eta-1}} \tag{114}$$

given the joint log-normality of $(q_{it}, \vartheta_{it})_{i\in[0,1]}$. Applying a law of large numbers to the inner integral, as well as the formulas for expectations of log-normal random variables, we compute:

$$\log C_t = \mathbb{E}[\log q_{it}] + \frac{1}{2}\frac{\eta}{\eta-1}\mathrm{Var}\left(\frac{\eta-1}{\eta}\log q_{it} + \frac{1}{\eta}\log\vartheta_{it} \right) + \frac{\mu_\vartheta}{\eta-1} \tag{115}$$

where the expectation and variance are over the cross-sectional distribution of the q_{it}'s. Substituting in Equation 112, observing that $\mathbb{E}[s_{it}^A] = \log A_t$ and $\mathbb{E}[s_{it}^\xi] = \log\xi_t]$, and matching coefficients, we obtain the following expression for $\chi_{A,t}^Q$:

$$\chi_{A,t}^Q = \eta\kappa_t^A \left(1 + \left(\frac{1}{\eta} - \gamma \right) \chi_{A,t}^Q \right) \implies \chi_{A,t}^Q = \frac{\eta\kappa_t^A}{1-(1-\eta\gamma)\kappa_t^A} \tag{116}$$

as desired. Next,

$$\chi_{\xi,t}^Q = \eta\kappa_t^\xi \left(\left(\frac{1}{\eta} - \gamma \right) \chi_{\xi,t}^Q \right) \implies \chi_{\xi,t}^Q = 0 \tag{117}$$

And the constant solves

$$\chi_{0,t}^Q = -\eta a_t + \frac{1}{2}\frac{\eta-1}{\eta}\mathrm{Var}\left(\log q_{it} + \left(\frac{\eta}{\eta-1} \right)^2 \frac{1}{\eta^2}\log\vartheta_{it} \right) \tag{118}$$

This verifies our conjecture that consumption is log-normal in aggregates as well as our conjecture that quantities are distributed log-normally across firms (conditional on A_t and M_t).

In order to obtain the expression for the price level, note that Equation 91 implies that

$$\theta \log P_t = \log\frac{i_t}{1+i_t} + \log M_t - \gamma\log C_t + \log\xi_t \tag{119}$$

And therefore we have

$$\log P_t = \frac{1}{\theta}\left(\log\frac{i_t}{1+i_t} + \log M_t - \gamma\chi_{0,t}^Q \right) - \frac{\gamma}{\theta}\chi_{A,t}^Q \log A_t + \frac{1}{\theta}\left(1 - \gamma\chi_{\xi,t}^Q \right)\log\xi_t \tag{120}$$

The result follows. □

A.5 Proof of Corollary 2

We can write $\chi^P_{A,t} - \chi^Q_{A,t}$ as

$$\frac{\kappa^A_t}{\gamma} - \frac{\eta\kappa^A_t}{1-\kappa^A_t(1-\eta\gamma)} \tag{121}$$

We first consider the case in which $\eta\gamma < 1$. Since $\kappa^A_t \in (0,1)$, we have that the denominator of the second term is positive. Thus, we can re-express the condition $\chi^P_{A,t} - \chi^Q_{A,t} > 0$ as:

$$1-\eta\gamma > \kappa^A_t(1-\eta\gamma) \tag{122}$$

which is true as $\eta\gamma < 1$ and $\kappa^A_t \in (0,1)$.

A.6 Proof of Theorem 2

Proof. We begin with a helpful calculation:

Lemma 3 (Prices *vs.* Quantities in Equilibrium)**.** *If all firms set quantities, then the comparative advantage of prices over quantities is given by:*

$$\begin{aligned}\Delta^Q_t = \frac{1}{2}(\eta-1)\Bigg(&\frac{1}{\eta}\sigma^2_{\vartheta,t} + 2\sigma_{\vartheta,z,t} - \eta\kappa^\xi_t\sigma^2_{\xi,s} \\ &+ \left(\frac{1}{\eta}(1-\eta\gamma)\frac{\eta\kappa^A_t}{1-\kappa^A_t(1-\eta\gamma)} + 2\right)(1-\eta\gamma)\frac{\eta\left(\kappa^A_t\right)^2}{1-\kappa^A_t(1-\eta\gamma)}\sigma^2_{A,s}\Bigg)\end{aligned} \tag{123}$$

Moreover, all firms can set quantities in equilibrium at time t if and only if $\Delta^Q_t \leq 0$. If all firms set prices, then the comparative advantage of prices over quantities is given by:

$$\begin{aligned}\Delta^P_t = \frac{1}{2}(\eta-1)\Bigg(&\frac{1}{\eta}\sigma^2_{\vartheta,t} + 2\sigma_{\vartheta,z,t} + \left(-\eta + \frac{1}{\eta}(1-\eta\gamma)^2\left(\frac{1-\kappa^\xi_t}{\gamma}\right)^2\right)\kappa^\xi_t\sigma^2_{\xi,s} \\ &+ \left(\frac{1}{\eta}(1-\eta\gamma)\frac{\kappa^A_t}{\gamma} + 2\right)(1-\eta\gamma)\frac{\left(\kappa^A_t\right)^2}{\gamma}\sigma^2_{A,s}\Bigg)\end{aligned} \tag{124}$$

Moreover, all firms can set prices in equilibrium at time t if and only if $\Delta^P_t \geq 0$.

