Innovative Pricing[1]

Pricing as an Instrument of Innovation

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Abstract. Textbook pricing theory is a standard application of supply and demand analysis of well defined products under a situation of full or almost full information. It has always had difficulties dealing with innovation and the introduction of new products.

The increasingly intangible nature of products leaves firms confronted with the strategic decision of determining what to charge for. They are reaching for new methods of pricing to capture the full value of their products, thus introducing pricing and financing schemes not thought of previously. The introduction of heterogeneous price levels and the bundling of more or less well defined goods and services in combination with the unpredictability of other agents in the market have made standard equilibrium theory with its restricted opportunity sets less useful as a theoretical foundation for optimal pricing. Hence, placing the pricing model in a wider opportunity environment, firms' theoretical pricing and bundling decisions will deviate from what has previously been considered rational.

Innovative Pricing (IP), is introduced as part of the product development process. It defines the product such that a base for efficient pricing can be identified, i.e. a base that makes it possible for the firm to capture a maximum value in the market. IP, hence, becomes an act of innovation.

I formulate a model in which each firm sets its prices under these experimental and unpredictable conditions. The Innovative Pricing solutions that are realized in the model become part of the product innovation and, hence, have to be seen as part of the innovation process.

Key words: Innovative Pricing – Experimentally Organized Economy – Firm Dynamics Pricing - Innovation – Information Technology

JEL-classification: O31, D81

1 Introduction

Pricing is a neglected aspect of the economics of innovation. When innovation economists speak of pricing they do this in the context of introducing new and superior products, and not as a part of the innovation itself. In fact, when Schumpeter introduces his five aspects of innovation: product, process, market, package and input he does not recognize pricing as being part of the innovative process.

The rapid introduction of information technology have brought increased attention to the old problem of pricing products the marginal cost of which are close to zero. Recently firms' willingness to price their products even below marginal costs have been increasingly observed, often in the form of free software. What pricing mechanism lies behind such, economically, peculiar practices? Part of the answer can be found in the network and spillover economics literature. Demand spills from one product to the next in the form of an extra value that is difficult or impossible to define. The entrepreneurial process of identifying and pricing such demand spillovers is part of what characterizes the Innovative Pricing problem.

Schumpeter's view of innovation was fairly linear and was conceived as the identification of commercially viable inventions by the entrepreneurs who develops innovative products for the market. Schumpeter stated that change in science and technology was only interesting in so far as they were capable of transforming the outside world, and this transformation had to be successful in the marketplace. If not successful in the market the innovation would not diffuse and hence, would cause no positive change (Roberts, 1998). Economists have often misinterpreted this fundamental premise in their attempts to integrate innovation into the framework of the theory of the firm. New technologies are crucial, but need complementary innovations before they can be commercialized (Dahmén ,1950; Hahn, 1993; Eriksson and Lindh, 2000). Thus, the transformation from a technical invention to an innovation requires the support of a bundle of complementary products in order to be successfully introduced in the market. Part of the innovation management process will therefore be to structure the innovation such that it can be priced appropriately i.e. brought successfully to the market. I will show that pricing in fact has to be a necessary part of the commercialization and realization of an invention and hence, will add an important dimension to theory.

I will illustrate the notion of IP with the help of a standard pricing model. By increasing the complexity of the model we will, at a certain level, be forced to leave the closed and bounded opportunity set of the mainstream neoclassical model and instead seek intellectual support in the theory of the Experimentally Organized Economy (EOE) (Eliasson 1988). In the EOE, firms are able to incorporate only a fraction of all information residing in its state space and will therefore make as rational decisions as they can based on to them available information. The decisions based on this information will often be very mistaken and rarely be the best ones ex post. Pricing decisions in the experimental model will, hence, be more or less biased, leading to irregularities disturbing the equilibrium. Above all, under the uncertainty prevailing in the EOE, agents will be unable to comprehend the pricing decisions of other firms in the market. A complex situation emerges and IP will, hence, be necessary.

2 Background to the model

In this section I describe the basic model. First, a simple product model will be illustrated in order to demonstrate the basic logic of our pricing problem. By increasing the complexity of the model the disequilibrium situation in which IP is necessary will be defined.

Consider an economy with two firms (i = [1,2]), each with the product portfolio[2]:

[2] The product portfolio should be interpreted as a vector of defined product characteristics representing the base of billing. This type of product description has been used previously in a stable equilibrium setting by for instance Bromwich (1990).

$$Q_i = \sum_{j=1}^{n} q_j = [q_1, q_2, \ldots, q_n]$$

Where n is the number of products.

