Smart Entry in Local Retail Markets for Electricity and Natural Gas

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This version: November 2009

Abstract

Consider a market with switching costs that is initially served by a monopolistic incumbent. How can a competitor successfully enter this market? We show that an offer to undercut the incumbent by a fixed margin serves this purpose. This strategy dominates traditional entry where the entrant just offers a lower price because it restrains the ability of the incumbent to block entry by limit pricing. We also consider adding a price ceiling to insure customers against future price increases. While this has a strategic advantage in markets with elastic demand, it is too risky if substantial cost increases are possible.

Keywords: Entry strategies, Price competition, Electricity, Natural gas

JEL–classification: D43, L11, L41

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1 Introduction

Retail markets for electricity and natural gas have traditionally been served by local monopolies in most countries. After the formal opening of these markets due to deregulation, actual competition remained mostly sluggish. That is not very astonishing as products are homogeneous, procurement costs of the firms are likely to be similar, and switching is costly for consumers due to search for a new supplier, paperwork and unknown quality of service. Under such circumstances the incumbent should be able to apply a limit pricing strategy by reducing its price far enough to make entry unprofitable. The disadvantage of the entrant is reinforced by the fact that switching costs imply that customers will only have an incentive to switch if it is likely that the entrant's tariffs will be permanently lower.

Nevertheless at least in Germany there has been a substantial amount of switching in local markets for electricity and natural gas. The most successful entrant seems to be "E WIE EINFACH" a subsidiary of E.ON which is one of the four big players in the German energy market[1]. E WIE EINFACH entered the market in February 2007 and has until now gained almost a million customers. This result has been achieved by applying a price strategy that has seemed to be very attractive to consumers and difficult to counter by the local incumbents. The company guarantees his customers to sell them electricity at a price of one cent/KWh and natural gas at a price of two cents/m^3 below the general price of the so called local primary provider (the incumbent). This offer not only implies that current prices are undercut, but also that any price reduction by the incumbent will immediately yield a similar price decrease for the customers of E WIE EINFACH. Moreover, until recently, the company also insured consumers against future price increases by adding a price ceiling at the current price level (for electricity the guarantee lasted for two years, for natural gas it was restricted to one year). This price ceiling, however, has been no longer granted for new customers since the 15th of July 2008 in the case of natural gas and since November 2008 in the case of electricity.

A seemingly similar strategy is being applied by "eprimo" a subsidiary of RWE. This company offers a price ceiling for electricity and additionally a one-time payment of 80 Euros to switching consumers. Note, however, that there is an important difference between the two offers. While "eprimo" directly addresses the problem of switching costs and insures its customers against price increases, it does not guarantee to meet price reductions by the incumbent. As we will show in our analysis such a guarantee is essential to restrain the ability of the incumbent to block further entry by limit pricing.

[1]The other three are RWE, Vattenfall and EnBW. Note that it is important that E WIE EINFACH is backed by a large parent company, as potential customers can therefore be confident that an offer by E WIE EINFACH is reliable.

Concerning entry in local retail markets for electricity and natural gas, the theoretical analysis in our paper tries to answer the following questions:

- Does the strategy of E WIE EINFACH, namely offering to undercut the price of the incumbent by a fixed margin (below referred to as "fixed margin price undercutting"), actually facilitate entry in local retail markets for electricity and natural gas?

- Under what circumstances is "traditional" entry by just offering a lower price than the incumbent likely to be successful? How does it then compare to fixed margin price undercutting?

- How can we explain why E WIE EINFACH initially complemented fixed margin price undercutting by adding a price ceiling but abandoned this strategy later on?

- What is the impact on profits, consumer surplus and welfare if a new firm enters with any of the three entry strategies considered: price competition ("traditional entry"), "plain" fixed margin price undercutting and fixed margin price undercutting with price ceiling?

Beyond this direct application our analysis may also shed some light on the broader issues of entry strategies and of strategic pricing. To emphasize the specific contribution of our paper we will now shortly discuss the economic literature that is dealing with these two questions.

Entry has been a main theme in the literature on industrial organization. However, most papers focus on the question of entry deterrence (see Tirole, 1988, ch. 8 for an overview). The surprisingly scarce literature on entry strategies mostly considers timing of entry decisions by two or more potential entrants (see e. g. Narasimhan and Zhang, 2000), the location decision in settings with horizontal differentiation (see e. g. Neven, 1987), and entry dynamics under vertical differentiation (see e. g. Bergemann and Välimäki, 2002). Only the last paper specifically considers a situation with an incumbent and an entrant. Here entry strategies differ with respect to the aggressiveness of pricing. When the new product is a certain improvement over the existing product, the price at the stage of entry will be below the pricing level in a static equilibrium. However, if it is initially unsure whether the new product is actually an improvement, pricing will be more aggressive. Different entry strategies are also discussed in the literature on foreign direct investment. An example is Görg (2000) who compares the options of a greenfield investment versus the acquisition an existing local firm. However, we are not aware of any contribution to the analysis of entry strategies that specifically considers the option of making the own price be explicitly dependent on the price of the incumbent.

While not being discussed in an entry context, such strategies that are commonly referred to as "price coordination" have been discussed in other settings. These price strategies are often formulated in such a way that customers, after having purchased an object, are given the privilege to receive either a lower price (price–beating) or at least the same price (price–matching) as is offered by the cheapest competitor the customer is able to find. Therefore customers can be separated into two groups by their level of information: sophisticated customers, who do search, and unsophisticated customers, who do not — maybe because of too high searching costs. The seminal paper in this area is Salop (1986), which mainly points out the collusive effects of such price strategies.[2] A more formal analysis of the anticompetitive impact of price–matching was conducted by Doyle (1988), who investigated the possible outcome of monopoly pricing. On the other hand Belton (1987) and Corts (1996) show that meeting competition clauses can actually have pro–competitive effects under specific circumstances. While our analysis focuses on similar aspects, there are some major differences to the classical literature on price coordination. First of all we consider this kind of pricing as a strategy to enter an initially monopolistic market as opposed to a pricing strategy in an oligopoly. A second departure is the importance of switching costs in our analysis (see Klemperer and Farrell, 2007, for a general discussion of the economic impact of switching costs).[3] Finally we also consider the addition of a price ceiling to the price–beating strategy.

The remainder of the paper is organized as follows. We first describe the basic structure of our model (section 2). In section 3 we compare fixed margin price undercutting with price competition in a setting with inelastic demand. The advantage of a price ceiling in the case of elastic demand is derived in section 4, where we also compare the different strategies with respect to their impact on profits and welfare. Section 5 introduces cost shocks and cost uncertainties in order to demonstrate the problems of a price ceiling under such circumstances. Section 6 concludes.

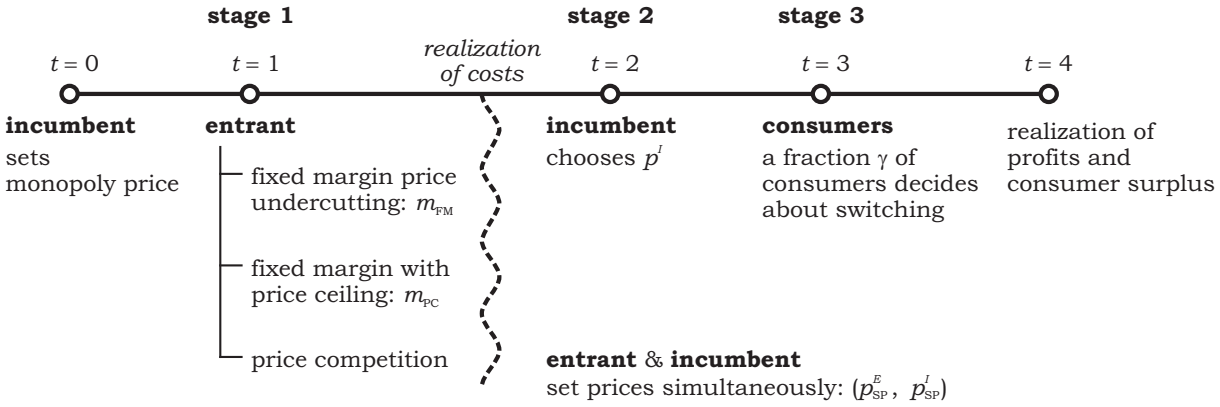
[2]See also Bartholomae and Morasch (2007) who show how the so called oil price indexing of natural gas prices can have similar effects.

