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Pass-through, vertical contracts, and bargains

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HIGHLIGHTS

- We analyze the vertical determinants of cost pass-through.
- Vertical contracts and relative bargaining power impact pass-through rates.
- We investigate the relation between wholesale and retail pass-through rates.
- We generalize the result of Bresnahan and Reiss (1985) to Nash-bargaining.

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ABSTRACT

This paper analyzes the determinants of pass-through that are specific to vertical relationships between wholesalers and retailers. The type of vertical agreement firms contract upon as well as their relative bargaining power are identified as major determinants of pass-through rates.

1. Introduction

A major issue in international economics is to understand the effect of exchange rate fluctuations on prices of traded goods (Engel, 2002). Exchange rate shocks are typically transmitted to prices on less than proportional increases ("incomplete pass-through"), and with a time delay.[1]

When tackling this issue in the standard model where wholesalers import goods and then contract with retailers in their local market, it is important to understand the impact of firms' vertical relations on pass-through and to identify at which level (wholesale, retail, or both) incomplete pass-through takes place. Although recent empirical findings on the relationship between pass-through at the wholesale and retail levels have been put forward by Nakamura and Zerom (2010) and Goldberg and Hellerstein (2013), for instance, there is a lack of theory work addressing this question.

In this paper, we aim at filling this gap by investigating the determinants of pass-through that are specific to vertical relationships. We highlight the relation between the type of agreement firms contract upon, their relative bargaining power, and pass-through rates. In addition, we explore the link between pass-through rates at various stages of the supply chain and the role of the slope of demand curvature. We also extend a classical result from Bresnahan and Reiss (1985) on the relationship between retail and wholesale markups to the case where firms bargain over the wholesale price.

In the literature, particular attention has been given to the role of *horizontal* market structures and functional forms of demand and supply in affecting the pass-through rate of costs to prices. This line of work was pioneered by Bulow and Pfleiderer (1983) in the case of a monopolist facing linear costs, and recently generalized by Weyl and Fabinger (2013) to various market structures and demand and cost forms. These papers have emphasized, in particular, that pass-through depends on demand curvature.

Theory work on the role of *vertical* determinants of pass-through is scarce. Bresnahan and Reiss (1985) show that when a

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[1] See the recent empirical evidence from, e.g., Gopinath et al. (2011).

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manufacturer sets linear prices the ratio of the retailer's markup to that of the manufacturer is equal to the retail pass-through rate, that is, the rate at which wholesale prices affect retail prices. Weyl and Fabinger (2013) extend this result to a chain of imperfectly competitive markets as an application of their main findings to vertically-related markets. Adachi and Ebina (2014a) show that the total chain pass-through rate is greater than the wholesale one if and only if demand is log-concave.[2] In these analyses, however, the authors do not investigate the impact of contract type or bargaining power on pass-through or how the retail pass-through rate compares to the wholesale one.

Theory seems thus lagging as the empirical literature used the relation between cost shocks and prices to infer vertical structure and contractual agreements (Villas-Boas, 2007), firms' relative bargaining power (Draganska et al., 2010) or the use of non-linear pricing contracts and vertical restraints (Bonnet et al., 2013).

The remainder of the paper is as follows. The basic model with linear pricing and bargaining is presented in Section 2 and solved in Section 3, provided with an extensive analysis of the results. Different contractual agreements are investigated in Section 4. Finally, Section 5 concludes.

2. Model and pass-through rates

2.1. The model

A manufacturer (or wholesaler), M, produces an input at a constant marginal cost, c, and sells it to a retailer, R, at a linear wholesale price, w. The retailer then sells at a linear price p to consumers.

Firms bargain over the linear wholesale price. We follow the classic setting of Horn and Wolinsky (1988) by considering the Nash-bargaining solution of this problem. The manufacturer has an exogenous bargaining power $\theta \in [0, 1]$, and the retailer has the remaining bargaining power $1-\theta$. Firms can only bargain over the input price, and retail pricing is not contractible at this stage of the game.[3] The canonical Stackelberg-manufacturer setting proposed by Spengler (1950) thus corresponds to the case where $\theta = 1$. Finally, firms face no outside option to sell or buy the input, therefore both have a disagreement payoff of zero.[4]

Retail demand at price p is given by $q(p)$. We assume that demand is well defined at any price, is three times differentiable and decreasing in price everywhere over the relevant range where it is positive, i.e., $q'(p) < 0$.