If firm 1 innovates, the innovation will be entered as an addition to the product vector $Q_{1.}$ The innovative firm will have a new product portfolio which can be illustrated by:

$$Q_1 = \sum_{j=1}^{n+1} q_j = [q_1, q_2, \ldots, q_n, q_{n+1}] = Q_2 + q_{n+1}$$

Innovations are proprietary to the inventor when used commercially (they are protected by either a patent system, by incomplete information or by the absence of competitive competence to innovate).

The demand for products within a portfolio of alternatives is rarely independent of demand for other products. An increase in sales of one product is therefore likely to affect the sales of the other products. Some products have little value in isolation, but if offered to a large number of consumers, or if bundled with other products generate more value than the sum of each. Hence, they will fetch a higher price. Such spillovers or demand externalities have attracted considerable attention in economic theory and have subsequently been termed network externalities (Katz and Shapiro 1985,1994).

The demand effects within firm 2's product bundle can be described as:

$$X_2 = \begin{bmatrix} x_1^1 & \cdots & x_1^n \\ \vdots & \ddots & \vdots \\ x_n^1 & \cdots & x_n^n \end{bmatrix}$$

Where x_k^j is the increase in demand of product k as result of additional sales of j.

$$\begin{aligned} x_k^j &= 0 \qquad \textit{if no effect} \\ x_k^j &< 0 \qquad \textit{if an increase in demand of } j \textit{ has a negative effect on demand of } k \\ x_k^j &> 0 \qquad \textit{if an increase in demand of } j \textit{ has a positive effect on demand of } k \end{aligned}$$

Thus, the indirect networking effects for the product bundle of firm 1 will look:

$$X_1 = \begin{bmatrix} x_1^1 & \cdots & x_1^n & x_1^{n+1} \\ \vdots & \ddots & \vdots & \vdots \\ x_n^1 & \cdots & x_n^n & \vdots \\ x_{n+1}^1 & \cdots & \cdots & x_{n+1}^{n+1} \end{bmatrix}$$

The effects of firm 1's exclusive access to the product innovation, enables it to use its pricing competence to under price the other products of its product portfolio. There can be two reasons for this possibility.

First, in the short term, firm 1 can price products within Q_2 below marginal cost in order to charge a higher price for its whole portfolio Q_1. This strategy will be optimal if the positive indirect networking effects that stem from a low priced Q_2 motivate a higher price for the innovation. Since the innovation is proprietary to firm 1 it can leverage this unique feature to capture monopoly profits for the whole package.

Second, a considerably more aggressive strategy is for firm 1 to leverage its innovation to threaten the profitability of firm 2. The product portfolio Q_2 is the only source of revenue for firm 2. In the long run, below marginal cost pricing of Q_2 will drive firm 2 out of the market. Firm 1 would then, in my model, become a monopolist on all three products.

This is the standard result for a two firm oligopoly, with a small number of products, each with known indirect networking effects. Under the assumption of full information the strategies will boil down to a regular monopoly pricing optimization problem. This framework results in models that are fully defined punctually. Only then does the exact rational expectations solution exist. Several economists have tried to extend the model by approximating uncertainty with calculable risks thus staging it within a stochastic version of equilibrium theory i.e. efficient rational expectations within the fundamentals of equilibria. This may be all right for some theoretical problems but not for dealing with our pricing problem. Attempts to incorporate imperfect information into the equilibrium models are logically inconsistent. The problem lies in the models' inability to deal with structured uncertainty i.e. change in the indirect networking effects when it is not generated by a known, stable distribution function. Treating information as a good within an equilibrium framework brings up the problem of prices and quality, since agents are assumed to be unaware of the quality, i.e. of the importance, of the information that can be acquired. All this will prevent agents to predetermine its character even in expectation. We, hence, need to modify the model to include some dynamic content and to illustrate the concept of IP.

One common critique of models of full information is the habit of ignoring transaction costs but also, if they take place, decisions that affect the nature of the transaction, i.e. the solution or its equilibrium properties (Eliasson, 1990). In reality, transaction costs are often so large that they very well might prevent the transaction from taking place at all. Transaction costs in fact account for at least half of the cost of an average firm (ibid).

High transaction costs combined with uncertainty of the indirect networking effects between products will, even with relatively few products, offer an unstable optimal product/price opportunity set.

