CAN COMPETITIVE FORCES REINFORCE NOMINAL WAGE RIGIDITIES?

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ABSTRACT

While rigidities in nominal factor costs imply a finite slope in the aggregate supply curve, this paper asks, "Do rigidities increase if there is a more competitive economy?" Several authors claim that real rigidities of monopoly power reinforce nominal rigidities due to price adjustment costs. This paper argues almost the opposite: that "real rigidities" due to competition (i.e., lack of monopoly power) reinforce nominal rigidities when firms are reluctant to raise prices due to competitive pressure. In the model, nominal factor costs are stickier than output prices. Thus risk-averse firms are slower to raise output prices than to lower them. ***JEL Classification:*** E12

INTRODUCTION

For a typical firm, nominal factor contracts–especially labor contracts–tend to be in force over a longer period than the firm's choice of a price at which to sell its output. Of course, assuming that output prices may be changed with relatively greater frequency than may nominal factor costs is not the same as assuming that output prices may be changed instantaneously. As Stiglitz (1999) and Balvers (1992) have noted, firms often must make price and output decisions in a context where nominal factor prices have previously been set by contracts currently in force, but demand–and possibly even industry supply–have not yet been observed. In such a setting, then, there is considerable uncertainty regarding the impact of an individual firm's pricing decision since the price must be set prior to observing the industry demand and supply curves.

The consideration of the role of uncertainty in pricing decisions as a source of rigidities is not new. Previous studies have considered at least three different sources of uncertainty as possible factors contributing to price rigidities in an economy. First, much attention has been paid to market interactions and to monopoly power as sources of uncertainty in setting prices. Woglom (1983) and Rowe (1987), for example, have considered the impact on the stickiness of output prices of strategic price-setting behavior under kinked-demand, oligopolistic pricing conditions. However, the uncertainty in such analyses arises from strategic pricing when firms possess monopoly power, not from

uncertainty regarding what–for example–demand for the product will be in the next period.

Uncertainty in a context of perfect competition has been assessed by Ball and Romer (1991). In the Ball and Romer model, which is based on the model of Blanchard and Kiyotaki (1987), coordination failure in pricing in the face of a monetary shock may lead to multiple equilibria under monopolistic competition with menu costs. Ball and Romer find that as the industry approaches perfect competition, a wide range of multiple equilibria will result. Blinder, Canetti, Lebow, and Rudd (1998) have questioned this result, finding instead that the range of multiple equilibria shrinks as the industry approaches perfect competition. Regardless of which analysis is correct, the uncertainty in such models is due exclusively to the monetary shock and to uncertainty regarding the pricing decisions of other firms.

Greenwald and Stiglitz (1989) do not rely upon strategic pricing by monopolistic or monopolistically competitive firms to model price stickiness. Rather, they assume that there is relatively little uncertainty for firms surrounding the setting of output and employment, but relatively great uncertainty concerning the consequences of price and wage decisions.

This paper explores new territory. While rigidities in nominal factor costs certainly imply a finite slope in the aggregate supply curve, the question this paper asks is, "do rigidities increase if there is a more competitive economy?" Authors like Blanchard claim that the real rigidities of monopoly power reinforce the nominal rigidities due to price adjustment costs. The analysis argues almost the opposite: that "real rigidities" due to competition (i.e., lack of monopoly power) reinforce nominal rigidities due to nominal labor contracts. More specifically, due to the extreme consequences resulting from setting a price that is too high in a competitive setting, firms are assumed to be more willing to lower prices to meet their rational expectations than they are to raise prices. In the model, nominal factor costs are relatively more sticky (due to contracts, etc.) than are output prices, and firms make employment, output, and pricing decisions prior to observing demand. For simplicity firms are assumed to have no fixed costs, but they obviously face variable costs in the form of labor costs: Different levels of output require different levels of labor, and there are diminishing returns to labor, so it follows that each unit of output has a different marginal cost of production—consistent with the theory of the firm in microeconomics.

