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Upstream Merger in a Successive Oligopoly: Who Pays the Price?

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Upstream Merger in a Successive Oligopoly: Who Pays the Price?*

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Abstract

This study develops and uses a successive oligopoly model, with an unobservable non-linear tariff between upstream and downstream firms, to analyze the possible anti-competitive effects of an upstream merger. We find that an upstream merger may lead to higher average prices paid by downstream firms, but that there is no change in the prices paid by consumers. The model is tested empirically on data for an upstream merger in the Norwegian food sector (specifically, the market for eggs). Consistent with the theoretical predictions of the model, we find that the merger had no effect on consumer prices, but led to higher average prices from the downstream to the upstream firm.

Keywords: Upstream merger, non-linear prices, Vertical contracts

JEL Classification: K21, L41

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1 Introduction

Merger control has been especially concerned about horizontal mergers. The reason is obvious. Such mergers may lead to less intense rivalry between firms and, in turn, higher consumer prices. It is argued that the closer are the substitutes the firms produce, the larger is the potential anti-competitive effect.[1] However, an upstream merger in a successive oligopoly may not fit easily into such an intuitive and simple reasoning. The existence of a non-linear wholesale price contract between upstream and downstream firms, such as a two-part tariff consisting of a marginal wholesale price and a fixed wholesale price (or some rebate scheme), may affect the price for final consumers following an upstream merger. The purpose of this study is to investigate the price effects of an upstream merger. We show theoretically that an upstream merger that leads to more market power may have no effect on the downstream firms' consumer prices (prices to the final consumers). Such an upstream merger is expected only to lead to a profit shift between upstream and downstream firms. The theoretical predictions are tested on data from an upstream merger in the Norwegian food sector, and more particularly in the egg market. In line with theoretical predictions, we find that this

[1] One clear statement of this principle appears in the US Horizontal Merger Guidelines from August 2010, where they focus on diversion ratios: *'Diversion ratios between products sold by one merging firm and products sold by the other merging firm can be very informative for assessing unilateral price effects, with higher diversion ratios indicating a greater likelihood of such effects.'* (page 21). This principle was first explained in Werden (1996). It was further elaborated in Farrell and Shapiro (2010), who introduced the concept of *Upward Pricing Pressure* (UPP).

particular upstream merger led to higher average wholesale prices, but led to no change in consumer prices. The downstream firms, and not the final consumers, pay the price for the upstream merger.

Most models of horizontal mergers neglect the role of vertical structure in an industry.[2] This can be an innocuous assumption, if any price increase from an upstream to a downstream firm due to an upstream merger is passed on to consumers. However, even with a simple linear wholesale price between upstream and downstream firms, the pass-through rate can vary a lot depending on - among other things - the demand function.[3] If non-linear pricing between upstream and downstream firms were introduced, there might be an even less clear relationship between the prices offered by upstream to downstream firms and the downstream firms' prices to its final consumers. The reason is that changes in the bargaining power due to an upstream merger may lead to changes in the fixed transfer between the upstream and the downstream firms rather than in the marginal wholesale price, and thereby would provide less incentive for the downstream firm to change the prices offered to the final consumers.

In this paper, we develop a model with a successive oligopoly. The downstream firms set linear prices to the end-users, while the upstream and down-

[2]Two seminal articles are Farrell and Shapiro (1990) and Werden (1996). The first analyzed horizontal mergers with Cournot competition and identical products, while the second analyzed horizontal mergers in a setting with Bertrand competition and differentiated products.

[3]See, for example, Crooke et al. (1999), who demonstrate the very diverse predictions for post-merger price increases following on from the choice of a linear, logit, almost-ideal demand system (AIDS), or isoelastic demand function.

stream firms bargain over a non-linear contract. Contracts between upstream and downstream firms are unobservable. The non-linear contract could take many forms, such as a rebate scheme. To simplify, without loss of generality, this is modeled as if the upstream firms set a two-part tariff consisting of a price per unit and a fixed fee. In this setting, we show theoretically that an upstream merger will not have any effect on the prices per unit paid by downstream firms (*i.e.* the marginal wholesale price), but only on the fixed fees for the merging parties. The intuition is that unobservable contracts make it impossible to deviate from a marginal wholesale price equal to marginal cost, and therefore that all bargaining power stemming from the upstream merger will be transmitted into changes in the merging parties' fixed wholesale fees. When the downstream firms' input price on the last unit is not changed following an upstream merger, the downstream firms have no incentive to change the prices they offer to consumers.