Decision-makers, in this case firms, have little or no knowledge of neither the demand level nor the structure of the market. Unless firms are familiar with the distribution of the uncertainty variable, or can reconstruct the distribution by studying large numbers of output variables, before the structure of the market changes, they will be unable to comprehend all parameters of the economy. In fact Muth (1961) presents empirical observations of how agents often make better predictions of key variables than economic equilibrium models. Lindh (1992) draws attention to this point. He observes

that firms will never be able to locate equilibrium points within the rational expectations model if it does not know the distribution function beforehand and the distribution function belongs to a class of easy or uncomplicated functions.

Once we introduce these dynamic assumptions into the model, we are outside the standard equilibrium framework because the equilibrium points do not remain in the same position but actually move as firms search for them. Hence, depending on where and how a firm decides to search will affect the end points. An agent will, because of incomplete information and lack of knowledge of the distribution function, be unaware weather the pricing mix it has chosen is an optimum. Eliasson (1992) presents the neoclassical or Walras-Arrow-Debreu (WAD) model on stochastic form by stating the following:

1. Agents maximize utility- MAX(u)
2. Expectations are formed from subjective probability distributions conditioned by "all available information" (Ω), that is, historic realizations of all stochastic variables – $EXP(X) = P(X | \Omega)$.
3. Agents form (from points 1 and 2) actual, ex-post probability distributions that are identical with the subjective probability distributions under point 2- EX POST $P(X) = P(X | \Omega)$.
4. EX POST P(X) are stationary

Point 3 is the critical assumption that has to be given up when we enter the EOE. Identifying the ex post P(X) from data presented in the non-linear EOE constitute the fundamental difficulty of IP when formulated in the abstract form. The complex procedure of searching for the optimal combination of output and price is affected directly by the complexity of the (unknown) distribution function and the local receiver competence of the agent (Eliasson, 1990). Thus the pricing competence is unique for each agent in the market. This will enable firms to invent new unexpected price/product constellations not perceived by other agents in the market and can, if proven commercially successful, be comparable to regular product innovations. These IP schemes will be firm specific depending on the firms' ability to leverage their uniqueness. IP will, hence, depend not only on the pricing competence of the agent but also on its product opportunity set. Such competence is what defines IP.

IP is not a problem in the standard Walras-Arrow-Debreu model (by assumption) but emerges as the critical agent problem in the EOE. This has several implications for the firm. In equilibrium theory, price can be based on marginal cost. In EOE many costs are not known even in expectation. Firms are unable to calculate cost or customer value because they are unaware of the cost and character of the product. The economy twists and turns as a result of the irrational and unforeseeable interactions between agents. This again brings up the need for Innovative Pricing.

3 Characteristics of IP

How can firms set a price to meet a profit maximization objective under complex and hostile conditions? The solution is to identify a unique feature of the product, or more correctly a characteristic of the firm that relates to other intangible characteristics in a predictable way. In this sense the firm is setting up and enacting subjectively controlled pricing and product experiments, based on hypotheses about market opportunities. This is the essence of the EOE, and once its assumptions are accepted, we have an explaination why organizations behave differently and why their behavior changes in different ways and at different rates over time, even when the purpose is similar[3].

Under the common situation of high transaction costs, firms might find it beneficial only to set a positive price on this stable characteristic and relate the pricing of this feature to charge for the whole bundle. This identification of a stable pricing variable is an act of innovation because it facilitates and coordinates combinations of resources that are new to the market.

Such a feature could be a stable point where the market price is relatively stable and accepted. This characteristic of the product can then be used as a temporary monopoly in order to set a more, for the firm, profitable price for the whole. By measuring the consumption of just one product within a bundle the transaction cost of measuring and setting up all the others is reduced. This issue raises the problem of identifying which characteristic of a product bundle to measure and charge for. The competence needed to identify such relatively stable ex post distributions, is similar to the problem Antonov and Trofimov (1993) discuss[4], as well as the practical problem of predicting share prices in a volatile stock market, using historic data on share prices.

Positive indirect networking effects, once identified by agents in an economy, can motivate not only a change in price but also a switch in the direction of the revenue stream, thus changing prices into costs. Firms can be motivated to subsidize a product, pricing it far below its value to the consumer, giving the product away for free or even paying the customer for using the product. The motivation is that the firm will be able to exploit, by IP, indirect networking effects, resulting from the increased demand for such a low price product, and hence generate a higher profit.