Below, we will refer to the curvature of demand: $E(p) \equiv q(p)\,q''(p) / \left[q'(p)\right]^2$. Formally, the demand curvature is the elasticity of the slope of inverse demand. It takes well-identified values for common demand forms. For instance, $E = 0$ when demand is linear, $E = 1$ when it is of the negative exponential form, and $E = 1 + 1/\varepsilon$ when it displays a constant elasticity ε. In addition, a negative curvature is equivalent to the demand form being concave, and a curvature lower than unity to the demand being log-concave.

2.2. Pass-through rates

Our focus is on the determinants of three pass-through rates. The first one is the retail pass-through rate, dp/dw, which corresponds to the variation in retail price following a change in the wholesale price. The two other rates are the wholesale pass-through rate, dw/dc, and the total pass-through rate, dp/dc, which represent the impacts of a cost shock for the manufacturer on the wholesale and retail prices, respectively. In order to understand whether incomplete pass-through occurs at the wholesale or at the retail level, it is important to be able to compare the retail pass-through rate to the wholesale one.

3. Analysis

The game is solved by backward induction.

3.1. Retail pricing

In the last stage of the game, the retailer takes the wholesale price, w, as given, and sets the retail price, p. Its profit is thus given by $\pi_R = (p-w)\,q(p)$. The retailer's profit maximization problem gives the following first-order condition (omitting arguments):

$$q + (p^* - w)q' = 0. \tag{1}$$

The corresponding second-order condition is equivalent to:

$$2 - E > 0, \tag{2}$$

and is assumed to be satisfied everywhere over the relevant interval. Solving for the equilibrium price leads to:

$$p^* = w - \frac{q}{q'}. \tag{3}$$

3.2. Wholesale pricing

When firms engage in Nash bargaining, the first-stage equilibrium is determined by solving the following maximization problem:

$$\text{argmax}_w \left\{\pi_M^{\theta} * \pi_R^{1-\theta}\right\}, \tag{4}$$

where $\pi_M = (w-c)\,q$ is the manufacturer's profit and $\pi_R = -q^2/q'$ from Eq. (3). The first-order condition is equivalent to:

$$\theta\left(-\frac{q^2}{q'}\right)\left[q + \left(w^* - c\right)q'\frac{dp^*}{dw}\right] + (1-\theta)\left[\left(w^* - c\right)q\right]\frac{dp^*}{dw}(-q)(2-E) = 0, \tag{5}$$

with the retail pass-through rate $dp^*/dw = 1/(2-E)$ obtained from Eq. (3).

The second-order condition of the wholesale maximization problem is equivalent to:

$$(2-E)^2\left[1 + (1-E)(1-\theta)\right] - \theta^2\frac{q}{q'}E' > 0, \tag{6}$$

with $E' \equiv \partial E/\partial p$, and is assumed to be satisfied everywhere over the relevant interval. Solving Eq. (5) for w gives the equilibrium wholesale price:

$$w^* = c - \frac{q}{q'}\frac{\theta(2-E)}{\left[1 + (1-E)(1-\theta)\right]}. \tag{7}$$

3.3. Pass-through

Implicitly differentiating these equilibrium results, we obtain the retail and wholesale pass-through rates.

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[2] In follow-up work, Adachi and Ebina (2014b) derive related results in the case of two-tier Cournot oligopoly markets.

[3] This implies (some) double marginalization under linear input pricing. However, the other contracts considered in Section 4 allow for supply chain coordination and industry-profit maximization.

[4] Because our aim is to demonstrate that pass-through may depend on firms' relative bargaining power, it is out of the scope of this paper to consider nonzero disagreement payoffs.