[3]We will refer to the relevant papers from the switching cost literature in the course of the discussion of our model.

2 Basic Model

We consider a three–stage game as depicted in fig. 1.[4] There are three players: a monopolistic incumbent (I), an entrant (E) and consumers, who are initially served by the incumbent. Both firms are retailers of a homogeneous product x with inverse demand given by $p(x)$. Hence, price competition between the two firms would result in the well–known Bertrand–paradox if there are no switching costs and procurement costs of both sellers are identical. However, we assume that consumers have to bear switching costs d, resulting in an asymmetry between entrant and incumbent.

Figure 1: Time structure of the model: Players and strategies



With the exception of the second stage under price competition this is a game of perfect information which therefore may be solved by backward induction. In the first stage the entrant has to choose between three different entry strategies:

- **Strategy FM** The first option is to undercut the incumbent's price by a fixed margin. This margin will be maintained if the incumbent changes its price in the second stage, resulting in a price $p^E_{FM}(p^I) = p^I - m_{FM}$.

- **Strategy PC** The entrant may supplement the margin by a price ceiling that is determined by the monopoly price p^M and the chosen undercutting margin. This implies that the entrant cannot increase its price if the incumbent chooses a price above the initial monopoly price (either due to rising procurement costs or strategic considerations). However he is obliged to lower his price to maintain the initially

[4] Note that $t = 0$ describes the initial situation with a monopolistic incumbent. While the monopoly price at this point of time is important for the determination of the margin m and the price ceiling, we do not consider this to be an extra stage of the game as it is just assumed that the incumbent charges the monopoly price under the given cost and demand structure. From the point of view of our analysis this monopoly price is therefore just an exogenous variable.

set margin whenever the incumbent's price decreases. The resulting price is thus given by $p^E_{PC}(p^I, p^M) = \min\{p^I - m_{PC}, p^M - m_{PC}\}$.

- **Strategy C** Finally, the new firm can enter the market as a "normal" competitor. In this case he will compete with the incumbent in a simultaneous pricing game in the second stage that yields prices $(p^I_C, p^E_C) = \min\{p^I - m_{PC}, p^M - m_{PC}\}$

Note that the three strategies differ with respect to commitment ability and timing as indicated in fig. 1. As the incumbent may react in stage 2 to any price offer by a "normal" entrant (strategy C) by lowering his own price, it seems to be most sensible to model this situation as simultaneous price setting game. In other words: neither the incumbent nor the entrant can commit themselves to a certain price.[5] In the case of the other two strategies the fixed margin proposed by an entrant ensures that his price is automatically adjusted whenever the incumbent decides to alter his own price. This yields a sequential structure where the entrant sets his margin first and the incumbent optimally reacts to the given margin.

As indicated in fig. 1 there may be cost uncertainties which are assumed to be resolved between $t = 1$ and $t = 2$.[6] As only the distribution of the uncertain costs are known by the entrant in stage 1, he has to form expectations about the procurement costs in order to determine the strategy that maximizes his expected profits. The incumbent will then choose his price in stage 2 based on the actual costs as well as on the entrant's decision. This situation will be analyzed in section 5. Until then we assume for both incumbent and entrant identical and constant average costs for procurement and distribution that are normalized to zero for simplicity.

For all entry strategies we assume in stage 3 that a fraction $\gamma \in (0, 1]$ of all consumers observes the resulting price offers. These consumers decide whether they switch to the entrant or stay with the incumbent. Note that a value of $\gamma < 1$ seems to be sensible description of reality as due to search costs not all consumers will frequently search for competing offers in such markets. The prices that result from the behavior of entrant and incumbent in stages one and two determine realized individual demand for the strategies "switch to entrant" and "remain with the incumbent". Based on this information, a consumer is able to compare her individual net consumer surplus for the two options. If she

[5]Note that the unique equilibrium of the simultaneous game is also an equilibrium of a sequential game where the entrant could commit to its price offer. Both games yield qualitatively identical results insofar as the incumbent will always deter entry by setting a limit price. However, unlike the simultaneous game, the sequential game does not have a unique equilibrium: the entrant may set any price $p^E_C \in [0, p^M - d]$ and the incumbent will react by setting $p^I(p^E_C) = p^E_C + d$ which results in a continuum of equilibria without switching in the given range of prices.

[6]The volatility of procurement costs is particularly pronounced in the market for natural gas. This has to be taken into account by a potential entrant when he chooses his strategy.

switches to the entrant, she obtains the following gross benefit measured as change in consumer surplus:

$$\Delta CS = \int_0^{x^E} p(x)dx - \int_0^{x^I} p(x)dx \tag{1}$$

with x^E indicating the demand at p^E and x^I indicating the demand at p^I. A consumer will only switch if this gross benefit from switching exceeds her switching cost d. Therefore the margin $m^*(p^I)$ that induces her to switch can be calculated from $\Delta CS(m^*) = d$. The exact value of the critical margin depends on two factors: the price charged by the incumbent and the price elasticity of the demand.

Figure 2: Determination of the minimal margin

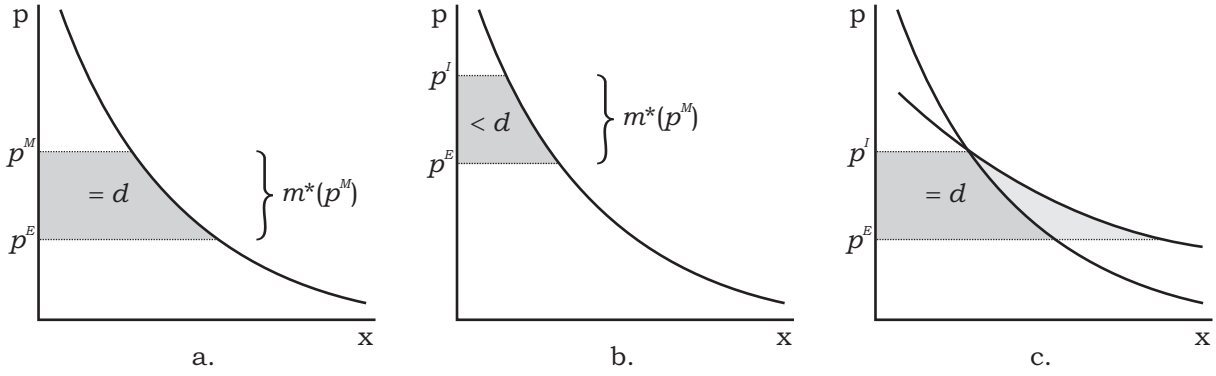


Figure 2 illustrates the impact of these two factors. (i) As long as demand is not completely price inelastic, the higher the incumbent's price, the higher the margin necessary to cover the consumer's switching costs (cf. **a** and **b**). If the entrant chooses the critical margin based on p^M as his strategy in stage 1, the incumbent may prevent switching by raising his price to $p^I > p^M$ in stage 2. (ii) The critical margin is lower for a higher price elasticity of demand: realized demand his higher at any price below the initial price level and therefore a lower margin is sufficient to cover the switching costs. Put differently, as shown in **c**, if we assume that the same amount of x was consumed at the initial price of the incumbent for two different demand functions, the change in consumer surplus for a given margin will be larger for more elastic demand.