Products with a high value to the consumer but with a low marginal cost, such as public goods, are well suited for Innovative Pricing, since their reproduction is cheap. Several luck seekers, often calling themselves independent strategic consultants, point to the recent growth and changes in the creation and handling of different information and content services with the assistance of information technology as the prime enabler of these types of pricing/bundling constellations. However, as shown in Jonason (1999a), the process of identifying Innovative Pricing solutions to charge for direct and indirect network externalities has been used by firms for a considerable time, long before the recent technical advance in information handling and processing.

A firm has a whole array of characteristics that can be charged for. Because of incomplete information, transaction costs and irrational and unpredictable behavior of the economy in general the optimal charging of a bundling combination, however, is nearly impossible to find. Instead firms are forced to leverage on those features that it regards as stable. Firms will need to locate parameters that are unique or nearly unique i.e. those that

[3] See Canter et al. (1990) for an elaborate investigation of the technological and economic implications of different strategies and learning rules for firms driving technical progress.

[4] Antonov and Trofinov (1993) find that in experiments that long-term performance increases when decisions are taken by actors individually, not being constrained by centrally imposed guidelines in their case Keynesian or Neoclassically based predictions.

have few or distant substitutes in the economy, since the firm, giving away all other products (i.e. setting a price below marginal cost), come to rely more heavily on its unique characteristics.

Given the unique production set and competence of each firm to innovate (introduce new characteristics into the opportunity set) combined with its organizational competence introduces an evolutionary problem of selection similar in nature to that of genetic learning algorithms, in this case finding a fit characteristic to use as a base for pricing[5].

A firm's innovative competence is synonymous with the ability to identify and exploit the stable and unique features of its product bundle. Commercial success in IP is based on the firm's ability to direct the flow of revenues through the product bundle, and tap these revenue flows to maximize its own profit-seeking objective. A product can, hence, be high in demand but still be unprofitable unless the firm that offers the product has the ability to define a base such that it can be efficiently priced.

The economy does not remain in this stable state, however. Instead, the market constantly changes the networking effects between products as a result of decisions taken by other agents in the economy, the introduction of new innovations ,as old technical innovations become public and with the diffusion of IP decisions[6]. In the oligopoly model presented previously, the proprietary addition to the product vector enabled firm 1 to reap temporary monopoly profits for its whole bundle. However, by introducing new pricing characteristics and product combinations, firm 2 has the opportunity to strike gold and be able to circumvent firm 1's monopoly by a substitute bundle which switches the networking effect over to firm 2 which thus achieves a temporary monopoly.

By constantly leveraging different unique price product bundles the boundary between price and product becomes diffuse. The innovative competence lies in coordinating both pricing and product resources to be able to define and gain access to a bundle, such that it can be efficiently priced.

New innovations in the IT-industry are often based on more efficient ways of handling and processing information and not always on the introduction of new physical products, although the exploitation of such innovations are realized at a physical level (Jonason, 1999b). This relates back to pricing being a part of the theory of innovation. There is, in fact, little difference between the innovation of the information industry, for instance, the arrangement of information flows in a new operative systems kernel, for a more efficient use of processing power than competing technologies (such as that of the OS Linux). The mathematical algorithm for more efficient processing of router tables (such as that of the Swedish company Effnet) illustrates this effect. For instance designing an innovative mixture of different pricing combinations to direct the flow of revenues within a product bundle and allow the firm to charge a higher price. For instance, giving part of a product bundle away for free the firm might still manage to increase the net flow of revenue because of the reduction in transactions costs and the indirect networking effects resulting from the increased demand of the complementary bundled products. These examples only differ in the resources they coordinate. Whether

[5] See Ballot and Taymaz (1998) for a micro to macro simulation or Birchenhall et al. (1997) and Holland (1975) for a closer description of the use of Genetic Algorithms in evolutionary modeling.

[6] Since the IP strategy cannot be protected by other means than asymmetric information it will instantly diffuse as soon as it comes to the knowledge of other firms in the market.

the innovation materializes as an efficient steering of information, or in the form of revenue streams does not affect the fact that both are new ways of coordinating resources not seen previously in the market. They are therefore acts of innovation.

4 Conclusion

Innovative Pricing (IP) is the entrepreneurial process of defining a product such that it can be efficiently priced. IP is comparable to any type of innovation, since it enables agents to raise the price of the product through redefinition. This makes it possible for the firm to bypass the billing bases of similar products in the market. An Innovative Pricing scheme can , however, only be compared to a technical innovation if has not been thought of previously by other agents in the market. Such a situation is excluded by assumption in the mainstream Walras-Arrow-Debreu (WAD) model. Under rational expectations all agents will have rational knowledge of the effects of every pricing decision taken by every agent and would, hence, be able to anticipate any experimental or creative combination since increasing efficiency then would imply increased rationality. By a slight modification of the assumptions of the WAD model a different world, requiring very different rational behavior of firms emerges, the Experimentally Organized Economy (EOE). Innovative Pricing (IP) becomes necessary.