In an effort to increase the robustness of the model, the model incorporates several assumptions made in the aforementioned literature. For example, as in Stiglitz (1999) and Balvers (1992), output prices are set before demand and supply are completely known. Similarly, as in Greenwald and Stiglitz (1989) and Stiglitz (1999), firms are assumed to be risk averse.

While incorporating such elements, the model is nevertheless able to provide a fresh perspective on output price rigidities inasmuch as it differs from the existing literature in a variety of ways. First, while Balvers (1992) assumes that competitive firms form expectations rationally, he does not consider whether there might be reasons to believe that firms might be risk averse. In contrast, the present model incorporates an assumption of risk aversion.

Second, while Greenwald and Stiglitz (1989) incorporate risk aversion among firms, the key to the Greenwald and Stiglitz result is that there is more uncertainty regarding wage and price decisions than regarding output and the

employment of factors. The analysis presented here differs in that wages–via contracts–are considerably more sticky than are output prices that may be changed with greater frequency.

Third, the present analysis does not rely upon any form of kinked demand curve. Moreover, one goal of the present analysis is to explain price stickiness even when firms are much more closely identified with perfect competition than with oligopoly. Finally, in the coordination failure literature much of the resulting rigidity is due to strategic interaction among the firms, with no uncertainty regarding the location of industry demand. Here firms are presented with a situation where demand next period is anticipated via rational expectations, but firms are risk averse in setting their price in light of a rational expectation of demand.

This paper, then, presents a model of a firm that operates within a competitive environment as one possible extension of the existing reasons for observed price stickiness in output markets. In the model, a firm is quick to lower prices, but reluctant to raise them due to the competitive pressures present. In the next section I present a description of the essential model of the firm, and I follow with a description of the price-setting rules followed by a firm depending upon (a) a firm's degree of risk aversion and (b) whether a firm's rational expectation of the competitive price next period lies above or below the current competitive price. The paper concludes by discussing the obvious extensions that follow from the analysis.

MODEL FUNDAMENTALS

The model of the firm is adapted from Balvers (1992). There exist an infinite number of identical risk- averse firms. Each firm's objective is to maximize the expected profit from selling a good produced under conditions of decreasing returns. The key distinguishing feature of the model is that each firm must select its output quantity and product price prior to the observation of demand.

In making their price and output decisions, firms employ a Bayesian approach wherein they form a prior regarding the demand for their product during the period of interest. Firms would prefer to set a high price for their product in order to increase total revenues, holding constant the quantity sold. However, due to the competitive nature of the output market, a firm will only sell its output if it is the low-price seller of the output.

Expected real profits are maximized given a competitive price *P*. Based upon rational expectations, a firm selects its own price *p* and the level of output before demand is revealed. The firm's objective function, then, is

$$\pi(P) = \max_{p,s} \frac{p}{P} E[\min(s,d)] - \frac{w}{P} l(s), \qquad (1)$$

subject to

$$d = \begin{cases} 0 & for \quad p > P, \\ \dfrac{D}{n_f} + \varepsilon & for \quad p = P, \\ D & for \quad p < P, \end{cases} \tag{2}$$

where s is the firm's level of output, d is the firm's quantity demanded, w is the nominal wage paid to labor, $l(s)$ is the labor demand as a function of the number of units of output, D is aggregate demand, and n_f is the number of firms with price $p = P$. ε indicates that at least some consumers will choose randomly from among the firms that offer the competitive price.