3 Entry With Fixed Margin Price Undercutting vs. Price Competition Under Inelastic Demand

In a first step we want to highlight the working of entry by fixed margin price undercutting and compare it to entry with strategy C in a stripped–down model. For simplicity we

assume inelastic demand and identical consumers with a maximum valuation v. In the period considered, each consumer is assumed to buy exactly one unit of the good as long as the price does not exceed her net valuation.[7] Here the minimal margin to induce switching just equals d. Furthermore, we consider at first a situation where $\gamma = 1$, i. e. where all consumers consider switching.

Without competition the monopolistic incumbent maximizes his profit by setting the price to $p^M = v$. Note that in this simple setting the monopolist obtains the complete rent and the market is efficiently served. Therefore, any switching by consumers to the entrant will yield a welfare loss due to switching costs.[8] Under the "traditional" entry strategy we get the well–known results for price competition with asymmetric costs.

Proposition 3.1 (No switching under price competition)
Price competition with switching costs yields prices $p_C^I = d$ and $p_C^E = 0$. All consumers stay with the incumbent.

Proof If the monopolist charges a price $p^I \in [p^M, d)$, the entrant would set a price $p^E = p^I - d - \varepsilon$ with $\varepsilon \to 0$. As a result all consumers would switch to the entrant and the profit of the incumbent would equal zero. The entrant's incentive to charge a lower price can only be avoided if the incumbent lowers his price to $p^I = d$. In order to induce switching, the entrant would then need to reduce his price to $p^E = -\varepsilon$. However, this is not optimal as a price below zero would yield a negative profit. ∎

Note that we observe no entry in this setting, only a reduction in prices due to potential competition. The incumbent blocks entry by applying a limit pricing strategy.[9]

We obtain a completely different result if we assume entry by fixed margin price undercutting. In this case the entrant sets his margin m first, then the incumbent reacts by setting his price p^I, and finally consumers decide about switching based on prices p^I and p_{FM}^E. While the incumbent might still be able to lower his price far enough to induce negative profits for the entrant, the entrant is committed and cannot be driven out of the market. This yields a quite strong result.

Proposition 3.2 (Fixed margin price undercutting is effective)
The entrant sets m marginally greater than d. The incumbent stays at price p^M and all consumers switch to the entrant. The entrant earns a surplus $p^M - m$ per consumer.

[7] To be precise, the demand is thus inelastic only in $p \in [0, v]$.

[8] Klemperer (1988) shows in a more general setting with elastic demand that entry may reduce welfare in the case of switching cost.

[9] An early discussion of this concept can be found in Bain (1949). See Klemperer (1987) for limit pricing in a switching cost context and for a short discussion of other more recent attempts to model limit pricing.

Proof In order to induce consumers to switch, the margin m has to be greater than the switching costs d. Therefore the entrant will set his margin at $m = d+\varepsilon$, with ε arbitrarily close to zero. If the monopolist faces this strategy, he cannot improve his situation by changing the price relative to the pre–entry value p^M. Reducing his price would just lower the entrant's price by the same amount. As the margin m stays constant and exceeds the switching costs, all consumers are going to switch to the entrant. ∎

While trying to enter the market in the traditional way is not a successful strategy, fixed margin price undercutting not only allows the entrant to enter the market, but also ensures the largest feasible profit for him. Note, however, that entry does not actually yield competition, since the incumbent is just replaced by the entrant and thus entry is only beneficial to the entrant himself. While the price is below the monopoly value, consumer surplus remains unchanged as consumers have to bear the switching costs.

The results obtained are quite extreme in some respects. This partially stems from unrealistic assumptions, which shall be relaxed in the further analysis. In the given setting either all consumers stay with the incumbent or all switch to the entrant. In reality, only a fraction of the consumers is likely to switch, which may be either due to differences in switching costs or in the consumers' awareness of a competing supplier. Modeling differences in switching costs would not only greatly complicate the analysis, but also introduce a mostly non–observable exogenous parameter. An easier way to — at least partially — handle the problem, is the assumption that at a given point of time only a fraction of all consumers contemplate about changing their supplier. This seems to be in line with empirical observation and is sufficient to produce results that are far less extreme.

If we assume that only a fraction γ of all consumers switches, equilibrium strategies for fixed margin price undercutting remain unchanged. As a result γ consumers will switch to the entrant while $1-\gamma$ will stay with the incumbent. Things get a little bit more complicated with traditional entry. Here, the limit pricing strategy of the incumbent is no longer optimal for small γ. As a pure Nash-Bertrand equilibrium does not exist under these circumstances, we follow Shy (2001) and assume that equilibrium price strategies fullfil the conditions for an undercut–proof equilibrium (see Shy, 2001, pp. 307 ff.).[10] Proposition 3.3 summarizes the results for the two strategies:

Proposition 3.3 (Limited switching under price competition)
The equilibrium strategies under fixed margin price undercutting do not depend on γ and

[10] Alternatively we could have assumed that the entrant chooses its price first and is then commited to this offer. As discussed above, we decided to assume a simultaneous game in order to obtain a unique equilibrium in the limit–pricing game.

are given by $m = d + \varepsilon$ *and* $p^I = p^M$*. However, under price competition the incumbent will only choose the limit price* $p^I = d$ *as long as* $d > (1-\gamma)v$*. If switching costs are lower, the incumbent stays at the monopoly price and the entrant enters the market with price* $p_C^E = (1-\gamma)v - d$*.*

Proof The proof of proposition 3.2 for fixed margin price undercutting can be applied directly to the case with $\gamma < 1$. For price competition we have to compare the profit of the incumbent in a situation where he does not change the initial (monopoly) price to the situation where he decreases his price to prevent entry (limit pricing). Any price between those two boundaries would only decrease the incumbent's profit (since a price decrease affects all intra–marginal units sold as well) without having any impact on the decision of consumers (as the entrant would still enter the market). Hence, we get

$$p_C^I = \begin{cases} v & \text{for } \gamma \leq (v-d)/v \\ d & \text{for } \gamma > (v-d)/v \end{cases}, \tag{2}$$

implying profits of $(1-\gamma)v$ and d, respectively. The entrant will choose his price according to

$$p_C^E = \max\{0, (1-\gamma)v - d\}, \tag{3}$$

where a price of 0 implies that the entrant stays out of the market (and the incumbent chooses a price of d). For any positive value of p^E the entrant obtains profits $[(1-\gamma)v - d]\,\gamma$. The entrant will not choose a price $v - d$ since in this case a marginal decrease in the incumbent's price to $v - \varepsilon$, with ε arbitrarily close to zero, would only marginally decrease the incumbent's profit, but would prevent customers from switching. Hence (3) is the highest price the entrant could set if he wants to ensure that the incumbent is not going to react (as long as $d > (1-\gamma)v$) — this is exactly what is required for an undercutproof equilibrium. ∎

Note that the price chosen under traditional entry is pushed downward due to the incumbent's threat to lower his price (slightly) below p^M in order to avoid switching of consumers. Nevertheless, the difference between strategies FM and C is mitigated in this modified setting, as entry in the traditional way may now be feasible.[11] Note, however, that fixed margin price undercutting is always at least as profitable as the traditional entry strategy.

[11] This is related to the more general result that small scale entry is usually relatively easy in settings with switching cost. See Klemperer (1987) as the seminal paper and Klemperer and Farrell (2007) for an overview.