A firm, by offering a product set below its marginal cost, will come to depend on a second set of products to cover its loss of revenues. This means that it subjects itself to uncertainty since it now has to rely more heavily on only one set of products for revenue, instead of two. It will therefore be important for the firm to protect the proprietary access (uniqueness) of this billing base for future profits by preventing other agents from bypassing it.

References

Antonov M, Trofimov, G (1993) Learning through Short-Run Macroeconomic Forecasts in a Micro-to-Macro Model. Journal of Economic Behavior and Organization, 21(2), June.

Birchenhall C, Kastrinos N, Metcalfe S (1997) Genetic Algorithms on Evolutionary Modelling. Journal of Evolutionary Economics, 7:375-393.

Bromwich M (1990) The Case for Strategic Management Accounting: The Role of Accounting Information for Strategy in Competitive Markets. Accounting, Organizations and Society,15:27-46

Ballot G, Taymaz E (1998) Human Capital, Technological Lock-in, and Evolutionary Dynamics. in Eliasson and Green (eds.), (1998) Microfoundations of Economic Growth. University of Michigan, Prisi, Ann Arthur

Canter U, Hanusch H, Pyka Andreas (1998) Routinized Innovations: Dynamic Capabilities in a Simulation Study. in Eliasson G, Green (eds.) (1998) Microfoundations of Economic Growth. University of Michigan, Prisi, Ann Arthur

Coase RH (1937) The Nature of the Firm. Economica, New Series, IV, (13-16), 386-405

Dahmén E (1950) Svensk Industriell Företagsamhet, Kausalanalys av den Industriella Utvecklingen 1919-39. 2 vols., IUI, Stockholm. Dissertation. (The English summary of this Swedish edition is reproduced in this volume)

Eliasson G (1988) Schumpeterian Innovation, Market Structure and the Stability of Industrial Development. In Hannusch (1988) Evolutionary Economics, Cambridge University Press

Eliasson G (1990) The Firm as a Competent Team. Journal of Economic Behavior and Organization, North Holland, 13:275-298

Eliasson G (1992) Business Competence, Organizational Learning and Economic Theory: Establishing the Smith-Schumpeter-Wicksell (SSW) Connection. in Scheriv-Perlman (eds.) (1992) Entrepreneurship, Technological Competition and Economic Growth- Studies in the Schumpeterian Tradition. University of Michigan, Prisi, Ann Arthur

Eriksson C, Lindh T (2000) Growth Cycles with Technology Shifts and Externalities. Economic Modeling, 17:139-170.

Hahn FH (1993) On Growth Theory. In: Economics in a Changing World. Proceedings at the tenth International Economic Association World congress in Moscow 1992, Macmillan, London.

Holland J (1975) Adaptation in Natural and Artificial Systems. Ann Arbor: University of Michigan Press.

Jonason A (1999a) Trading in, and Pricing of not Easily Defined Products and Services. in Eliasson(ed.) (1999) Internet Economics and Internet Technology. Trita Series-IEO R 1999:06, Research Report, Royal Institute of Technology, Stockholm

Jonason A (1999b) Protecting Content on the World Wide Web. Trita Series-IEO R 1999:18, Research Report, Royal Institute of Technology, Stockholm

Katz ML, Shapiro C (1985) Network Externalities, Competition, and Compatibility. American Economic Review, 75:424-40.

Katz ML, Shapiro C (1994) Systems Competition and Network Effects. Journal of Economic Perspectives, 8: 93-115

Lindh T (1992) Lessons from Learning to have Rational Expectations. In Day D, Eliasson G, Wihlborg(eds.) (1992) Market for Innovation Ownership and Control, North Holland

Muth JF (1961) Rational Expectations and the Theory of Price Movements, Econometrica, 29:315-35.

Roberts R (1998) Managing Innovation: The pursuit of Competitive Advantage and the Design of Innovation Intense Environments. Research Policy 27:159-175

Schumpeter JA(1911) (English edition 1934) The Theory of Economic Development. Harvard Economic Studies, Vol. XLVI. Cambridge, MA: Harvard University Press (originally published in German)