Proof. From Theorem 1, we have that:

$$\Delta = \frac{1}{2}(\eta-1)\left(\frac{1}{\eta}\sigma^2_\Psi - \eta\sigma^2_P - 2\sigma_{\Psi,\mathcal{M}} - 2\eta\sigma_{P,\mathcal{M}}\right) \tag{125}$$

Moreover, using the expressions derived in Section 4.1, we have that:

$$\begin{aligned}
\sigma_\Psi^2 &= \sigma_\vartheta^2 + \sigma_C^2 \\
\sigma_P^2 &= \gamma^2\sigma_C^2 + \sigma_\xi^2 - 2\gamma\sigma_{C,\xi} \\
\sigma_{\Psi,\mathcal{M}} &= \gamma\sigma_C^2 - \sigma_{C,A} - \sigma_{\vartheta,z} \\
\sigma_{P,\mathcal{M}} &= \gamma\sigma_{C,A} - \gamma^2\sigma_C^2 + \gamma\sigma_{C,\xi}
\end{aligned} \tag{126}$$

Substituting these formulas, we obtain Equation 36:

$$\Delta = \frac{1}{2}(\eta-1)\left(\frac{1}{\eta}\sigma_\vartheta^2 + 2\sigma_{\vartheta,z} + \frac{1}{\eta}(1-\eta\gamma)^2\sigma_C^2 - \eta\sigma_\xi^2 + 2(1-\eta\gamma)\sigma_{C,A}\right) \tag{127}$$

Moreover, applying Propositions 1 and 2, we have that firms' uncertainty about these objects in each regime $X \in \{Q, P\}$ are given by:

$$\begin{aligned}
\left(\sigma_{C|s,t}^X\right)^2 &= \left(\chi_{A,t}^X\right)^2\sigma_{A|s,t}^2 + \left(\chi_{\xi,t}^X\right)^2\sigma_{\xi|s,t}^2 \\
\sigma_{C,A,t}^X &= \chi_{A,t}^X\sigma_{A|s,t}^2
\end{aligned} \tag{128}$$

Thus, if all other firms set quantities:

$$\Delta_t^Q = \frac{1}{2}(\eta-1)\left(\frac{1}{\eta}\sigma_{\vartheta,t}^2 + 2\sigma_{\vartheta,z,t} - \eta\sigma_{\xi|s,t}^2 + \left(\frac{1}{\eta}(1-\eta\gamma)\chi_{A,t}^Q + 2\right)(1-\eta\gamma)\chi_{A,t}^Q\sigma_{A|s,t}^2\right) \tag{129}$$

And if all other firms set prices:

$$\begin{aligned}
\Delta_t^P = \frac{1}{2}(\eta-1)\Bigg(&\frac{1}{\eta}\sigma_{\vartheta,t}^2 + 2\sigma_{\vartheta,z,t} + \left(-\eta + \frac{1}{\eta}(1-\eta\gamma)^2\left(\chi_{\xi,t}^P\right)^2\right)\sigma_{\xi|s,t}^2 \\
&+ \left(\frac{1}{\eta}(1-\eta\gamma)\chi_{A,t}^P + 2\right)(1-\eta\gamma)\chi_{A,t}^P\sigma_{A|s,t}^2\Bigg)
\end{aligned} \tag{130}$$

Substituting coefficients and exploiting the fact that the conditional variances are given by $\sigma_{A|s,t}^2 = \kappa_t^A\sigma_{A,s}^2$ and $\sigma_{\xi|s,t}^2 = \kappa_t^\xi\sigma_{\xi,s}^2$, we obtain:

$$\begin{aligned}
\Delta_t^Q = \frac{1}{2}(\eta-1)\Bigg(&\frac{1}{\eta}\sigma_{\vartheta,t}^2 + 2\sigma_{\vartheta,z,t} - \eta\kappa_t^\xi\sigma_{\xi,s}^2 \\
&+ \left(\frac{1}{\eta}(1-\eta\gamma)\frac{\eta\kappa_t^A}{1-\kappa_t^A(1-\eta\gamma)} + 2\right)(1-\eta\gamma)\frac{\eta\kappa_t^A}{1-\kappa_t^A(1-\eta\gamma)}\kappa_t^A\sigma_{A,s}^2\Bigg)
\end{aligned} \tag{131}$$

and

$$\Delta_t^P = \frac{1}{2}(\eta - 1)\left(\frac{1}{\eta}\sigma_{\vartheta,t}^2 + 2\sigma_{\vartheta,z,t} + \left(-\eta + \frac{1}{\eta}(1-\eta\gamma)^2\left(\frac{1-\kappa_t^\xi}{\gamma}\right)^2\right)\kappa_t^\xi \sigma_{\xi,s}^2 \right. \\ \left. + \left(\frac{1}{\eta}(1-\eta\gamma)\frac{\kappa_t^A}{\gamma} + 2\right)(1-\eta\gamma)\frac{\kappa_t^A}{\gamma}\kappa_t^A\sigma_{A,s}^2\right) \tag{132}$$

yielding the claimed expressions. □

We now resume the proof of Theorem 2. Define meta-complementarity $\Delta_t^{P-Q} = \Delta_t^P - \Delta_t^Q$ and observe that:

$$\Delta_t^{P-Q} = \frac{1}{2}(\eta - 1)\left[\frac{1}{\eta}(1-\eta\gamma)^2\left(\frac{1-\kappa_t^\xi}{\gamma}\right)^2 \kappa_t^\xi\sigma_{\xi,s}^2 \right. \\ \left. + \left(\frac{1}{\eta}(1-\eta\gamma)^2\left((\chi_{A,t}^P)^2 - (\chi_{A,t}^Q)^2\right) + 2(1-\eta\gamma)(\chi_{A,t}^P - \chi_{A,t}^Q)\right)\kappa_t^A\sigma_{A,s}^2\right] \tag{133}$$

First, when $\eta\gamma = 1$, we have that $\Delta_t^{P-Q} = 0$.

