DISCOUNTING PRICE RIGIDITIES

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ABSTRACT

This paper examines an exposition of the menu cost version of price rigidity promoted by Mankiw and other New Keynesian economists. The inconsistency of the micro model's assumption of single period profit from price changes is examined in light of an assumption on the macro level of a positive opportunity cost of capital. In essence, the macro model assumes multi-period profit concerns through discounting of future profits. When the positive opportunity cost of capital is applied to the micro model of price change incentives, the price rigidity argument breaks down as an extreme case of the more general model. An equational reconciliation of this problem is presented. Implications for the price rigidity argument in light of the approach from this less restrictive model are included in the conclusion. A change in the way New Keynesian economics is presented in the classroom is strongly encouraged by these results.

INTRODUCTION

A major goal of the New Keynesian research agenda is to develop microeconomic foundations for price rigidities that form the basis for transmission of monetary events to real variability in the macroeconomy. The assumptions of monopolistically competitive firm structures and the presence of menu costs have been utilized to justify large business cycle results from changes in individual firms' demand. This is because changes in profit are small (second order) and are often offset by a similarly small menu cost which results in a threshold effect and thus, price rigidity (Mankiw, 1991).

Most of the applications of this scenario involve the recognition of the possibility of a transfer of price rigidity to the macroeconomy if monopolistically competitive firm structures characterize a significant portion of the economy (i.e., are 'representative'). A characteristic of macro models to which this concept is applied, however, is often ignored when micro level price rigidity is asserted. The characteristic is a positive opportunity cost of capital that implies that firms will

discount future incremental cashflows, including expected changes in profit from the price change decision. In other words, a firm, rather than making its price change decision based on a comparison between a one time menu cost and the change in profit in a single time period, will instead discount future incremental profits resulting from the price change decision.

In essence, the decision to incur the cost of a price change can be thought of as an investment decision. It may therefore be treated similarly to capital budgeting, cash management, and receivables management models.

In these models, the present value of incremental cash inflows is compared to the corresponding present value of incremental cash outflows. The implication is that, in order to produce a rigidity, the menu cost (present value of cash outflows) must exceed the present value of all future changes in profit expected from that price change.

An alternative treatment of the menu cost is to consider it to be an operating cost, rather than a capital investment decision. There are several ways to rationalize this scenario which one may wish to group into the 'near rationality' model.

A SIMPLE NON MARKET CLEARING MODEL WITH A POSITIVE OPPORTUNITY COST OF CAPITAL

The macroeconomic framework onto which we graft the assertions of the New Keynesian theory is important to the overall effect of nominal price rigidities and real rigidities. A simple representation of this type of model is the Barro and Grossman non market clearing format (Barro, Grosman 1976, ch 2). In this model a positive opportunity cost of capital exists.

Price rigidities are utilized in order to highlight the transmission of monetary shocks to real variables within an equational system. The micro justification for price rigidity is of great importance to the New Keynesian agenda, which is for the most part dedicated to finding microfoundations for rigidities rather than accepting exogenous assertions serving the same purpose.

It is assumed here that New Keynesian theorists would accept the proposition that the existence of a positive opportunity cost of capital in the macro model should be consistent with the micro level foundations. Therefore, a monopolistically competitive firm will discount benefits and costs at the market opportunity cost. In most versions of macro models, this is represented as a generic 'interest rate.' Even if the interest rate is not the rate of discount used by

firms, we can imagine that the discount rate used may co-move positively with market interest rates. The acceptance of this proposition results in several implications which can be addressed in this extension.

Although market clearing conditions are not possible under the Barro and Grosman price rigidity model, we still consider an economy which is internally consistent. The essence of this type of model is represented by "internal consistency conditions", reflecting not only price rigidity but also, in a recessionary period, a constraint on output representing excess supply.