Finally, we analyze which of the two strategies is preferable from the consumers' point of view. While in the case of price competition under certain conditions no market entry occurs, market entry by the entrant will always be successful in the case of price undercutting. However, it can be shown that even potential price competition without actual entry is favorable for consumers since in this situation they benefit from lower prices due to limit pricing by the incumbent without having to bear the switching costs.

Proposition 3.4 (Price competition is favorable for consumers)
Consumers considering switching almost always strictly gain by potential as well as actual market entry with price competition. By contrast, beyond the arbitrarily small ε payed to induce switching, fixed margin price undercutting does not have any positive impact on consumer surplus in a setting with inelastic demand.

Proof From proposition 3.3 we know that the incumbent will choose the limit price if $d > (1-\gamma)v - d$. As long as entry is not blocked by the initial monopoly price, p^I will be smaller than p^M and the price reduction of the incumbent makes all consumers better off. If $d \leq (1-\gamma)v - d$, the fraction $\gamma < 1$ of the customers that considers switching actually switches to the entrant and pays a price $p_C^E = \max\{0, (1-\gamma)v - d\}$. If this price is above zero, switching consumers strictly gain as $(1-\gamma)v - d$ is smaller than $v - d$ for $gamma < 1$.

In the case of a fixed margin all consumers that consider switching actually switch to the entrant and pay $p^M - m = v - d - \varepsilon$ (see proposition 3.2). However, when abstracting from the arbitrarily small payment of ε, net consumer surplus remains unchanged, as switching customers have to pay their switching costs d. ∎

In the following section we relax the assumption of inelastic demand and turn to the more realistic case where individual demand reacts elastically to price changes.

4 Advantage of Price Ceiling Under Elastic Demand

Assuming inelastic demand helped to highlight the difference between fixed margin price undercutting and traditional price competition. However, this assumption is quite restrictive insofar as the incumbent is not able to affect the critical margin by adjusting his price in the setting with inelastic demand . Therefore we will now generalize our analysis by considering a specification with elastic demand. Here the incumbent would have an incentive to prevent switching by slightly raising his price in stage 2 if the entrant has chosen his margin based on the initial monopoly price (see figure 2).

In the setting with elastic demand we will now deal with the following questions:

- Does the incumbent actually increase his price in equilibrium or is the entrant able to adjust his margin to counteract this incentive?
- How does the introduction of a price ceiling by the entrant affect the size of the margin and the price set by the incumbent in the second stage?
- Is traditional entry with price competition still inferior to fixed margin price undercutting? Is there any advantage in introducing a price ceiling?
- What can be said about the impact of the three entry strategies on welfare?

To keep the formal analysis as simple as possible we assume identical linear inverse demand functions $p(x) = 1 - x$ for each individual consumer. As procurement and distribution costs are still normalized to zero, the monopoly price in this setting is given by $p_M = 1/2$. According to (1), the gross change in consumer surplus when switching to the entrant is given by

$$\Delta CS = \left(1 - p^I + \frac{m}{2}\right) m. \tag{4}$$

If the incumbent sets the price equal to the monopoly price, $p^I = p^M$, this equation simplifies to $m(1+m)/2$. For given switching costs d we can derive the minimum margin necessary to attract consumers for any given price of the incumbent:[12]

$$m^* = \sqrt{\left(1 - p^I\right)^2 + 2d} - \left(1 - p^I\right). \tag{5}$$

As before we assume that a consumer switches only if her gain from switching at least equals her switching costs d. If the incumbent sets the monopoly price, the minimum margin is given by

$$m^* = \frac{\sqrt{1 + 8d} - 1}{2}. \tag{6}$$

To determine the subgame perfect Nash–equilibria we use backward induction. While the decision problem of a consumer in stage 3 is still straightforward, the analysis of the price setting behavior of the incumbent in stage 2 becomes more intricate under elastic demand. Contrary to the case of inelastic demand, the incumbent now has the possibility to react to the margin set by the entrant and in turn to deter consumers from switching. However, unlike the situation under price competition, the incumbent does not reduce his price to prevent entry in the case of strategy FM. Instead he has an incentive to raise the price to reduce the advantage of a switching consumer for the given margin.[13] While

[12] Figure 2 illustrates how the critical margin is determined.

[13] Lowering the price would not help as the entrant is not commited to the price but to his margin and a given margin will result in a higher change in consumer surplus if p^I is reduced.

the potential reactions of the incumbent go in different directions for fixed margin price undercutting and entry with traditional price competition, respectively, the impact on the price of a successful entrant is similar. To prevent any of the two forms of limit pricing, the entrant must charge a lower price than $p^M - d$ (either through directly reducing the own price or by choosing a higher margin).

We first consider fixed margin price undercutting. Since the incumbent observes the entrant's decision about the margin, he could react by choosing a price that is high enough to deter his customers from switching. Hence, the entrant has to take this into account when setting the margin. Therefore the margin must not only be high enough to attract consumers, but also deter the incumbent from choosing a price above p^M. To calculate this critical value of the margin, we must first determine the price $p^I_{\max}$ at which the profit of the incumbent is just as high as if he had sticked to the monopoly price and accepted to loose γ of his customers to the entrant. In general, the underlying condition is given by

$$(1-\gamma)p^M x(p^M) = p^I_{\max} x(p^I_{\max}) \tag{7}$$

and for our linear example solving for $p^I_{\max}$ results in

$$p^I_{\max} = \frac{1+\sqrt{\gamma}}{2}. \tag{8}$$

If the margin is set high enough that consumers still switch to the entrant at $p^I_{\max}$, the incumbent prefers to charge the monopoly price to its remaining $(1-\gamma)$ customers instead of blocking entry by charging a price slightly above $p^I_{\max}$. To obtain the critical margin we must insert $p^I_{\max}$ in equation (5). This results in

$$m^{\text{crit}}_{\text{FM}} = \frac{1}{2}\left(\sqrt{8d + (1-\sqrt{\gamma})^2} - 1 + \sqrt{\gamma}\right). \tag{9}$$

As long as $p^M - m_{\text{crit}} > 0$, entry with strategy FM is profitable. The resulting profit per switching consumer is then given by

$$\pi^E_{\text{FM}} = \frac{1}{4}\left[2(1-\sqrt{\gamma})\sqrt{8d + (1-\sqrt{\gamma})^2} - (1 + 8d - 4\sqrt{\gamma} + 2\gamma)\right]. \tag{10}$$

We can now answer the first question raised above. In equilibrium the incumbent does not charge a price above the monopoly price, because the potential entrant either sets a margin that makes blocking entry unprofitable for the incumbent or refrains from entering if entry with the critical margin yields negative profits.[14]

[14]There exists a parameter range where entry with the critical margin is not profitable, but the potential entrant could set a lower margin which induces the incumbent to react with a (profitable) price increase

By adjusting the margin appropriately, entry with fixed margin price undercutting is still feasible under elastic demand as long as switching costs are not to high and/or the share of consumers that consider switching is not to large. However, profits are substantially reduced relative to the situation where the margin maus only be high enough to cover switching costs. We will now turn to question two and show that adding a price ceiling renders an adjustment of the margin unnecessary. The price ceiling deprives the incumbent of his strategy to block switching, because increasing his price no longer reduces the change in consumer surplus as the price of the entrant remains fixed. Note that prices will still be adjusted downward like in strategy FM if the incumbent charges less than the monopoly price. Lowering the price is therefore also not profitable for the incumbent. Hence, the entrant sets the optimal margin to m^* as determined in (6). This margin is just high enough to induce switching at the initial monopoly price. By doing this he earns

$$\pi^E_{\text{PC}} = \frac{1}{4}\left[2\sqrt{8d+1} - (1+8d)\right] \tag{11}$$

from each switching consumer. By comparing (11) with (10) it could be shown that π^E_{PC} exceeds π^E_{FM} in the relevant parameter range for γ and d. However, it is even possible to derive a more general result that is not restricted to the linear specification.