Second, suppose that $\eta\gamma < 1$. We observe that the first term in brackets is strictly positive. Turning to the second term, as $\eta\gamma < 1$, we have that $\Delta_t^{P-Q} > 0$ if $\chi_{A,t}^P > \chi_{A,t}^Q$; but this is guaranteed by the relevant case of Corollary 2. Thus, $\Delta_t^{P-Q} > 0$ when $\eta\gamma < 1$.

Third, suppose that $\eta\gamma > 1$. Once again, the first term in brackets is strictly positive. Thus, it suffices to show that:

$$\frac{1}{\eta}(1-\eta\gamma)^2\left(\chi_{A,t}^{P^2} - \chi_{A,t}^{Q^2}\right) + 2(1-\eta\gamma)(\chi_{A,t}^P - \chi_{A,t}^Q) > 0 \tag{134}$$

See that we can factor the left-hand side of this expression as:

$$(1-\eta\gamma)(\chi_{A,t}^P - \chi_{A,t}^Q)\left(\frac{1}{\eta}(1-\eta\gamma)(\chi_{A,t}^P + \chi_{A,t}^Q) + 2\right) \tag{135}$$

By Corollary 2, we have that $\chi_{A,t}^P < \chi_{A,t}^Q$. Thus, the expression in question is strictly positive if and only if:

$$2 > \frac{1}{\eta}(\eta\gamma - 1)(\chi_{A,t}^P + \chi_{A,t}^Q) \tag{136}$$

We now observe that $\chi_{A,t}^P + \chi_{A,t}^Q < 2\chi_{A,t}^Q$. Moreover, $\chi_{A,t}^Q$ is an increasing function of κ_t^A and is therefore bounded above by $\frac{\eta}{1+\eta\gamma-1} = \frac{1}{\gamma}$. Thus, we have that:

$$\frac{1}{\eta}(\eta\gamma - 1)(\chi^P_{A,t} + \chi^Q_{A,t}) < \frac{2}{\eta\gamma}(\eta\gamma - 1) = 2 - \frac{2}{\eta\gamma} < 2 \tag{137}$$

This establishes that $\Delta^{P-Q}_t > 0$ if $\eta\gamma > 1$. Taken together, we have shown that $\Delta^{P-Q}_t \geq 0$ and $\Delta^{P-Q}_t > 0$ if and only if $\eta\gamma \neq 1$, establishing the claim. □

A.7 Proof of Corollary 3

Proof. We have shown that $\Delta^P_t \geq \Delta^Q_t$. There are two possible cases. First, suppose that $\Delta^Q_t \geq 0$. In this case, $\Delta^P_t \geq 0$ and there exists a price-setting equilibrium. Second, suppose that $\Delta^Q_t < 0$. In this case, a quantity-setting equilibrium exists. Thus, there always exists a price-setting equilibrium and/or a quantity-setting equilibrium. □

A.8 Proof of Lemma 2

Proof. From Lemma 3, we have

$$\Delta^Q(\Omega_t, \sigma^A_t, \sigma^\xi_t) = \frac{1}{2}(\eta - 1)\Bigg(\Omega_t - \eta\kappa_\xi(\sigma^2_{\xi,t}, \sigma^2_{\xi,s})\sigma^2_{\xi,s} + \left(\frac{1}{\eta}(1-\eta\gamma)\frac{\eta\kappa_A(\sigma^2_{A,t}, \sigma^2_{A,s})}{1-\kappa_A(\sigma^2_{A,t}, \sigma^2_{A,s})(1-\eta\gamma)} + 2\right)(1-\eta\gamma)\frac{\eta\left(\kappa_A(\sigma^2_{A,t}, \sigma^2_{A,s})\right)^2}{1-\kappa_A(\sigma^2_{A,t}, \sigma^2_{A,s})(1-\eta\gamma)}\sigma^2_{A,s}\Bigg) \tag{138}$$

and

$$\Delta^P(\Omega_t, \sigma_{A,t}, \sigma_{\xi,t}) = \frac{1}{2}(\eta - 1)\Bigg(\Omega_t + \left(-\eta + \frac{1}{\eta}(1-\eta\gamma)^2\left(\frac{1-\kappa_\xi(\sigma^2_{\xi,t}, \sigma^2_{\xi,s})}{\gamma}\right)^2\right)\kappa_\xi(\sigma^2_{\xi,t}, \sigma^2_{\xi,s})\sigma^2_{\xi,s} + \left(\frac{1}{\eta}(1-\eta\gamma)\frac{\kappa_A(\sigma^2_{A,t}, \sigma^2_{A,s})}{\gamma} + 2\right)(1-\eta\gamma)\frac{\left(\kappa_A(\sigma^2_{A,t}, \sigma^2_{A,s})\right)^2}{\gamma}\sigma^2_{A,s}\Bigg) \tag{139}$$

where

$$\kappa_A(\sigma^2, \sigma^2_s) = \kappa_\xi(\sigma^2, \sigma^2_s) = \frac{\sigma^2}{\sigma^2 + \sigma^2_s} \tag{140}$$

are increasing functions of σ^2. Since σ^A_t, σ^ξ_t enter both Δ^Q and Δ^P only through the sufficient statistics κ_A, κ_ξ, and these respectively are increasing functions of σ^A_t, σ^ξ_t, it suffices to show comparative statics in Ω_t, $\kappa_{A,t}$, and $\kappa_{\xi,t}$.