Price levels are not included as arguments in the equational system. This is because prices are predetermined in the model. One New Keynesian justification for this is the existence of monopolistically competitive firm structures which set prices according to a suboptimal position which is near rational; that is, only a small departure from full rationality (optimality). The reason for this justification is that price changes, although costless, do not appreciably increase profit, because profit is second order (Akerlof, Yellen, 1991). The alternative to a near rational explanation of price inertia is to assume the presence of positive but fixed costs of changing price, or a menu cost. Although menu costs are small, it is argued, the change in profit from the price change is also small, and therefore the firm does not change price in reaction to a small change in nominal aggregate demand. A threshold effect prevails, in other words, where the firm will only change price if the increase in profit from doing so exceeds the cost incurred by the price change. Often, theorists tend to reject that a suboptimal choice is normative, even though it may be justifiable as an assumption because of observed occurrences in the real world. It therefore appears that for New Keynesian theory to remain a theory strictly embedded in optimizing micro behavior, that the menu cost version of price inertia is the crucial point to argue theoretically and prove empirically.

Price rigidity is the vehicle which "teases a market failure" out of an otherwise internally consistent model (Gordon, 1990, p.1136). The transmission of monetary shocks to real variables is carried out via an interest rate mechanism. For example, consider a purely monetary event. A monetary restriction often involves a fall in the flow supply of real money balances accompanied by a rise in the flow supply of government securities.

The effects in the non market clearing framework are that the decrease in the flow supply of real money balances creates excess demand in the money market, and the increase in the flow supply of government securities (an earning assets component) causes excess supply in the earning assets market. The

automatic correction is carried out by an increase in the rate of interest, restoring market clearing in both markets. The interest rate increase suppresses investment demand and consumption demand, which causes further excess supply (supply in excess of an already constrained supply curve) in goods markets (and further excess supply in the labor market). Output and labor employed thus adjusts downward, initiating a form of multiplier effect (as defined by the equational system). This highlights the accepted theory that price rigidity in combination with a demand constraint can result in significant negative macroeconomic consequences.

One might ask, why do firms not change price? With the presence of an exogenously determined demand constraint, firms would not be conditionally maximizing profit if they lowered price. If monopolistically competitive firm structures are representative, however, the price rigidity is explained by the menu cost. This is not to say that price levels do not change; it is simply that they are non-reactive (inertial) to a change in nominal aggregate demand, up to a point (threshold).

THE MENU COST MODEL

Mankiw's model of menu cost price rigidity involves a direct comparison of the menu cost to the change in profit that would result if the firm changed price. It seems logical to compare the benefit of the price change directly with the cost of the price change to determine the rationale of changing price.

In the menu cost version of price rigidity profit is assumed to be a continually differentiable function of the price of the firm's output. That is, it differs from perfect competition in that product price is an argument in the profit function; in the case of perfect competition, price is predetermined (firms are price takers). A key to the menu cost argument is that small deviations from the profit maximizing price result in only an infinitesimal change in the second order profit function.

The demand function (and therefore, marginal revenue function) faced by the imperfect competitor is downward sloping. Equationally, marginal revenue may be stated in terms of the price elasticity of demand and the price of the firm's output:

(1.1)

where:

Demand is defined in terms of real output and nominal GNP:

(1.2)

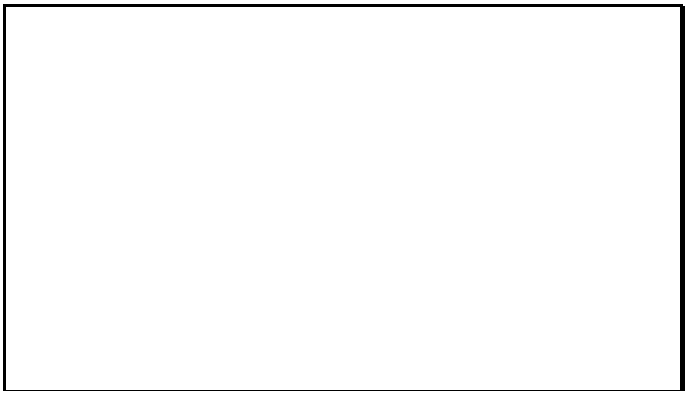
where:

Nominal aggregate demand (Y) becomes a shift variable for the price function. We define total cost in terms of productive factor costs, real output, and nominal aggregate demand:

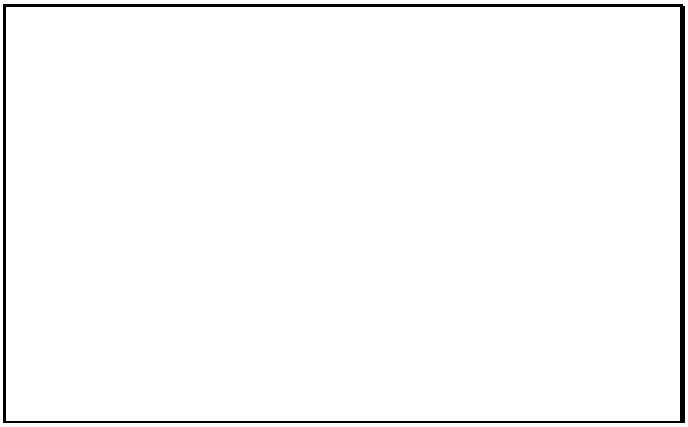
(1.3)

where:

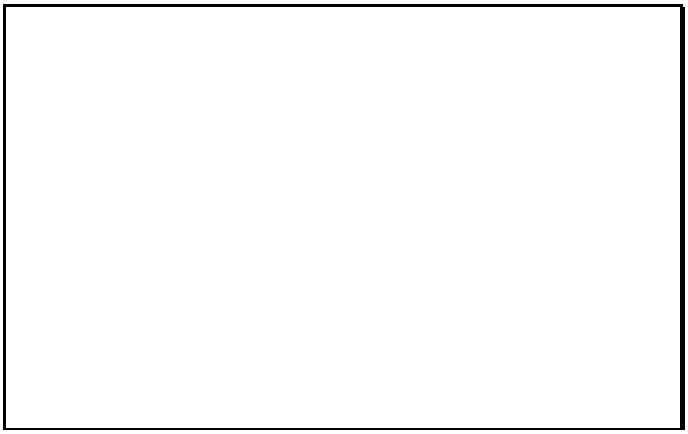
This equational form assumes that if input costs, output, or nominal aggregate demand rise, then (ceteris paribus) the firm's total cost will rise. Graphically, this can be represented as downward sloping demand and marginal revenue. For the sake of simplicity, we will also assume constant marginal cost and linear demand curve as shown in Exhibit 1.



We can illustrate the effects of a change in nominal aggregate demand, where the firm would be able to sell less output at a given price. The firm's demand curve shifts to the left in Exhibit 2. We can compare the positions of a profit maximizing firm versus a firm with nonresponsive pricing by considering the disequilibrium position (Exhibit 3; dotted lines):



We can more simply illustrate what the firm would gain versus what the firm would lose upon changing price by considering the relevant (current period) demand curve and the suboptimal price charged by the unresponsive firm (Exhibit 4).



The gain to the firm of resetting price may be defined for a one period model as rectangle B in the graph, whereas the firm would lose rectangle A if it reset price. The relationship of A to B depends on the price elasticity of demand, of course, but we know that the net gain to the firm would be B-A. It is important to recognize this net gain as a second order function, because a central argument

in the menu cost position is that the gain from cutting price is small. The firm incurs a one time cost of changing price: a menu cost. The second order gain in profit from changing price need only to be smaller than the menu cost to prevent the price change for a fully maximizing firm. The resulting decision rules relating the menu cost (Z) to the single period change in profit (B-A) logically follow: If B - A < Z, then it is fully rational for the firm not to change price. On the other hand, if B - A > Z, then it is fully rational for the firm to change price.

EFFECTS OF A MENU COST IN A MODEL WITH A POSITIVE OPPORTUNITY COST OF CAPITAL

In most macro models, including the one exemplified here, a positive opportunity cost of capital exists. It is therefore logical to assume that the existence of this opportunity cost of capital would be applied to the microfoundations.

With this in mind, the change in present and future profits resulting from the price change should be discounted to a present value. We can directly compare this present value to the (also discounted) cost of the price change or price change plan (whereby future plans for price changes would be considered as well).

Assume for simpler exposition that the cost of a single price change to occur now is already in present value. This is similar to the assumption Mankiw makes that the menu cost is a fixed, one time cost of a price change. This amount is known with certainty, if the cost will fully accomplish the price change.

Not only would the price change affect incremental profits in the current period, but also would affect incremental profits in future periods. On what basis would the decision be made to change price, or, not to change price?