Proposition 4.1 (Dominance of price ceiling)
In a setting with a downward sloping demand curve the incumbent has an incentive to prevent market entry by increasing his price in $t = 2$. The entrant can avoid this price increase either through setting a higher margin or by choosing a price ceiling. In both cases the equilibrium strategy of the incumbent is to charge the monopoly price. However, as the strategy with price ceiling entails a lower margin, it dominates fixed margin price undercutting without a price ceiling.

Proof Under fixed margin price undercutting the entrant has to account for the incumbent's reaction when choosing the margin. With downward sloping demand the incumbent could reduce the change in consumer surplus for a given marging by raising his price. The optimal margin must therefore be based on a price that is high enough to make the incumbent just indifferent between selling to all consumers at this price and charging the monopoly price to the remaining $(1-\gamma)$ customers who do not consider switching. This is not necessary with a price ceiling where the margin could be set according to the monopoly price. Since the chosen level of the margin is higher under "pure" fixed margin

that blocks entry. Formally there exist multiple equilibria with zero profit for the entrant in this parameter range. However, because refraining from entry results in the same profits for the entrant as an (unsuccessfull) attempt to enter the market, we rule out these pareto dominated equilibria as unreasonable.

price undercutting than under the strategy with price ceiling, the corresponding profits under strategy FM are lower. If switching costs are low enough to ensure positive profits for the entrant under both strategies, the consumers that consider switching actually switch to the entrant in equilibrium under both strategies, as the incumbent has either no incentive (fixed margin price undercutting) or no possibility (price ceiling) to prevent them from doing so. ∎

Looking at the formulas for the profits under the two strategies shows an interesting difference. Under a price ceiling the profits per switching consumer are independent of the share of consumers that consider switching, whereas in the case of fixed margin price undercutting the profits decreases with increasing γ. The intuition behind this is simple: The more consumers are willing to switch to the entrant, the more aggressively the incumbent will react, i. e. the higher the price he will set in order to keep his customers which in turn implies the necessity of a higher margin. In contrast, under price ceiling the incumbent cannot react. The margin corresponds exactly to the switching costs and is therefore independent of γ.

In a next step we will now take a look at the traditional entry strategy. While this strategy has been shown to be inferior to fixed margin price undercutting in the setting with inelastic demand, the situation is different under elastic demand as the incumbent could in principle limit entry under both strategies as long as no price ceiling is introduced. Therefore we will now check whether fixed margin price undercutting is still the preferable entry strategy.

If the entrant decides to enter the market as a normal competitor, the information structure in stage 2 of the game changes from perfect to imperfect information, i. e. both competitors decide simultaneously about their price strategies. In this situation the incumbent has two options: he can either retain the monopoly price or, in order to keep the entrant out of the market, he can set a limit price. In turn the entrant must undercut the incumbent to compensate the consumers for their switching costs. The margin necessary to undercut the incumbent is given by (6), which results in an optimal price

$$p_C^E = 1 - \sqrt{(1-p^I)^2 + 2d}, \tag{12}$$

yielding a profit per switching consumer of

$$\pi_C^E = \left(1 - \sqrt{2d + (1-p^I)^2}\right) \sqrt{2d + (1-p^I)^2}. \tag{13}$$

This profit depends positively on p^I, i. e. a decrease in the incumbent's price lowers the entrant's profit (strategic complements). Taking this into account we can calculate the

limit price of the incumbent, p_L^I. This price is chosen to turn the entrant's profits negative, i. e. to fulfill the condition $\pi_C^E(p_L^I) = 0$. Hence, we get

$$p_I^L = 1 - \sqrt{1-2d}, \tag{14}$$

resulting in incumbent profits under limit pricing of

$$\pi_L^I = \begin{cases} \sqrt{1-2d} - (1-2d) & \text{for } d \leq 0.375 \\ 0.25 & \text{for } d > 0.375 \end{cases}. \tag{15}$$

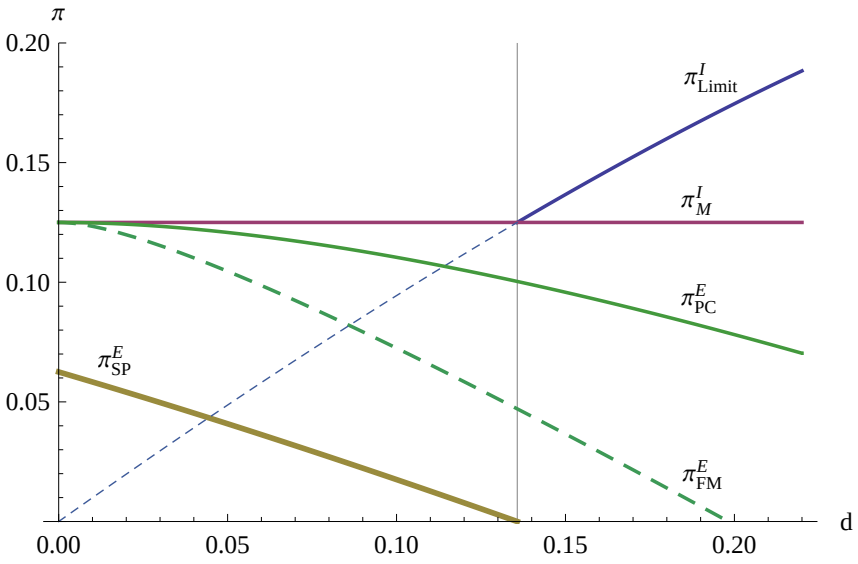
For values of $d > 0.375$ the monopoly price is sufficient to keep the entrant out of the market and hence the limit price would be higher than the monopoly price. Note that under limit pricing both price and profit are independent of γ. The incumbent chooses limit pricing as long as the profits from serving all customers at a lower price is larger than keeping only $1-\gamma$ at the higher monopoly price. The entrant has to account for this and has to choose a price, where the monopolist is just indifferent between serving the remaining $1-\gamma$ customers at the monopoly price (earning $(1-\gamma)\pi_M^I = (1-\gamma)/4$) or keeping all customers at the lower limit price π_L^I. The profit of the entrant from this price strategy is given by

$$\pi_C^E = \frac{1}{2}\sqrt{8d + (1+\sqrt{\gamma})^2} - \frac{1}{4}(1+\sqrt{\gamma})^2 - 2d. \tag{16}$$

Figure 3 shows for a given γ how the profits of the different entry strategies depend on the level of the switching costs d. The figure not only illustrates the results obtained until now but is also intended to make it easier to understand the arguments in the proof of the following proposition which states the general inferiority of entry with strategy C. Because this enables us to directly compare the profits of incumbent and entrant, we have chosen $\gamma = 0.5$ (under successful entry profits of incumbent and entrant would then be identical if both charge the same price). Note that we depict average profits per consumer in the figure, i. e. profits per consumer — except the one under limit pricing — are divided by two because only half of the consumers are served by each firm.

Let us first consider entry with strategy C. As we can see from the figure, limit pricing by the incumbent is unprofitable if $d < 0.136$, i. e. $(1-\gamma)\pi_M^I > \pi_L^I$. In this parameter range the incumbent decides to charge the monopoly price and the potential entrant enters the market as he earns positive profits by charging p_C^E. Note, however, that even for $d = 0$ profits π_C^E are substantially smaller than π_M^I and profits of the entrant further decline with rising switching costs. If $d > 0.136$ the incumbent favors limit pricing and thus prevents entry under price competition. Due to potential entry the incumbent will set a price below the monopoly price until $d > 0.375$ (not shown in the figure). Here the monopoly price is already sufficient to keep the potential entrant out of the market.