We split the proof based on comparative statics with respect to each parameter. First, consider the derivative with respect to Ω_t. By inspection of the formulas in Lemma 3,

$$\frac{\partial \Delta^Q}{\partial \Omega_t} = \frac{\partial \Delta^P}{\partial \Omega_t} = \frac{1}{2}(\eta - 1) > 0 \tag{141}$$

Second, consider the derivative with respect to σ_t^A. As argued earlier, it suffices to show comparative statics in κ_t^A. We split by the parameter case of $\eta\gamma$:

1. $\eta\gamma < 1$. Δ^Q is strictly increasing in κ_t^A if and only if

$$\left(\frac{1}{\eta}(1-\eta\gamma)\frac{\eta\kappa_t^A}{1-\kappa_t^A(1-\eta\gamma)} + 2\right)(1-\eta\gamma)\frac{\eta\left(\kappa_t^A\right)^2}{1-\kappa_t^A(1-\eta\gamma)} \tag{142}$$

   is strictly increasing in κ_t^A. As $\eta\gamma < 1$ and $\frac{\eta\kappa_t^A}{1-\kappa_t^A(1-\eta\gamma)}$ is strictly increasing in κ_t^A and strictly positive, we have that the term in parentheses is strictly positive and strictly increasing. The term outside parentheses is strictly increasing and strictly positive for the same reasons. Moreover, Δ^P is strictly increasing in κ_t^A if and only if:

$$\left(\frac{1}{\eta}(1-\eta\gamma)\frac{\kappa_t^A}{\gamma} + 2\right)(1-\eta\gamma)\frac{\left(\kappa_t^A\right)^2}{\gamma} \tag{143}$$

   is strictly increasing in κ_t^A. As $\eta\gamma < 1$, this is immediate.
2. $\eta\gamma > 1$. By Lemma 3, we have that Δ^Q is strictly decreasing in κ_t^A if and only if Expression 142 is strictly decreasing in κ^A. Define $\omega = 1 - \eta\gamma$ and observe that we need to show that:

$$\left(\frac{\omega\kappa_t^A}{1-\omega\kappa_t^A} + 2\right)\frac{\omega\left(\kappa_t^A\right)^2}{1-\omega\kappa_t^A} \tag{144}$$

   is a strictly decreasing function of κ_t^A. Taking the derivative of this expression and rearranging, we require that:

$$\omega\kappa_t^A\left(\omega^2\left(\kappa_t^A\right)^2 - 3\omega\kappa_t^A + 4\right) < 0 \tag{145}$$

   As $\omega < 0$, we require that $\omega^2\left(\kappa_t^A\right)^2 - 3\omega\kappa_t^A + 4 > 0$. This is positive if the quadratic on the left-hand side has no real roots. As $9\omega^2 - 16\omega^2 < 0$, the quadratic indeed has no real roots and so Δ_t^Q is strictly decreasing in κ_t^A.
   Δ_t^P is strictly decreasing in κ_t^A if and only:

$$\left(\frac{\omega}{1-\omega}\kappa_t^A + 2\right)\frac{\omega}{1-\omega}\left(\kappa_t^A\right)^2 \tag{146}$$

is strictly decreasing in κ_t^A. Taking the derivative of this expression and rearranging, we require that:

$$\kappa_t^A < \frac{4}{3}\frac{\omega-1}{\omega} \tag{147}$$

which is always satisfied as $\omega < 0$.

Now consider the derivative with respect to σ_t^ξ. As argued earlier, it suffices to show comparative statics in κ_t^ξ. For Δ^Q, we observe immediately that

$$\frac{\partial \Delta^Q}{\partial \kappa_t^\xi} \propto -\eta < 0 \tag{148}$$

For Δ^P, we calculate

$$\frac{\partial \Delta^P}{\partial \kappa_t^\xi} \propto \left(\frac{1-2\eta\gamma}{(1-\eta\gamma)^2} - 4\kappa_t^\xi + 3(\kappa_t^\xi)^2\right) \tag{149}$$

The sign of this derivative depends on the sign of the term in parentheses. This is a strictly convex quadratic, so a sufficient condition for it to be negative for all $\kappa_t^\xi \in (0,1)$ is that it is negative at $\kappa_t^\xi = 0$ and $\kappa_t^\xi = 1$. A sufficient condition for it to be negative at $\kappa_t^\xi = 0$ is $\frac{1-2\eta\gamma}{(1-\eta\gamma)^2} < 0$, which occurs if and only if $\eta\gamma > \frac{1}{2}$. It is easily verified that the same condition ensures $\partial\Delta^P \Big/ \partial\kappa_t^\xi \mid_{\kappa_t^\xi=1} < 0$. Thus, if $\eta\gamma > \frac{1}{2}$, Δ^P is decreasing in κ_t^ξ for all $\kappa_t^\xi \in (0,1)$. □

A.9 Proof of Theorem 3

Proof. First, taking the limit of $\alpha \to -\infty$ in Corollary 5, we observe that the dynamics of the economy are

$$\begin{aligned} \log C_t &= \chi_{0,t}^P + \frac{1}{\gamma}\log A_t \\ \log P_t &= \tilde{\chi}_{0,t}^P \end{aligned} \tag{150}$$