Observe that, due to the competitive nature of the output market, the competitive price P will be the minimum price posted by the sellers of the output. That is,

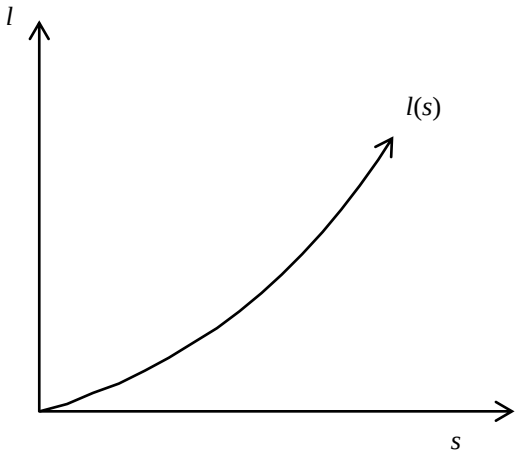
$$P = \min(p_1, p_2, ...). \tag{2}$$

The function $l(s)$ is strictly convex in outputs, with

$$\frac{dl(0)}{ds} = 0; \frac{dl(\infty)}{ds} = \infty; l(0) = 0.$$

Figure 1 depicts a representative labor demand function.

FIGURE 1
A REPRESENTATIVE LABOR DEMAND FUNCTION



Please note that the presence of the assumption that nominal wages

change less frequently than nominal output prices does not somehow imply that labor costs are some sort of "fixed cost" and thus irrelevant to a firm's pricing or output decision. In fact there are no "sunk" costs—of any kind—in the model, and this is true for two reasons. First, costs in the firm's objective function consist of labor only; thus there are no traditional "sunk" costs in the model by design. Second, labor—and, consequently, labor costs—can be viewed only as variable in the model because labor, *l*, varies with the level of output, *s*. Adding to this the fact that the labor function is a strictly convex function of the level of output (i.e., that there are diminishing marginal returns to labor), it follows that each unit of output has a higher marginal labor cost than the last. Thus the essential microtheoretic foundations of the model are sound, and accord well with the traditional theory of the firm in microeconomics.

COMPETITIVE PRESSURE AND RISK AVERSION

The optimal level of output may be obtained by partial differentiation of the objective function with respect to the level of output *s*. Let $F(\cdot)$ be the cumulative distribution function of the demand disturbance ε. Writing $E[\min(s, d)]$ in integral form, application of Leibniz's rule for differentiating integral expressions with variable bounds[1] to the objective function (1) gives

$$\frac{\partial \pi}{\partial s} = \frac{p}{P} - F(s - E(d))\frac{p}{P} - \frac{w}{P} l_s(s) = 0. \tag{3}$$

Rearranging terms gives

$$\frac{p}{P} - F(s - E(d))\frac{p}{P} = \frac{w}{P} l_s(s),$$

so that the optimal level of output occurs where the marginal production cost is equal to the expected marginal benefit.

Observe that, while the optimal level of output may be obtained via differentiation of the objective function in (1) with respect to the output level *s*, the objective function is discontinuous in prices due to the constraint given in (2). Hence differentiation of the objective function with respect to price is not possible. The following discussion asserts how a given firm, under risk aversion in a competitive environment, might select the price of output next period given information available in the current period.

In the present model, due to the extreme consequences surrounding setting a price above the competitive price, firms are obviously reluctant to raise their selling price all the way to the expected value of the equilibrium price. Indeed, a price that is even slightly higher than the competitive price will result in few—if any—revenues for the firm during that period.

The notion that output prices may be relatively sticky, even in a competitive setting, is not new. In fact there is a rapidly-growing literature that explores this idea. For example, Genesove (2003) and Álvarez, *et.al.*, (2006) provide strong empirical evidence that firms will be reluctant to raise their own

prices in the event that gathering information about the likely market price in the next period is costly.

Further, Kackmeister (2002), Genesove (2003), and Zbaracki, *et.al.*, (2004) all point to "customer costs" as a source of price fixity even when output markets exhibit a high degree of competitiveness. Kackmeister's explanation for empirically-verifiable price fixity is that, over time, a given firm's repeat customers develop a sense of the price they "ought" to pay for a given good or service, making a price hike a risky prospect to the firm.