Figure 3: Average profits per consumer for the three entry strategies (at $\gamma = 0.5$



If the entrant enters with either FM or PC, the incumbent will always charge the monopoly price. As has been proved, profits under fixed margin price undercutting are always lower than under the strategy with price ceiling. Note that profits of entrant and incumbent are identical for $d = 0$: the entrant sets an arbitrarily small margin and therefore earns full monopoly profits from each switching consumer. As the profits of the entrant decline when switching cost increase, there exist values of d where profits would become negative and the entrant will therefore refrain from entry. For strategy FM the critical value is given by $d = 0.198$ while under PC the entrant enters until switching costs reach $d = 0.375$. Note that at the latter value entry is blocked anyway because switching costs are as high as the area below monopoly price line and inverse demand curve.

The results displayed in figure 3 suggest that strategy FM might be generally superior to strategy C. However, note that the curve for π^E_C is substantially flatter than the curve for π^E_{FM} and for lower values of γ profits π^E_C per consumer are much closer to the monopoly profits for small switching costs. While we are not able to demonstrate that strategy C is generally inferior to FM in the case of elastic demand, we can prove this fact for the given linear setting.

Proposition 4.2 (Entry strategy FM dominates C for linear demand)
In a setting with linear demand and identical and constant average costs the entry with fixed margin price undercutting yields always higher profits than entry with price competition.

Proof Subtracting profits under strategy C (equation (16)) from the profits under strat-

egy FM (equation (10)) and trying to simplify the resulting expression yields a still quite complicated formula. It is not possible to decide directly whether this expression is positive in the relevant parameter range. Based on the basic understanding obtained from the analysis for $\gamma = 0.5$, we will therefore prove the proposition in a more indirect way. We show that profit schedules $\pi^E_{\mathrm{FM}}(d)$ (like the one displayed in figure 3) lie above $\pi^E_C(d)$ for each $\gamma \in (0, 1]$. This is achieved by demonstrating that $\pi^E_{\mathrm{FM}}(d)$ intersects both the profit axis and the d-axis at higher values than $\pi^E_C(d)$ and by proving that the two profit schedules do not cross each other between their intersection points with the two coordinate axes.

By inserting $d = 0$ into the formulas for the profits and simplifying it can directly be seen that profits per consumer for fixed margin price undercutting are higher for zero switching costs as long as $\gamma > 0$ ($\pi^E_{\mathrm{FM}}(d = 0)$ coincides with the monopoly profits while the profits under entry with price competition are strictly lower). In a similar fashion we can derive that entry under price ceiling becomes generally unfeasible for lower switching costs (at $1/8(3-2\sqrt{\gamma}-\gamma)$ instead of $1/8(3-2\sqrt{\gamma})$ under fixed margin price undercutting). Finally, by applying the "Reduce"–unction in Mathematica on $\pi^E_{\mathrm{FM}}(d, \gamma) - \pi^E_{\mathrm{C}}(d, \gamma) = 0$, it can be shown that for values of d in the relevant range between 0 and 0.375 the two profit functions only intersect at $d = 3/8 - 3/32\gamma$. However, this is larger than $d = 3/8 - 1/8\gamma - 1/4\sqrt{\gamma}$, the value of d where entry is blocked by limit pricing. Thus the two profit schedules do not cross in the relevant area with positive profits. ∎

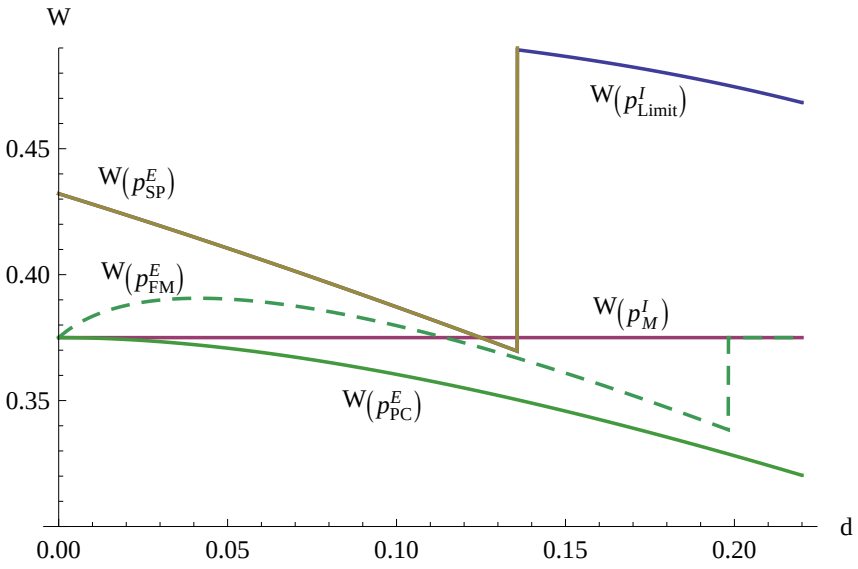
Finally, we are going to consider the welfare impact of the different strategies. Again we try to give a basic impression of the results by displaying them graphically. Figure 4 shows total surplus W (consumer surplus + producer surplus − switching costs) as a function of switching costs d for $\gamma = 0.5$.

Total surplus under monopoly ($W = 0.375$) serves as a reference point. Entry with price competition is most likely to improve welfare. Total surplus will be only reduced if switching costs are very close to the critical value without entry ($0.125 < d < 0.136$). The positive welfare impact is particularly pronounced for switching costs slightly above this threshold value as the threat of entry holds the limit price down (a positive impact is given for $0.136 < d < 0.375$) and thus consumers can benefit from the lower price without having to switch.[15]

If the entrant chooses to enter the market by using fixed margin price undercutting, total surplus increases compared to the monopoly case as long as $d < 0.114$. However, due to the fact that consumers now have to bear the switching costs and the price set by the entrant is still higher than under entry with price competition, the welfare improvement

[15]Note that entry with price competition will increase welfare for any switching cost for relatively high values of γ while the area with a negative impact becomes larger for small γ.

Figure 4: Total surplus for the three entry strategies (at $\gamma = 0.5$)



is not that pronounced. For switching costs between $0.114 < d < 0.198$, choosing the fixed margin strategy has even adverse effects. As noted above, for values of d beyond 0.198 no entry takes place. Based on the results for profits, it is straightforward to show that entry with fixed margin price undercutting generally yields lower total surplus than entry with price competition.

Finally, the price ceiling strategy always leads to a reduction i total surplus. Here, the entrant's margin is set exactly at a level that is just high enough to induce switching by consumers. Therefore net consumer surplus remains unchanged, and because the price of the entrant is below the price of the incumbent, producer surplus will be reduced. This result can be generalized beyond the linear example to a setting where the inverse demand curve is downward sloping and the cost–demand structure ensures that the marginal cost curve intersects the marginal revenue curve from below (this guarantees that the profit maximization problem of the monopolist is well defined).