Hence, $\log C_t - \log C_t^*$ is a constant, so $\text{Var}_t[\log C_t - \log C_t^*] = 0$, and $\log P_t$ is a constant, so $\text{Var}_t[\log P_t] = 0$. By implication, for any λ, the policymaker's loss is zero. Moreover, there exists no other policy that achieves zero loss. To see this, it suffices to observe that $\text{Var}_t[\log P_t] > 0$ under price-targeting dynamics for any $\alpha > -\infty$, and $\text{Var}_t[\log C_t - \log C_t^*] > 0$ for any α under quantity targeting dynamics since, for any $\kappa_t^A < 1$, $\frac{\eta\kappa_t^A}{1-\kappa_t^A(1-\eta\gamma)} < \frac{1}{\gamma}$. Finally, we show that the Condition D suffices to set price targeting implementable. Repeating the steps of the proof of Lemma 3, we have

$$\begin{aligned} \Delta_t = \frac{1}{2}(\eta-1)\Bigg(&\frac{1}{\eta}\sigma_{\vartheta,t}^2 + 2\sigma_{\vartheta,z,t} + \frac{1}{\eta}\left(1+\eta^2\gamma^2\left(2-\frac{1}{1-\alpha}\right)\frac{1}{1-\alpha} - 2\eta\gamma\right)\sigma_{C|s,t}^2 \\ &- \frac{\eta}{(1-\alpha)^2}(\sigma_t^\xi)^2 + 2\left(1-\frac{\eta\gamma}{1-\alpha}\right)\sigma_{C,A|s,t} + \left(\frac{2\eta\gamma}{1-\alpha}\frac{\alpha}{1-\alpha}\right)\sigma_{C,\xi|s,t}\Bigg) \end{aligned} \tag{151}$$

Taking the limit as $\alpha \to -\infty$ in Equation 151 to obtain

$$\Delta_t = \frac{1}{2}(\eta - 1)\left(\frac{1}{\eta}\sigma_{\vartheta,t}^2 + 2\sigma_{\vartheta,z,t} + \frac{1}{\eta}\left(1 - 2\eta\gamma\right)\sigma_{C|s,t}^2 + 2\sigma_{C,A|s,t}\right) \tag{152}$$

We next observe that, under price-targeting dynamics, $\sigma_{C|s,t}^2 = \frac{1}{\gamma^2}\sigma_{A|s,t}^2$ and $\sigma_{C,A|s,t} = \frac{1}{\gamma}\sigma_{A|s,t}^2$. Plugging these in, we obtain

$$\Delta_t = \frac{1}{2}(\eta - 1)\left(\frac{1}{\eta}\sigma_{\vartheta,t}^2 + 2\sigma_{\vartheta,z,t} + \frac{\sigma_{A|s,t}^2}{\eta\gamma^2}\right) \tag{153}$$

and we observe that Condition D requires that the term in parentheses be positive, meaning that firms have an incentive to target prices conditional on others' targeting prices.

We next derive the representation from the second part of the result. Corollaries 5 and 7 respectively characterize implementable dynamics under price and quantity targets. Therefore, the implementable set in Program 41 can be split into two: allocations that can be supported in a price-targeting regime and those that can be supported in a quantity targeting regime. We derive the functions $\mathcal{L}^Q(\alpha)$ and $\mathcal{L}^P(\alpha)$ by substituting in the relevant dynamics under each regime. In particular,

$$\begin{aligned}
\mathcal{L}^Q(\alpha) &= \left(\frac{\eta\kappa_t^A}{1-\kappa_t^A(1-\eta\gamma)} - \frac{1}{\gamma}\right)^2 \left(\sigma_t^A\right)^2 + \lambda\left(\left(\frac{1}{1-\alpha}\frac{\eta\gamma\kappa_t^A}{1-\kappa_t^A(1-\eta\gamma)}\right)^2\left(\sigma_t^A\right)^2 + \left(\frac{1}{1-\alpha}\right)^2\left(\sigma_t^\xi\right)^2\right)\\
\mathcal{L}^P(\alpha) &= \left(\frac{1}{\gamma}\frac{(1-\alpha)\kappa_t^A}{1-\alpha\kappa_t^A} - \frac{1}{\gamma}\right)^2\left(\sigma_t^A\right)^2 + \left(\frac{1}{\gamma}\frac{1-\kappa_t^\xi}{1-\alpha\kappa_t^\xi}\right)^2\left(\sigma_t^\xi\right)^2 + \lambda\left(\left(\frac{\kappa_t^A}{1-\alpha\kappa_t^A}\right)^2\left(\sigma_t^A\right)^2 + \left(\frac{\kappa_t^\xi}{1-\alpha\kappa_t^\xi}\right)^2\left(\sigma_t^\xi\right)^2\right)
\end{aligned} \tag{154}$$

We observe that $\mathcal{L}^Q$ and $\mathcal{L}^P$ are strictly increasing functions of α. From this, it follows that the policymaker's optimal choice reduces to selecting between α_Q^* and α_P^* (as any other α necessarily yields a greater loss). When only one of these exists, it follows that it is the optimum. When both exist, the policymaker simply follows the one with lower loss, as claimed. Moreover, by Theorem 2, we have that $0 \in \mathcal{A}^P \cup \mathcal{A}^Q$ and hence the previous cases are exhaustive. □

B Additional Theoretical Results

In this appendix, we consider the extensions of our baseline framework to incorporate price and quantity adjustment costs and decreasing returns to scale.

