RBB Economics

The potential for 'waterbed effects' in the UK grocery retail industry

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Executive summary

This note comments on the Association of Convenience Stores' ("ACS") paper addressing the potential existence of so-called "waterbed" effects in the UK grocery retail industry.[1] We argue that the model presented by the ACS rests on strong assumptions that have little relevance to the reality of the grocery industry. The ACS paper cannot therefore be used to support a conclusion that waterbed effects arise in grocery retailers' dealings with their suppliers.

The waterbed concept states that improvements in the terms that one downstream firm receives from a particular supplier may cause a worsening in the terms on which that supplier deals with other downstream firms. The theory relies upon the idea that a supplier may seek to compensate for revenue lost following a price cut in respect of one customer by increasing the price charged to others. However, this fails to take account of rational profit maximisation by suppliers. Were it profitable for a supplier to increase the price charged to customer A following a price cut to customer B, it would have been profitable for the supplier to do so prior to B receiving that price cut. A rational firm would already have exhausted profitable opportunities to increase A's price, independent of the terms offered to B.

Nonetheless, following the concept's citation in competition enforcement decisions, there has been some discussion in the academic literature of whether a logically coherent waterbed theory can be constructed. Researchers have demonstrated that, under certain conditions, a waterbed effect can be theoretically established. However, the models on which these results

[1] "*The 'Waterbed Effect': How Non-Cost Related Discounts to Large Retailers can Harm Consumers*", Association of Convenience Stores, 15 November 2006.

are founded tend to be somewhat contrived, and depend critically on assumptions that may have limited applicability to real world industries.

The ACS paper presents such a model, within which improvements in supply terms secured by one retailer will cause a worsening in the terms on which competing retailers are supplied. The ACS approach is highly theoretical, however, and its model's result is driven by unrealistic assumptions that do not reflect the observed structure of the UK grocery industry.

In particular, the ACS model rests on the assumption of a single monopolist supplier of each good, this supplier consequently holding absolute price setting power over retailers. The waterbed effect found by the ACS may be overturned once competing suppliers are introduced, particularly where retailers multi-source, maintaining relationships with a number of suppliers of substitutable goods. The ACS model requires that supermarkets will only stock one product in each category. Thus, where supermarkets are observed to stock more than one competing product (including own label products) in a given category – i.e. almost always – the ACS model is not a reliable guide for policy because it fails to reflect observed reality. The ACS conclusion that waterbed effects can occur in retailer/supplier relationships cannot be read across as applicable to the UK grocery industry.

Notwithstanding our view that the ACS model is not an accurate reflection of the grocery industry, even taking the ACS conclusion that waterbed effects will occur as given, it is not clear that consumers will be harmed as a result. In a dynamic setting, where firms take account of the effect their behaviour has upon suppliers and competitors, any waterbed effect observed will generate stronger incentives for downstream firms to compete vigorously, and to strive for greater efficiency. Such incentives are likely to benefit final consumers.

This possibility is overlooked by the ACS paper, which purports to analyse waterbed effects in a dynamic setting, but does so in a highly stylised manner. In order to retain the waterbed effect built into the static model, the ACS dynamic model contrives to eliminate the possibility of competing suppliers by assuming upstream territorial allocation akin to a cartel. Such a structure does not represent a realistic depiction of the market for the supply of inputs to grocery retailers, casting significant doubt on the applicability of the model to the current market investigation.

Given the failure of the ACS model to reflect the observed structure of the UK grocery retail sector, and the sensitivity of its results to assumptions that better reflect reality, we conclude that the ACS paper does not provide sound or reliable evidence that waterbed effects may be expected to exist in the grocery industry. In this regard it is particularly noteworthy that the Competition Commission's preliminary investigations have found no evidence of price differentials consistently in favour of larger retailers.[2]

[2] Paragraph 116, *Groceries Market Investigation: Emerging Thinking*, Competition Commission, 23 January 2007.