Proposition 4.3 (Welfare declines under price ceiling) *Entry with the price ceiling strategy reduces welfare relative to the initial monopoly situation if marginal costs of incumbent and entrant are identical and non–increasing.*

Proof As a monopolist the incumbent sets his price in a way that maximizes his profits and thus producer surplus. Any divergence from the monopoly price leads to a decrease in producer surplus. Under the price ceiling strategy the entrant sets the margin in way that consumers are just compensated for their switching costs. Therefore net consumer surplus does not change. Furthermore, as the entrant charges a lower price than the incumbent,

producer surplus on the market level decreases relative to the situation before entry. As consumer surplus remains unchanged under the price ceiling strategy and producer surplus is reduced, total surplus decreases. Non–increasing marginal costs ensure that splitting production among entrant and incumbent does not reduce average costs which could possibly undo the negative impact of incuring the switching costs. ∎

To sum up, while entry with price ceiling is the dominant strategy for the entrant and fixed margin price undercutting dominates entry with price competition, the ranking of entry strategies from a welfare point of view is just the other way round. Beyond that, entry under fixed margin price undercutting with a price ceiling — the entrant's best choice — does not only generate lower welfare than the other two entry strategies but also reduces total surplus relative to the initial monopoly situation.

5 Cost Shocks and Cost Uncertainty

How are our results affected if we allow for a change in marginal costs c between $t = 1$ and $t = 2$? To analyze this question we will first discuss the impact of an unforeseen cost shock. In this case the strategies are chosen optimally for the initial situation and we can check whether they are robust. Generally speaking this is the achilles heel of strategies with commitment because flexibility is valuable when things are changing. However, it should be noted that fixed margin price undercutting somehow combines commitment with flexibility as the price of the entrant is bound to the price of the incumbent which will be adjusted if costs change. Under cost uncertainty, the strategies are assumed to be chosen to maximize expected returns. As will be seen this does generally not coincide with choosing the optimal strategy for expected costs.

Note that the nature of decisions in the second stage game under entry with price competition is not affected by cost shocks or cost uncertainty because prices are chosen at a point of time at which actual costs are already known. Therefore we can no longer expect to obtain a general result for the ranking of strategy C vs. strategies FM and PC as in section 4. We will not formally deal with this issue but restrict attention to the question whether PC still dominates FM (to possibly find an explanation why PC is no longer used by E WIE EINFACH). However, based on our result under certain costs, we can conjecture that price competition is likely to be generally superior to FM for values of γ very close to 0 (where profits are almost identical under certainty); for small switching costs C may then even be better than PC. For larger values of γ the disadvantage of entry with price competition seems to be too pronounced to change the ranking for realistic dimensions of cost shocks or cost uncertainty.

Again, we may illustrate our analysis with the help of a numerical example based on

the linear demand system introduced in section 4. To deal with cost shocks and cost uncertainty we need to include procurement costs c in our formulas for linear demand (until now we have normalized these costs to zero). The monopoly price is then given by $p_M = (1+c)/2$. The formula for $p^I_{\max}$, the highest price where blocking entry yields higher profits for the incumbent then selling at the monopoly price to the remaining $1-\gamma$ customers, changes to

$$p^I_{\max} = \frac{1}{2}\left[1 + \sqrt{\gamma} + c(1-\sqrt{\gamma})\right]. \tag{17}$$

Note that this value is strictly increasing in c. The critical margin for the entrant under fixed margin price undercutting, which depends on $p^I_{\max}$ and thus on the level of realized costs, changes accordingly.

$$m_{\text{crit}} = \frac{1}{2}\left[\sqrt{8d + (1-\sqrt{\gamma})^2(1-c)^2} - (1-\sqrt{\gamma})(1-c)\right]. \tag{18}$$

It is easy to see that for $c = 0$ equations (17) and (18) simplify to (8) and (9) respectively.

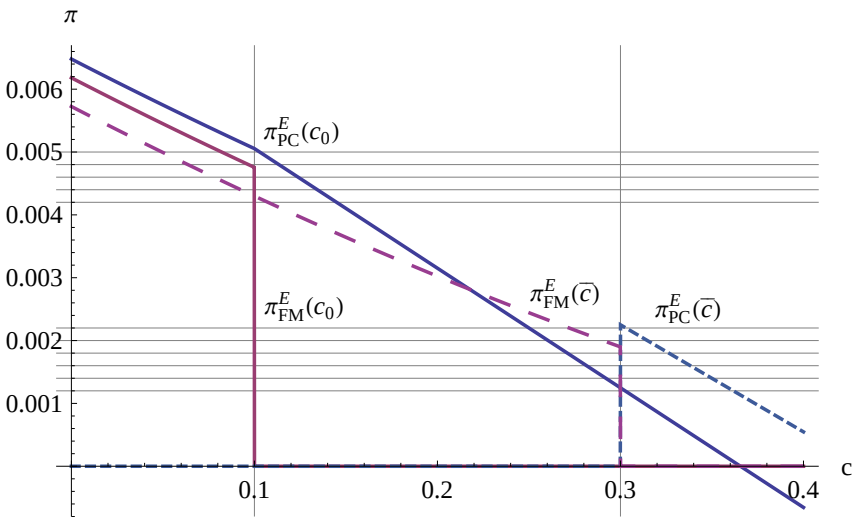
What happens if the firms have to face an unforeseen cost shock, i. e. if costs are $\hat{c}$ instead of the initial value c^0?

- If costs are reduced relative to c^0, the outcomes under both FM and PC are affected in the same manner. As the incumbent reduces its price from $\pi^M(c^0)$ to $\pi^M(\hat{c})$, prices of the entrant decrease accordingly. As the price $p^I_{\max}$ is lower for smaller costs, the margin that has optimally been chosen for $c^0 > \hat{c}$ still ensures that the incumbent has no incentive to block entry of a firm with strategy FM. Because the change in consumer surplus for a given margin gets higher with lower prices, it is also ensured that consumers will switch. While profits are lower than in the case where margins are set optimally according to $\hat{c}$ (i. e. without a price shock), both strategies are robust in the sense that firms still enter and even earn higher profits than at initial cost levels (prices are lower than costs and the price reduction yields higher sales). Note also that strategy PC still dominates FM as the margin is higher under the latter strategy.

- A cost increase induces the incumbent to set a higher monopoly price and the critical price $p^I_{\max}$ rises as well. Under strategy PC the price ceiling leads to a price that is fixed at the initially planned level, while it is the margin that remains unchanged under FM. With a fixed price of the potential entrant the actual margin will increase and a change in consumer surplus that exceeds the switching costs is ensured. However, entry under fixed margin price undercutting without a price ceiling will be blocked as the margin is no longer high enough to cover the switching costs. Therefore strategy PC is again preferable to FM as long as the costs do not rise so much as to induce losses at the price ceiling.

As before we try to graphically illustrate our results. This is done in figure 5, where we display profits for strategies FM and PC for different realizations of c. Note, however, that such a graphical representation is less generaly now: we not only have to assume some share γ of costumers who consider switching but must also set the switching costs d to a specific level and choose an initial value of procurement costs c^0. We tried to select values for these parameters that yield curves where the results are easily visible and where we can discuss both the setting with cost shocks and with cost uncertainty. After trying different values, we found that assuming $\gamma = 0.03$, $d = 0.1$ and $c^0 = 0.1$ worked best for this purpose. Generally the profits for FM and PC must be relatively close together to make our point when dealing with cost uncertainty. This could have been also achieved with lower switching costs and higher γ, but in this case the curves would have been very close to each other which would have compromised the visibility of the outcomes.

Figure 5: Comparison of entry strategies FM and PC under cost shocks and cost uncertainty (profits as a function of realized costs at $\gamma = 0.03$, $d = 0.1$ and $c^0 = 0.1$)



Let us now consider the case with cost uncertainty. The difference to the cost shock lies in the fact that the entrant can anticipate the possibility of changing costs and may choose a strategy that is better suited to deal with the cost uncertainty. This is particularly important for strategy FM: by setting a higher margin the potential entrant could secure entry for costs that exceed the initial value. While the actual realization of the costs is still not known to the entrant, we assume that there exists a probability distribution for these costs ex ante. For a given probability distribution the optimal strategy that balances the effects for the different possible cost realization can be found.