Employing data from the market for apartment rentals, Genesove reinforces this notion, observing that apartment rents exhibit extremely slow price adjustments, even when controlling for the contractual nature of the apartment market. Using data from the United States between 1974 and 1981—a period of tremendous price inflation—Genesove shows that 29 percent of units studied had no change in their nominal rents from year to year. Genesove concludes his analysis by noting that holding rents constant can help a landlord retain existing tenants, and increase the likelihood that a potential new tenant will accept the landlord's current rental price. Simply put, overshooting the rental price may be costlier for a landlord than undershooting it.

Zbaracki, *et.al.*, observe that raising output prices brings with it costs both of *notifying* existing customers of a price change and—in the case of a price hike—*justifying* that price change. Thus a company is likely to postpone a price increase if that increase would raise issues such as customer loyalty for the firm.

Richards and Patterson (2005) provide a nice overview of efforts in this area, and the interested reader should consult the aforementioned three papers—Kackmeister, Genesove, and Zbaracki, *et.al.*—as well as Levy, Dutta, and Bergen (2002) for extensive empirical support.

Thus the model in this section builds upon these ideas by explicitly assuming that firms are risk-averse when it comes to raising their nominal output prices. Surprisingly, no existing paper accomplishes what the present paper contributes.

Hence, this paper assumes that a firm that rationally expects that the competitive price in the next period will lie somewhere above the competitive price in the current period will not raise its selling price all the way to the new expected value of the price level. Instead, a rational firm will price the product somewhere between the expected competitive price next period and the current competitive price. Of course, if the expected competitive price next period lies below the current competitive price, rational firms will move to exactly the expected value of the competitive price for next period. Lowering prices to the expected value of the competitive price is less risky than raising them to a higher expected value of the competitive price.

Suppose that the expected value of the competitive price next period is exactly the value of the competitive price this period. Then firms will set their output price next period according to

$$p = P_{-1}. \tag{4}$$

If, however, firms rationally expect the competitive price next period to be lower than the competitive price in the current period, then firms will set their output price according to

$$p = E(\min(p_1, p_2, ..., p_n)), \tag{5}$$

(6)

where *n* is the number of firms.

Finally, if the rational expectation of the competitive price next period lies above the competitive price this period, risk averse firms will not raise their prices to the rational expectation of the price level. Instead, they will raise their price to some level that lies between the current period's competitive price and the expectation of the competitive price next period. How high a firm is willing to raise its price above the current competitive level will depend upon a firm's degree of risk aversion. A firm that is not very risk averse will raise its price much higher than a firm that is more risk averse.

Let α be a parameter that signifies a firm's degree of risk aversion. If the rational expectation of the competitive price next period lies above the current competitive price, a firm will increase its price according to

$$p = \alpha P_{-1} + (1-\alpha)E(\min(p_1, p_2, ..., p_n)). \tag{7}$$

(7)

CONCLUDING COMMENTS

The study of sticky output prices is not new. Arslan (2010) is but one recent example of a very large literature.

But this paper presents a novel approach to an unexpected source of output price rigidity: competitive pressure. The model, expanding upon Balvers (1992), considers an environment where output prices and quantity decisions for the next period must be made before demand next period is revealed. Wages paid to inputs are more rigid than are output prices; output prices may be changed each period for next period, but wages paid to inputs are in force over multiple marketing periods. Due to the extreme consequences of setting a price that is too high, firms are obviously reluctant to raise their prices based upon a rational expectation alone; it is not acceptable to firms to have lots of customers half the time and no customers the other half of the time. Hence, firms will quickly lower prices to meet their rational expectation of the price next period, but are slow to raise prices. An interesting implication of the model is that, while Keynesian models tend to think of input prices as being sticky downward, here it is output prices that are sticky upward.

Several possible extensions could follow from the model given here. For example, one could consider whether the model yields market-wide results different from those found by Ball and Romer (1991) or Blinder, Canetti, Lebow, and Rudd (1998). Especially since these two analyses reach different conclusions regarding the impact of competition upon prices, the present model may help illuminate such differences.