B.1 Adjustment Costs

In this section, we extend our baseline model from Section 2 to feature price and quantity adjustment costs. Suppose that the firm is subject to adjustment costs in prices and quantities of the form $\delta_P \mathbb{V}[\log p]$ and $\delta_Q \mathbb{V}[\log q]$. For any fixed q, price adjustment costs are:

$$C^Q = \delta_P \mathbb{V}\left[-\frac{1}{\eta}\log q + \log P + \frac{1}{\eta}\log \Psi\right] = \delta_P\left(\sigma_P^2 + \frac{1}{\eta^2}\sigma_\Psi^2 + \frac{2}{\eta}\sigma_{P,\Psi}\right) \tag{155}$$

For any fixed p, quantity adjustment costs are:

$$C^P = \delta_Q \mathbb{V}\left[-\eta \log p + \log \Psi + \eta \log P\right] = \delta_Q\left(\sigma_\Psi^2 + \eta^2\sigma_P^2 + 2\eta\sigma_{\Psi,P}\right) \tag{156}$$

We can accordingly modify Theorem 1 to account for the presence of adjustment costs:

Proposition 4. *In the presence of adjustment costs, prices are preferred to quantities if and only if:*

$$\left(\exp\{\Delta\} - 1\right) V^Q \geq \left(\eta\delta_Q - \frac{1}{\eta}\delta_P\right)\left(\frac{1}{\eta}\sigma_\Psi^2 + \eta\sigma_P^2 + 2\sigma_{P,\Psi}\right) \tag{157}$$

where Δ is as in Theorem 1 and V^Q is the value of quantity setting. Thus, when $\delta_P = \eta^2\delta_Q$, prices are preferred to quantities if and only if $\Delta \geq 0$. Moreover, when $\delta_P > \eta^2\delta_Q$, if $\Delta > 0$, then prices are preferred to quantities. Further, when $\delta_P < \eta^2\delta_Q$, if $\Delta < 0$, then quantities are preferred to prices.

Proof. By definition we have that:

$$C^Q - C^P = \left(1 - \frac{\delta_Q}{\delta_P}\eta^2\right) C^Q = \left(1 - \frac{\delta_Q}{\delta_P}\eta^2\right)\delta_P\left(\sigma_P^2 + \frac{1}{\eta^2}\sigma_\Psi^2 + \frac{2}{\eta}\sigma_{P,\Psi}\right) \tag{158}$$

or:

$$C^Q - C^P = \left(\frac{1}{\eta}\delta_P - \eta\delta_Q\right)\left(\frac{1}{\eta}\sigma_\Psi^2 + \eta\sigma_P^2 + 2\sigma_{P,\Psi}\right) \tag{159}$$

Prices are preferred to quantities if and only if $V^P - V^Q \geq C^P - C^Q$. When $\delta_P = \eta^2\delta_Q$, this reduces to our main analysis. Otherwise, we have that $V^P - V^Q = (\exp\{\Delta\} - 1)V^Q$. So, we can write the condition as:

$$\left(\exp\{\Delta\} - 1\right) V^Q \geq \left(\eta\delta_Q - \frac{1}{\eta}\delta_P\right)\left(\frac{1}{\eta}\sigma_\Psi^2 + \eta\sigma_P^2 + 2\sigma_{P,\Psi}\right) \tag{160}$$

The remaining claims follow immediately from noting that $0 \leq \mathrm{Var}(\frac{1}{\sqrt{\eta}}\ln\Psi + \sqrt{\eta}\ln P) = \frac{1}{\eta}\sigma_\Psi^2 + \eta\sigma_P^2 + 2\sigma_{P,\Psi}$. □

Importantly, Δ continues to govern the qualitative trade-off between price-setting and quantity-setting. When price adjustment costs are larger, the balance tips further toward price-setting. When quantity adjustment costs are larger, the balance tips further to quantity-setting. Thus, while potentially relevant quantitatively, the qualitative economics of how Δ varies remains relevant in an expanded setting with adjustment costs. We abstract from this feature in the subsequent analysis for ease of exposition.

B.2 Decreasing Returns to Scale and Targets

In this section, we extend our baseline model from Section 2 to feature decreasing returns and therefore the possibility of real rigidities. Relative to the main text, we assume that the firm makes an investment commitment ex-ante prior to making its organizational target choice. The firm operates Cobb-Douglas technology according to the following production function:

$$q = \Theta K^{\alpha} L^{1-\alpha} \tag{161}$$

K is to be interpreted as an ex-ante input commitment, while L is a flexible input that can adjust to realized demand conditions. The price-setting problem of the firm is

$$V^P = \max_{K,p} \mathbb{E}\left[\frac{\Lambda}{P}\left(p\Theta K^{\alpha} L^{1-\alpha} - wL - rK\right)\right] \tag{162}$$

subject to $q = zp^{-\eta}$, where $z = \Psi P^{\eta}$. Similarly, the quantity-setting problem can be expressed as:

$$V^Q = \max_{K,q} \mathbb{E}\left[\frac{\Lambda}{P}\left(\left(\frac{q}{z}\right)^{-1/\eta} q - w\left(\frac{q}{\Theta K^{\alpha}}\right)^{1/(1-\alpha)} - rK\right)\right] \tag{163}$$

As in the main text, we assume that z, A, Λ, P, w, r are jointly log-normally distributed. The next proposition characterizes the comparative advantage of setting prices over quantities.

Proposition 5 (Technology and Organizational Targets)**.** *The comparative advantage of setting prices over quantities is given by:*

$$\Delta = \frac{1}{2}(\eta - 1)\left(\left(1 + \frac{1}{\eta} - \frac{1}{1-\alpha}\right)\left(\eta^2\sigma_P^2 + \sigma_\Psi^2\right) - 2\eta\sigma_{\tilde{\mathcal{M}},P} - 2\sigma_{\tilde{\mathcal{M}},\Psi}\right) \tag{164}$$

where the ex-post nominal marginal costs are given by $\tilde{\mathcal{M}} = w \times \Theta^{-\frac{1}{1-\alpha}}$