For a price change to occur under fully optimizing firm structures, the present value of all future incremental changes in profit discounted at an appropriate discount rate must exceed the amount of the menu cost. In other words, the present value of the benefit must outweigh the present value of the cost for the decision to be a positive net present value action.

In order to state this relationship precisely, let represent the discounted present value of current and future profits resulting from the price change:

(1.4)

We can state the decision rule in the same notation as the single period form above. If < Z, then it is fully rational for the firm to not change price. If, on the other hand, > Z, then it is fully rational for the firm to change price. If our analysis is limited to fully rational firms, then the menu cost should be treated as a capital investment expenditure.

THE MENU COST AS AN OPERATING COST

An alternative way to look at the menu cost, and an argument that might be pursued by practitioners, is that the menu cost in practice is not viewed as a capital investment decision. It is viewed, rather, as an ordinary operating cost, incurred in the normal operation of the company. In reality, expected changes in profit directly resulting from the price change may be difficult, if not impossible, to segment from changes in profit from other managerial actions. These arguments are natural pragmatic reactions to abstract models of managerial behavior.

It is difficult to argue that business practices should be ignored in the building of economic models. In the strict sense, allowing menu costs to be incurred without considering the effect on profit, however uncertain, is a satisficing, rather than a maximizing position. Although placement of models which reflect suboptimal positions has occurred in the New Keynesian research agenda, it appears that the overall agenda of microfoundations research is dedicated to fully rational models to explain price rigidity. Most efforts build upon fully rational, rather than near-rational, foundations.

FREQUENT PRICE CHANGES

It is conceivable that a firm may change price rather frequently, and not necessarily as a reaction to spending (This is an important point to consider, because the extreme view of the rate at which price changes occur is that of

instantaneous price change, reflecting the classical absence of friction, that New Keynesians wish to dispute). If this is the case, then the incremental changes in future profits attributable to the current price change under consideration may be difficult to predict beyond a short period. Future changes in spending and prices would certainly offset or enhance the effects of the current price change.

This dilemma could be addressed by the presence of uncertainty in the neoclassical sense. A discount rate (d in equation 1.4) which is positively related to the degree of variance of expected future changes in profit can be assumed. In this way, increases in 'risk' would result in a lower present value of future incremental changes in profit.

The inability to predict the nature of future price changes and their effect on incremental profit estimates may not seem to be a burdensome task. The accuracy of forecasts with the presence of multiple price change expectations, however, could result in highly uncertain profit estimates.

CONCLUSIONS

This simple extension of the menu cost version of price rigidity involves at least four implications for the Mankiw model. They are as follows:

(1) The discounted present value of future incremental changes in profit will tend to be large relative to the single (current) period incremental change in profit associated with price change. In other words, the total of the current period's change in profit in combination with the sum of the present value of all future changes in profit will exceed the one period change in profit pursued in the Mankiw model. In equational form:

(1.5)

(2) The firm is more likely to change price under conditions where a positive opportunity cost of capital exists, because the benefit from changing price is greater than in the absence of discounting.

(3) As the perceived variation of estimated future incremental changes in profit increases, the firm is more likely to leave prices unchanged. This is because as the discount rate (d) for future incremental changes in profit increases, falls. The smaller is (relative to the menu cost) the more likely is price inertia.

(4) The limit of the present value of future incremental changes in profit as the discount rate approaches infinity (as variance rises) is equal to the single period incremental change in profit as in Mankiw's framework. If viewed in this light, the single period model represents a special case which operates under the relatively extreme assumption of infinite discount rates. The single period model would therefore appear logically inconsistent with macro models where a positive but non-infinite opportunity cost of capital exists.

Although the conclusions from this simple extension of the menu cost model are rather modest, they do directly address one criticism of the model. Some have suggested that menu costs are small, and are therefore unlikely to cause firms to practice price inertia. The counter-argument is that the change in profit is also small (second order) and therefore, the menu cost, though small, results in price inertia.

The conclusion drawn from including a positive opportunity cost of capital is that considering all future changes in profit will tend to promote price change, at least to a larger degree than the single period Mankiw version. A lesser degree of price rigidity thus translates to the macroeconomy. If prices are relatively flexible, then it is less likely that price rigidity is the cause of large macro fluctuations.

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