The ACS model

This note comprises two sections, which consider in turn the static and the dynamic models presented by the ACS. While these models do demonstrate a theoretical waterbed effect, we show that neither model captures the observed facts of the UK grocery industry, undermining their relevance to the current inquiry. We demonstrate that the waterbed effect in the static model is generated by, and critically dependent upon, unrealistic assumptions, and that modifying the model to reflect more closely the observed reality of the industry may reverse the ACS conclusions. Moreover, we note that, even taking the model on its own terms, the ACS paper fails to take note of the dynamic investment incentives that any waterbed effect will create. These investment incentives may lead to a net increase in consumer welfare relative to a situation in which no waterbed effects exist.

1 The static model

The ACS presents a model in which there are several local downstream markets, each containing two firms, competing according to the Hotelling spatial differentiation model. These firms are a "large" retailer that operates in many local markets, and a number of independent retailers, each of which operates in a single local market. Retailers purchase a single input good, which is supplied by a single upstream monopolist. Alternatively, each retailer has the option of integrating backwards for a fixed cost and producing the input itself.

As the larger retailer expands its total sales volume, either through efficiency gains in one local market or acquisitions in other markets, the fixed cost of backward integration is spread over more units, and so becomes more attractive.[3] As a result, the alternative to dealing with the monopoly supplier becomes more credible, enhancing the retailer's bargaining position and allowing it to secure a lower input price for the good.

The larger retailer's lower input price then generates a waterbed effect because, when certain conditions apply, it weakens the independent retailer's fallback option. Intuitively, this occurs because a reduction in the larger retailer's input price will lead it to set a lower price to consumers, as a result of which it will win customers from the independent. As the independent's sales volumes fall, so backward integration will become a less credible alternative to relying on the monopoly supplier, weakening the independent's negotiating position, and allowing the supplier to raise the input price charged to the independent. By

[3] For clarity, this description of the process by which a waterbed effect arises in the ACS model considers the case in which the "large" retailer secures improved terms that generate worsened terms for the independent. Because the waterbed effect is a relative, rather than absolute, one, however, the same mechanism would also apply in the opposite direction: any increase in the independent's sales volume that cannibalises the larger firm's sales will lead to a worsening of the larger firm's supply terms.

increasing its input price this waterbed effect will then disadvantage the independent in the downstream grocery market.

As presented, the ACS model demonstrates that it is possible theoretically to construct a set of conditions under which waterbed effects can occur. However, this finding is only applicable to the UK grocery industry if the underlying assumptions reflect the observed structure of the industry. In our view the ACS model fails accurately to capture important observed characteristics of the grocery industry, rendering it irrelevant to the present inquiry. In particular, the waterbed effect claimed by the ACS is driven by two key factors:

- Retailers are assumed to deal with a price-setting monopolist upstream.
- Buyer power is modelled by the threat to incur a fixed switching cost, but retailers never actually make this investment (i.e. retailers never make strategic investments to improve their bargaining strength with suppliers).

In our view, neither of these assumptions is appropriate in the grocery market. Moreover, modifying the ACS model to incorporate more realistic assumptions removes the waterbed effect. We consider these two assumptions in turn.

The ACS model assumes that retailers deal with just one price-setting monopolist in any given area. This allows the supplier to set an input price to each retailer that is constrained only by the outside option available to it (in the case of the ACS model, backward integration). Replacing this assumption with the opposite extreme case of perfect competition amongst suppliers removes the waterbed effect entirely. With competition upstream, input prices for all retailers will be competed down to marginal cost and there will be no scope for a supplier to raise the price to retailers with lower sales volumes.

In reality, there is competition in the upstream market for the supply of grocery retailers, and supermarkets deal with several alternative suppliers for the vast majority of products sold. This casts a fundamental doubt on the policy relevance of the ACS model. Even where competing suppliers are differentiated, downstream firms may be able to switch between suppliers at no cost. Retailers generally stock multiple substitutable brands of most products, sourced from a number of competing suppliers. These ongoing parallel relationships give retailers a credible threat to readily substitute suppliers by switching shelf space from one brand to another. This removes suppliers' ability to increase the input price charged to a retailer whose sales volume falls, as that retailer would simply respond by switching shelf space to a competing supplier's product.