Proof. Let $\beta \equiv \Lambda/P$ denote the real stochastic discount factor and define the demand shifter $d \equiv \Psi P^{\eta}$. Let $\gamma \equiv \frac{1}{1-\alpha}$. Given (K, q), the flexible input choice implies $L = (q/(\Theta K^{\alpha}))^{\gamma}$, so variable costs satisfy

$$wL = w\left(\frac{q}{\Theta K^{\alpha}}\right)^{\gamma} = \mathcal{M}\, q^{\gamma} K^{-\alpha\gamma}, \qquad \mathcal{M} \equiv w\,\Theta^{-\gamma} \tag{165}$$

We first study the case of price targets. Using the demand curve $q = dp^{-\eta}$, expected discounted profits conditional on K can be written as

$$\mathbb{E}\Big[\beta\big(dp^{1-\eta} - \mathcal{M}\, d^{\gamma} p^{-\eta\gamma} K^{-\alpha\gamma} - rK\big)\Big] = m_1 p^{1-\eta} - m_2 p^{-\eta\gamma} K^{-\alpha\gamma} - m_r K \tag{166}$$

where we define the constants

$$m_1 \equiv \mathbb{E}[\beta d], \qquad m_2 \equiv \mathbb{E}[\beta \mathcal{M} d^{\gamma}], \qquad m_r \equiv \mathbb{E}[\beta r] \tag{167}$$

The first-order condition for p is

$$(1-\eta) m_1 p^{-\eta} + \eta\gamma\, m_2 p^{-\eta\gamma-1} K^{-\alpha\gamma} = 0 \tag{168}$$

which implies

$$p^{\eta\gamma-(\eta-1)} = \frac{\eta\gamma}{\eta-1}\frac{m_2}{m_1} K^{-\alpha\gamma} \tag{169}$$

Let $\delta \equiv 1 - \eta + \eta\gamma$. Then $\delta > 0$ and Equation 169 gives

$$p^{*}(K) = \left(\frac{\eta\gamma}{\eta-1}\frac{m_2}{m_1}\right)^{\frac{1}{\delta}} K^{-\frac{\alpha\gamma}{\delta}} \tag{170}$$

Using the first-order condition to substitute for the cost term,

$$m_2 (p^{*})^{-\eta\gamma} K^{-\alpha\gamma} = \frac{\eta-1}{\eta\gamma} m_1 (p^{*})^{1-\eta} \tag{171}$$

so the maximized expected discounted profits conditional on K are

$$\max_{p}\Big\{m_1 p^{1-\eta} - m_2 p^{-\eta\gamma} K^{-\alpha\gamma}\Big\} = \frac{\delta}{\eta\gamma} m_1 (p^{*}(K))^{1-\eta} \equiv D_P K^{\kappa} \tag{172}$$

where

$$\kappa \equiv \frac{\alpha\gamma(\eta-1)}{\delta} = \frac{\alpha(\eta-1)}{1+\alpha(\eta-1)} \in (0,1) \tag{173}$$

and the constant D_P is

$$D_P \equiv \frac{\delta}{\eta\gamma}\, m_1 \left(\frac{\eta\gamma}{\eta-1}\frac{m_2}{m_1}\right)^{\frac{1-\eta}{\delta}} \tag{174}$$

Therefore the ex-ante problem under price targets reduces to

$$V^P = \max_{K>0} \Big\{ D_P K^\kappa - m_r K \Big\} \tag{175}$$

We now consider quantity targeting. Under quantity targets, the objective conditional on K is

$$\mathbb{E}\Big[\beta\big(d^{1/\eta} q^{1-1/\eta} - \mathcal{M}\, q^\gamma K^{-\alpha\gamma} - rK\big)\Big] = n_1 q^{1-1/\eta} - n_2 q^\gamma K^{-\alpha\gamma} - m_r K \tag{176}$$

where

$$n_1 \equiv \mathbb{E}[\beta d^{1/\eta}], \qquad n_2 \equiv \mathbb{E}[\beta\mathcal{M}] \tag{177}$$

The first-order condition for q is

$$\left(1 - \frac{1}{\eta}\right) n_1 q^{-1/\eta} - \gamma\, n_2 q^{\gamma-1} K^{-\alpha\gamma} = 0 \tag{178}$$

so

$$q^{\gamma-(1-1/\eta)} = \frac{1-1/\eta}{\gamma}\frac{n_1}{n_2} K^{\alpha\gamma} \tag{179}$$

Let $\tilde{\delta} \equiv \gamma - 1 + 1/\eta > 0$. Then

$$q^*(K) = \left(\frac{1-1/\eta}{\gamma}\frac{n_1}{n_2}\right)^{\frac{1}{\tilde{\delta}}} K^{\frac{\alpha\gamma}{\tilde{\delta}}} \tag{180}$$

Using the first-order condition,

$$n_2 (q^*)^\gamma K^{-\alpha\gamma} = \frac{1-1/\eta}{\gamma} n_1 (q^*)^{1-1/\eta} \tag{181}$$

so the maximized expected discounted profits conditional on K are

$$\max_q \Big\{ n_1 q^{1-1/\eta} - n_2 q^\gamma K^{-\alpha\gamma} \Big\} = \frac{\tilde{\delta}}{\gamma} n_1 (q^*(K))^{1-1/\eta} \equiv D_Q K^\kappa \tag{182}$$

where the exponent on K is the same κ as under price targeting and

$$D_Q \equiv \frac{\tilde{\delta}}{\gamma} n_1 \left(\frac{1-1/\eta}{\gamma}\frac{n_1}{n_2}\right)^{\frac{1-1/\eta}{\tilde{\delta}}} \tag{183}$$