In the case of fixed margin price undercutting the optimal choice implies a cost $\tilde{c}$ where the margin is just high enough to guarantee entry (for $c > \tilde{c}$ the incumbent will block

entry). The profits of the entrant can then be written based on c, the actual realization of procurement costs, and on $\tilde{c}$:

$$\pi^E_{FM}(c,\tilde{c}) = \begin{cases} \pi^E_{FM}(c, m(\tilde{c})) & \text{for } \tilde{c} \geq c \\ 0 & \text{for } \tilde{c} < c \end{cases}. \tag{19}$$

Given that profits are zero for costs above $\tilde{c}$, the entrant has an incentive to set the margin strictly above the value that would result for expected costs. Actually we checked via simulations that even for probability distributions with low weight on the tails (but definite bounds $\underline{c}$ and $\overline{c}$]) like the triangular distribution, $\tilde{c}$ is quite close to the upper bound $\overline{c}$.

In the case of strategy PC the margin will be set according to the initial monopoly price, as this price is the reference point for the price ceiling. While a lower margin than $m^*(c^0)$ would yield higher profits for lower as well as higher costs, setting such a margin is quite costly as entry would be blocked for costs close to the initial value c^0. Given this, we will generally assume that under cost uncertainty the firm sets the margin $m^*(c^0)$ under strategy PC. Assuming that the potential entrant chooses the margin optimal with respect to the initial situation the price under strategy PC is then given by $\pi^E_{PC}(m^*(c^0), c)$. However, when proving that price ceiling is no longer assured to dominate strategy FM under cost uncertainty by a specific example, we explicitly check whether the chosen margin is optimal. Particularly if costs are expected to increase substantially in $t = 2$, the entrant faces a severe problem as he cannot react with a price increase (what would be the profit maximizing reaction if costs rise). In this case strategy PC is likely to yield lower profits than strategy FM and can even lead to losses.[16]

Proposition 5.1 (Cost shocks and cost uncertainty)
Strategy PC dominates FM for an unforeseeable cost shock as long as costs do not rise so much as to yield negative profits under price ceiling. Under cost uncertainty price ceiling may yield lower profits even in cases where market entry is assured for all possible cost.

Proof We already argued above that strategy PC dominates FM in the case of cost shocks as long as the price ceiling strategy results in positive profits. The margin is lower under price ceiling and unlike for strategy FM market entry is still ensured when costs are rising. However, if cost shocks are very pronounced entry with strategy PC may result in negative profits while profits with strategy FM are always non–negative (actually they are zero in the cases with negative profits under PC because entry is blocked).

[16]Note that losses may only result ex post as the margin could be adjust to ensure positive profits in expectation.

For the case with uncertainty we can show that expected profits under strategy FM may be positive and exceed expected profits under PC. To prove the failure of dominance by PC it suffices to find a counterexample. Such an example can be constructed based on the setting displayed in figure 5. Assume a discrete probability distribution with a probability of 1/3 for the initial value $c^0 = 0.1$ and probability 2/3 for the high cost outcome $\overline{c} = 0.3$. By looking at the figure and comparing the values for $\pi^E_{FM}(m^*(c^0), c)$ and $\pi^E_{FM}(m^*(\overline{c}), c)$, respectively, it can be seen that the margin under strategy FM should be based on the higher cost realization (the resulting loss in profits at realization c^0 is small relative to the complete loss in profits under $\overline{c}$ due to blocked entry). On the other hand it does not make sense to avoid the low profit outcome under strategy PC by setting the margin based on $\overline{c} = 0.3$ because this would imply that the firm stays out of the market at c^0. Finally, comparing the advantage of PC at c^0 with the advantage of FM at $\overline{c}$ and weighting it with the probabilities shows that FM yields higher profits in expectation. This proves that the dominance of strategy PC is no longer assured under cost uncertainty. ∎

These considerations might explain why "E WIE EINFACH" abandoned the price ceiling strategy in an environment with drastically rising procurement costs as has been the case specifically in the market for natural gas in 2007 and 2008. The argument is reinforced by the fact that the share of consumers that consider switching is not exogenous in reality but is likely to be particularly high if rising costs force the incumbent to raise prices. Beyond that procurement costs in the market for natural gas can be foreseen by consumers due to oil price indexing. Consumers have then a great incentive to switch to a firm with a price ceiling if increasing oil prices make higher gas prices in the future almost certain.

6 Conclusion

In the introduction we stated four questions. We will now summarize our findings by referring to these questions again.

- We found that fixed margin price undercutting does indeed facilitate entry in settings where the incumbent would otherwise block entry by applying a limit pricing strategy. Such situations have been shown to be most likely if a large fraction of the customers considers switching and/or switching costs are substantial.

- But even if "traditional" entry is successful because the incumbent is better off by accommodating entry and getting monopoly prices from his remaining customers, it is still the case that fixed margin price undercutting yields higher profits for the entrant. This is due to the fact that fixed margin price undercutting directly renders

limit pricing unfeasible, while a firm that is entering in the traditional fashion has to set a price that is low enough to make limit pricing unattractive for the incumbent.

- Beyond that it has been shown that adding a price ceiling even improves the performance of fixed margin price undercutting in settings with elastic demand. While the incumbent cannot use limit pricing, he may be tempted to raise its price above the monopoly level in order to reduce the advantage of switching for a given margin. Without a price ceiling the entrant must take this into account and has to choose an excessive margin to render this kind of strategy unprofitable. This is no longer necessary with a price ceiling because here the margin would be automatically expanded if the incumbent increases his price. While the strategy with price ceiling thus dominates all other options as long as costs are stable, incorporating the price ceiling can have detrimental effects if procurement costs are going to rise substantially as they did in 2008. It is then quite costly to be forced to sell at the low price that results from the price ceiling. In the real world this problem becomes even more severe as consumers may be more eager to switch when prices are going to rise. Therefore E WIE EINFACH might have gotten most of his new customers exactly at a time where the price of the incumbent was still low (triggering a low price ceiling) but a higher price has been already announced.

- To consider the last question let us now return to the case with stable costs. We found that successful entry is more likely with fixed margin price undercutting and that the entrant is always better off with this strategy. However, considering the impact on consumer surplus and welfare, traditional entry is assured to be better in almost all settings: if successful it yields lower prices, if blocked by limit pricing, it avoids switching costs and restricts the market power of the incumbent. While the entry strategy of E WIE EINFACH yields a higher probability of entry, a positive impact on welfare relative to the situation with a monopolistic incumbent is not generally assured. The performance is even worse if fixed margin price undercutting is combined with a price ceiling. Here welfare is sure to be reduced relative to the initial monopoly solution as net consumer surplus is unchanged and due to switching costs the additional profits of the entrant are lower than the lost profits of the incumbent.

We may sum up the central findings with respect to the problem at hand in two sentences. While the entry strategy of E WIE EINFACH proved to be quite smart indeed, the seemingly best option with price ceiling is not robust in an environment with rapidly rising costs and has therefore been abandoned. This is "good news" insofar as this specific strategy has shown to be the least desirable from a welfare point of view.

Considering the more general contribution of our paper to the theory of industrial organization, we have shown that not only incumbents but also entrants have the opportunity to improve their competitive position by a strategic move. In some circumstances entrants may be able to apply smart strategies that restrict the options of an incumbent in a way that he is no longer able to deter entry. While the specific kind of entry strategy discussed here may only be usable in markets with a similar structure, specifically with a long term relationship between suppliers and customers, it seems to be promising to consider entry strategies that are adapted to other settings and to analyze them in detail with the game theoretic toolkit.

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