It is interesting to note that the Competition Commission's preliminary empirical analysis of supply terms has focused on suppliers of "major branded goods".[4] Branded goods are the inputs for which the ACS model's assumption of significant upstream market power would be most appropriate. The fact that no evidence has been found of a waterbed effect even in

respect of these products casts further doubt on the relevance of the ACS paper to the grocery industry as a whole.

In summary, therefore, where supermarkets are able to choose between alternative suppliers of substitutable goods, and particularly where they are observed to maintain ongoing relationships with multiple competing suppliers in a given category – i.e. almost always – the ACS model is not a reliable guide for policy because it fails to accord with observed reality.

2 Waterbed effects in a dynamic setting

In this section we consider waterbed effects in a dynamic setting, that is, within models that allow for firms to employ longer-term strategies regarding entry, exit or making investments to improve their efficiency or bargaining position. First we consider the somewhat contrived dynamic model set out by the ACS. Second, we explain how, even taking the ACS model as given, the waterbed effects that it produces may actually enhance consumer welfare in a dynamic setting.

2.1 The “dynamic” ACS model

The "dynamic" ACS model is an extension of the static model that allows for free entry and exit among suppliers. It is important to note however that, in order to preserve the waterbed effect found in the static model, the dynamic framework is constructed so as to exclude the possibility of supplier competition. By design, there will only ever be one supplier serving each local market. The "dynamic" effect arises where the large retailer's increased buyer power reduces supplier profitability and thereby causes exit. In the event of exit, the exiting supplier's market(s) are assumed to be distributed evenly among the remaining suppliers.

Put differently, the ACS model assumes that there are regional suppliers that do not venture into each other's territory. When a supplier exits the market, the other suppliers share out the exiting supplier's lost market share among themselves. The model effectively therefore assumes a market sharing agreement exists among suppliers.

Consequently, the empirical relevance of the ACS dynamic model is limited. The model effectively requires there to be a collusive agreement among suppliers of a good for which there is no other available substitute (other than backward integration). This condition does not accord with the observed structure of the markets supplying the UK grocery retailers, undermining the model’s applicability to the current inquiry.

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[4] Note 2, *supra*.

The ACS "dynamic" model is also contrived on a theoretical level. The model makes an *ad hoc* assumption that, when supplier exit occurs, retailers' fallback options deteriorate. This phenomenon exacerbates the waterbed effect, but no explanation is provided for how or why supplier exit would weaken retailers' buyer power. While it would be clear that a reduction in the number of suppliers would weaken retailers' negotiating position were retailers choosing between competing suppliers, the ACS model explicitly rules out such upstream competition in order to create the waterbed effect. Given that each retailer faces a monopolist supplier, with its only alternative source of supply being backward integration, the exit of that monopolist to be replaced by a different monopolist will not affect the relative attractiveness of the outside option. Put differently, to argue that the retailer's fallback option improves with the number of suppliers is not consistent with the assumption (required to generate the waterbed effect) that suppliers do not supply outside their own territories.

2.2 Dynamic investment incentives

While considering the potential for waterbed effects to occur in the presence of supplier entry and exit, the ACS model is notably silent on the possibility that if waterbed effects occur, then they may increase retailers' incentives to invest in efficiency improvements. The intuition is straightforward: in the presence of waterbed effects, efficiency improvements benefit a retailer in the downstream market both by improving its own fallback option, and by weakening that of its rival. This is in addition to the standard profit-increasing benefit that efficiency improvements generate for a firm in the absence of waterbed effects.

The process by which this effect operates is as follows. Improvements in productive efficiency that reduce a firm's marginal costs will lead to that firm choosing a lower profit maximising output price, effectively using some of the increased margin generated by the cost reduction to fund sales volume increases. This is the standard incentive for firms to invest in efficiency improvements, which, as well as increasing profits, improve consumer welfare.