Thus,

$$V^Q = \max_{K>0} \Big\{ D_Q K^\kappa - m_r K \Big\} \tag{184}$$

We now calculate the comparative advantage of price targets. Since $\kappa \in (0,1)$, the maximizers satisfy

$$K_P^* = \left(\frac{\kappa D_P}{m_r}\right)^{\frac{1}{1-\kappa}}, \qquad K_Q^* = \left(\frac{\kappa D_Q}{m_r}\right)^{\frac{1}{1-\kappa}} \tag{185}$$

Substituting back gives

$$V^P = (1-\kappa) D_P \left(\frac{\kappa D_P}{m_r}\right)^{\frac{\kappa}{1-\kappa}} \qquad V^Q = (1-\kappa) D_Q \left(\frac{\kappa D_Q}{m_r}\right)^{\frac{\kappa}{1-\kappa}} \tag{186}$$

Taking log differences and simplifying (using $\gamma = 1/(1-\alpha)$ and $d = \Psi P^\eta$) yields

$$\log V^P - \log V^Q = \eta \log\left(\frac{m_1}{n_1}\right) + (1-\alpha)(1-\eta)\log\left(\frac{m_2}{n_2}\right) \tag{187}$$

Finally, under joint log-normality, for any log-normal X we have $\log \mathbb{E}[X] = \mathbb{E}[\log X] + \frac{1}{2}\mathrm{Var}(\log X)$. Applying this identity to m_1, n_1, m_2, n_2, and using $\log d = \log \Psi + \eta \log P$ and $\log \tilde{\mathcal{M}} = \log w - \gamma \log \Theta$, we obtain

$$\log V^P - \log V^Q = \frac{1}{2}(\eta-1)\left(\left(1 + \frac{1}{\eta} - \frac{1}{1-\alpha}\right)\left(\eta^2 \sigma_P^2 + \sigma_\Psi^2\right) - 2\eta \sigma_{\tilde{\mathcal{M}},P} - 2\sigma_{\tilde{\mathcal{M}},\Psi}\right) \tag{188}$$

which is the expression in the proposition. □

To interpret this expression, we may define uncertainty in firm-level demand as $d \equiv P^\eta \Psi$. Doing so allows us to write the above expression as

$$\Delta = \frac{1}{2}(\eta-1)\left(\left(1 + \frac{1}{\eta} - \frac{1}{1-\alpha}\right)\left(\sigma_d^2 - 2\eta\sigma_{\Psi,P}\right) - 2\sigma_{\tilde{\mathcal{M}},d}\right) \tag{189}$$

Notice that the formula in Theorem 1 is nested with $\alpha = 0$. Consequently, under DRS, demand shocks mechanically become more costly for firms engaged in price-setting. The reason is that the firm must employ relatively more labor to honor a given price commitment *ex-post*. Thus, this result demonstrates that all trade-offs with respect to uncertainty are robust to alternative technologies. We may also formally derive when the comparative advantage of price-setting is decreasing in the returns-to-scale parameter α.

Corollary 9. *Δ is decreasing in the returns-to-scale parameter α if and only if the following condition is satisfied:*

$$\frac{1}{2} > \frac{\sigma_{\Theta,d}}{\sigma_d^2 - 2\eta\sigma_{\Psi,P}}, \quad \textit{where} \quad d \equiv P^\eta \Psi$$

Proof. Differentiating Equation 164 with respect to α yields the condition directly. □

Thus, the core economics we are studying extends naturally to settings with decreasing returns to scale and real rigidities. We abstract from this feature in the subsequent analysis for ease of exposition.

C Estimation of the GARCH Model

In this Appendix, we describe in more detail the GARCH model to measure time-varying macroeconomic uncertainty in the analysis of Section 7.2. Our broad approach is inspired by findings in the literature that such statistical estimates provide a reasonable empirical analogue to underlying uncertainty about macroeconomic phenomena, and moreover that different precise methods give broadly comparable results (see, *e.g.,* Jurado et al., 2015). Our precise methods for this calculation are the same as those described in Appendix D of Flynn et al. (2026).

Specifically, we use quarterly-frequency data from the US from 1960Q1 to 2024Q4 on real GDP, GDP deflator, and capacity-utilization-adjusted TFP (Fernald, 2025). We express the former two variables in first differences in logarithms, so they represent real growth $\Delta \log Y_t$ and inflation $\Delta \log P_t$. We use the last variable, along with real GDP, to define a model-based analogue to the aggregate component of real marginal costs. That is, we define

$$\Delta \log \mathcal{M}_t^A = \gamma \cdot \Delta \log Y_t - \Delta \log A_t \tag{190}$$

where Y_t and A_t are directly measured, as real GDP and TFP, and the parameter γ controls the elasticity of real marginal cost growth to real GDP growth. Based on the microeconomic and macroeconomic analysis of Gagliardone et al. (2023), we calibrate $\gamma = 0.11$.

Using our time series on $(\Delta \log Y_t, \Delta \log P_t, \Delta \log \mathcal{M}_t^A)$, we estimate a constant conditional correlations (CCC) multivariate GARCH model, as introduced by Bollerslev (1990). This provides us with an estimate $\hat{\Sigma}_t$ of the one-quarter-ahead uncertainty about the vector of macroeconomic variables, which is measurable in the history of these variables (and the innovations in these variables) in all periods up to and including period $t-1$. We plug the implied uncertainties directly into Equation 62 to calculate our proxy for Δ_t, Δ_t^{raw}.

Finally, in presenting the results in Figures 4 and 5, we transform these incentives into z-score units. That is, starting with our raw estimate Δ_t^{raw}, we compute

$$\Delta_t = \frac{\Delta_t^{raw} - \text{mean}(\Delta_t^{raw})}{\text{sd}(\Delta_t^{raw})} \tag{191}$$

where we calculate the mean and standard deviation over the time series.

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