The present analysis might also be augmented in order to create a general equilibrium model. Such augmentation would permit closer inspection of the implications of the present model for a macroeconomy and shocks to it. In fact, the present paper ties in nicely with the notion that increased price flexibility can be destabilizing (see, for example, De Long and Summers (1986)). Several recent papers incorporate this view, including Kandil (2008)

and Palley (2008).

REFERENCES

Álvarez, Luis J., Emmanuel Dhyne, Marco Hoeberichts, Claudia Kwapil, Hervé Le Bihan, Patrick Lünnemann, Fernando Martins, Roberto Sabbatini, Harald Stahl, Philip Vermeulen, and Jouko Vilmunen. 2006. "Sticky Prices in the Euro Area: A Summary of New Micro-evidence." *Journal of the Euro Association* 4: 575-84.

Arslan, Mesut Mesut. 2010. "Measuring Real Activity in a Model with Sticky Price and Sticky Information." *Southwestern Economic Review* 38: 49-58.

Ball, Laurence, and David Romer. 1991. "Sticky Prices as Coordination Failure." *American Economic Review* 81: 539-52.

Balvers, Ronald. 1992. "A Keynesian General Equilibrium Model with Competitive Firms and Rational Expectations." *Journal of Economics* 56: 23-38.

Blanchard, Olivier Jean, and Nobuhiro Kiyotaki. 1987. "Monopolistic Competition and the Effects of Aggregate Demand." *American Economic Review* 77: 647-66.

Blinder, Alan S., Elie R. D. Canetti, David E. Lebow, and Jeremy B. Rudd. 1998. *Asking About Prices: A New Approach to Understanding Price Stickiness.* New York: Russell Sage Foundation.

De Long, Bradford and Lawrence H. Summers. 1986. "Is Increased Price Flexibility Stabilizing?" *American Economic Review* 76: 1031-44.

Genesove, David. 2003. "The Nominal Rigidity of Apartment Rents." *Review of Economics and Statistics* 85: 844-53.

Greenwald, Bruce, and Joseph E. Stiglitz. 1989. "Toward a Theory of Rigidities." *American Economic Review* 79.2: 364-69.

Kackmeister, Alan K. 2002. "Has Retail Price Behavior Changed since 1889? Evidence from Micro Data." PhD Dissertation. University of California, Berkeley.

Kandil, Magda. 2008. "Price Flexibility in Developing Countries: Evidence and Implications." *Applied Economics* 40: 1905-18.

Levy, Daniel, Shantanu Dutta, and Mark Bergen. 2002. "Heterogeneity in Price Rigidity: Evidence from a Case Study Using Microlevel Data." *Journal of Money, Credit, and Banking* 34: 197-220.

Palley, Thomas I. 2008. "Keynesian Models of Deflation and Depression Revisited." *Journal of Economic Behavior & Organization*: 68: 167-77.

Richards, Timothy J., and Paul M. Patterson. 2005. "Retail Price Fixity as a Facilitating Mechanism." *American Journal of Agricultural Economics* 87: 85-102.

Rowe, Nicholas. 1987. "An Extreme Keynesian Macro-economic Model with Formal Micro-economic Foundations." *Canadian Journal of Economics* 20: 306-20.

Sargent, Thomas J. 1987. *Macroeconomic Theory.*2nd ed. Orlando, FL: Academic Press.

Stiglitz, Joseph E. 1999. "Toward a General Theory of Wage and Price Rigidities and Economic Fluctuations." *American Economic Review* 89.2: 75-80.

Woglom, Geoffrey. 1982. "Underemployment Equilibrium with Rational Expectations." *Quarterly Journal of Economics* 97: 89-107.

Zbaracki, Mark J., Mark Ritson, Daniel Levy, Shantanu Dutta, and Mark Bergen. 2004. "Managerial and Customer Costs of Price Adjustment: Direct Evidence from Industrial Markets." *Review of Economics and Statistics* 86:

ENDNOTES

1. See, for instance, Sargent (1987), p. 117.

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