In the ACS framework, however, the increase in sales enjoyed by a firm that reduces its costs will have an additional benefit of rendering its outside option more attractive, as the fixed cost of backward integration will be spread over greater volumes. That firm will therefore be able to negotiate a reduced input price from its supplier. Moreover, by expanding its sales at the expense of its rivals, a more efficient firm will weaken those rivals' negotiating positions with the supplier, by making their outside option of integration less attractive. The rivals' input prices will therefore increase, further benefiting the firm that introduced invested in efficiency improvements. As such, the ACS waterbed effect creates an enhanced incentive for each firm to become more efficient, relative to the standard case of no waterbed effect.[5]

[5] In a related setting where firms have the same credible threat to integrate backwards for a fixed cost but are Cournot competitors in the downstream market, it has been shown that this dynamic effect might well be beneficial for consumers. See Inderst, R. and T. Valletti (2006), 'Price Discrimination in Input Markets, mimeo.

This logic generalises to other means by which downstream firms can increase their sales volumes. The presence of waterbed effects would therefore increase downstream firms' incentives to compete vigorously on price, quality and product range (via innovation). As well as the standard incentive to increase volumes via these channels, retailers would take account of the effect that increased sales will have in reducing their own input prices and increasing those of their rivals.

At the Annex, we provide a simple model in which downstream competition takes place between grocery chains (rather than one chain and a series of independents, as in the ACS model), and firms' outside option is to invest in efficiency improvements. This model demonstrates that waterbed effects can sharpen investment incentives and thereby benefit consumers, a possibility that the ACS fails to consider. The model presented in the Annex could also be modified to demonstrate enhanced investment incentives for a chain dealing with independents. However, for ease of exposition – and to take into account the reality that retail chains compete with other retail chains – we focus on competition between grocery chains.

Annex

As an example of how a waterbed effect might intensify competition between supermarket chains, we consider an extended version of the ACS model. In particular, we introduce an additional stage at the beginning of the ACS set-up. At this initial stage, each chain has the choice of integrating backwards (at cost *F*), which gives it the ability to produce the input at a zero marginal cost. The rest of the game is as in the ACS set-up, i.e. if a chain does not integrate backwards at stage 1 it still has access to the outside option as defined in the ACS model when it considers the supplier's offer at stage 2. This modification allows us to test the robustness of the ACS model to changes in the timing assumptions.

More formally,

- At stage 1 each chain chooses one of two strategies (Invest, Don't Invest). If a chain chooses "Invest" then it pays *F* upfront, and credibly commits to obtain the input at zero marginal cost. If a chain chooses "Don't Invest" then its investment possibility remains and this determines the chain's outside option at stage 2.

- At stage 2 the supplier makes simultaneous *take it or leave it* offers involving a linear wholesale price to each chain. Each chain decides whether to take the offer or go for its current outside option. The latter is either to obtain the input at zero marginal cost (i.e. for a chain that has invested at stage 1) or to obtain the input at zero marginal cost *and* pay *F* (i.e. for a chain that has not already invested).

- At stage 3 the chains engage in downstream Hotelling competition, where their input cost is given by their previous actions. That is, for a chain that has declined the supplier's offer at stage 2 the input cost is zero, while for a chain that has accepted the supplier's offer at stage 2 the input cost is equal to the wholesale price offered by the supplier.

Without loss of generality we focus on the case where there is only one local market (since our aim is not to consider incentives to merge but to consider incentives of already large chains to invest in an environment where waterbed effects may apply).

We proceed by backwards induction. At stage 2, if chain A has not invested at stage 1 then the supplier leaves chain A indifferent between obtaining the input at zero cost, by backwards integrating at cost *F,* and paying the wholesale price $w_A > 0$. On the other hand, if chain A has invested then the supplier offers it wholesale price equal to zero (A's current outside option):

- if chain A has invested then the wholesale price offered to chain A is zero.
- if chain A has not invested then the wholesale price offered to chain A satisfies:

$$\pi_A(w_A, w_B) = \pi_A(0, w_B) - F$$

where $w_B > 0$ is chain B's wholesale price.

Rearranging, we have:

$$\pi_A(0, w_B) - \pi_A(w_A, w_B) = F$$

By the implicit function rule:

$$\frac{dw_A}{dw_B} = -\frac{\frac{\partial \pi_A}{\partial w_B}(0, w_B) - \frac{\partial \pi_A}{\partial w_B}(w_A, w_B)}{-\frac{\partial \pi_A}{\partial w_A}(w_A, w_B)} < 0,$$

Thus, a reduction in B's wholesale price leads to an increase in A's wholesale price provided that the numerator of the above expression is positive, as is the case in the Hotelling model.[6]

Turning to stage 1, chains must decide whether or not to integrate backwards. The payoff matrix is set out below.

		Chain A: Invest	Chain A: Don't Invest
Chain B	Invest	$\pi_A(0,0) - F$, $\pi_B(0,0) - F$	$\pi_A(w_A^+, 0)$, $\pi_B(0, w_A^+) - F$
	Don't Invest	$\pi_A(0, w_B^+) - F$, $\pi_B(w_B^+, 0)$	$\pi_A(w_A, w_B)$, $\pi_B(w_B, w_A)$

[6] The denominator is positive since an increase in A's input price has a negative impact on A's profit. If the numerator is also positive then the overall expression must be negative and hence the waterbed effect will apply. The numerator is positive where (as is intuitively appealing) A suffers more from a reduction in B's wholesale price the higher is A's own wholesale price.

where due to the negotiation at stage 2 the following conditions hold:

$$\pi_A\left(w_A^+,0\right)=\pi_A\left(0,0\right)-F$$

$$\pi_B\left(w_B^+,0\right)=\pi_B\left(0,0\right)-F$$

$$\pi_A\left(w_A,w_B\right)=\pi_A\left(0,w_B\right)-F$$

$$\pi_B\left(w_B,w_A\right)=\pi_B\left(0,w_A\right)-F$$

For chain B, investing is a weakly dominant strategy at stage 1 because

if A invests	$\pi_B\left(0,0\right)-F = \pi_B\left(w_B^+,0\right)$
If A does not invest	$\pi_B\left(0,w_A^+\right)-F > \pi_B\left(w_B,w_A\right)$

The inequality in the second row of this table follows since $w_A^+ > w_A$ (due to the waterbed effect, i.e. as seen from the above conditions that result from negotiation at stage 2).

By symmetry, investing is also a weakly dominant strategy for chain A at stage 1. Chains A and B both therefore choose to integrate backwards in order to reduce their input price.

Further, since both chain A and B backwards-integrate (and $w_A > 0$ and $w_B > 0$), consumer prices must be lower than in the situation where neither backward integrates.

This shows that modifying the ACS framework to allow competing retail chains to integrate backwards before the "monopoly" supplier sets prices gives rise to the following results:

- The waterbed effect increases the incentives for backwards integration because $\pi_B\left(0,w_A^+\right)-F > \pi_B\left(0,w_A\right)-F$ and in consequence backwards integration occurs endogenously.
- Once investment occurs, stage 2 offers are such that chain stores can switch seamlessly between sourcing from the "monopoly" supplier and their alternative option and so the model allows retailers to stock products from more than one supplier in equilibrium. This outcome is more in line with reality than that predicted by the ACS model.
- Final consumers benefit from backwards integration.

In short, modifying the ACS model to allow for the more realistic assumption that powerful retailers can invest in improving their fallback options before their suppliers set prices leads to the result that consumers are not harmed by the waterbed effect. It would be straightforward to modify the model presented in this annex to consider a retail chain competing with an independent store. Once again, both firms would have the incentive to sink *F* at stage 1 with the effect that final consumers benefit.