The theoretical model is simple, but captures the idea that an upstream merger may mainly lead to changes in non-marginal wholesale fees. The empirical prediction would then be that an upstream merger leads to higher average prices paid by downstream to upstream firms (due to higher non-marginal wholesale fees), while there are no changes in the prices charged to the downstream firms' consumers. We test these predictions on the data for an upstream merger in the egg industry in Norway in 2005. The egg producer Prior acquired Norgården, and the merged entity increased its market share for eggs in Norway from 61% to 74% for deliveries to the four grocery chains

selling eggs to final consumers.[4] Norway imposes heavy constraints on egg imports, so according to the traditional approach to horizontal mergers, such a merger would have anti-competitive effects. The Norwegian Competition Authority disapproved the merger, arguing among other things that it would lead to higher prices to consumers. This decision was overturned after an appeal to the Ministry of Government Administration and Reform. The Ministry accepted that it was an anti-competitive merger, but allowed it in order to increase the upstream firms' and, in turn, farmers' revenues. This therefore presents a unique chance to investigate an upstream merger that both competition authorities and other parties claimed had an anti-competitive effect.

Monthly prices (price indices) for eggs at the wholesale and consumer level are available for the period 2000-2009, which is several years before and after the merger in 2005. First, we find no effect of the upstream merger on consumer prices. This is consistent with our prediction, but might be explained by no additional exploitation of market power by the upstream firms after the merger. Second, we find a structural break in the average prices paid by the downstream firms to the merging parties. This is not consistent with what we would expect if there were no increases in upstream market power. The results are consistent with the prediction that the upstream merger lead to changes in the fixed transfers to the merged firm, and thus that the upstream firms do have market power. The results are also in line

[4]In this paper, the terms 'acquisition' and 'merger' will be used interchangeably

with anecdotal evidence indicating that fixed fees and rebates are used in the secret vertical contracts in this particular market. We investigate other possible explanations – such as changes in upstream firms' costs or changes in retail concentration – but these other factors cannot explain the observed price patterns.

Although upstream mergers are common, the theoretical literature on them is sparse. Some early contributions focused on linear contracts between upstream and downstream firms, and therefore do not capture the main mechanism focused on in this paper.[5] Inderst and Wey (2003) model non-linear contracts, but they assume that downstream firms are independent and therefore do not capture any possible anti-competitive effects in the downstream market. Milliou and Petrakis (2007) apply a successive duopoly model to study upstream mergers, but they focus on how upstream mergers may influence the choice between two-part tariffs and a linear wholesale price. They assume Cournot competition downstream and observability. This leads to marginal wholesale prices below marginal costs, and even more so after an upstream merger. In their main model, unlike in our study, they therefore find that an upstream merger leads to lower consumer prices. Finally, O'Brien and Shaffer (2005) apply a model similar to ours, except for assuming monopoly in the downstream market and observable contracts. The theoretical model presented here is an extension of their model, and it is found that

[5]See Horn and Wolinsky (1988), von Ungern-Sternberg (1996) and Dobson and Waterson (1997).

their main results extend to a more general setting with several downstream firms and unobservable contracts.[6] We also claim generalizability beyond the finding for our specific theoretical model tailor-made to the Norwegian egg market. We argue that this might happen with several models that include non-linear contracts between upstream and downstream firms.

The empirical literature on the price effects of upstream mergers is even more sparse. To our knowledge, Villas-Boas (2007a) and Manuszak (2010) are the only empirical investigations that explicitly analyze the price effects in the consumer market from an upstream merger.[7] They do not have access to wholesale prices. They estimate consumer demand, make assumptions concerning the price tariff between the upstream and the downstream firms, and then use their demand estimates to simulate the effects of an upstream merger on consumer prices.[8] In contrast to their study, we have data for wholesale prices and can test how the upstream merger affected average wholesale prices.

The article is organized as follows. Section 2 presents the model and

[6] O'Brien and Shaffer (2005) indicate that their results extend to an oligopoly setting downstream, but they do not explicitly model downstream competition.

[7] There are other empirical studies of mergers that do not discuss vertical structure, but which nevertheless can shed light on whether there is any price effect of an upstream merger that is passed on to final consumers. See, for example, Ashenfelter and Hosken (2010). They analyze five upstream mergers in the US. They find that four of the five resulted in higher prices to final consumers.

[8] They focus mainly on situations with a linear contract between upstream and downstream firms. There are studies that use estimated consumer demand to test for the contract between upstream and downstream firms, for example whether it is non-linear (see, for example, Villas-Boas (2007b) and Bonnet and Dubois (2010)). However, these papers do not analyze the effects of upstream mergers.

derives testable predictions. Section 3 illustrates the results by reporting the observed price effects of an upstream merger in a the Norwegian egg industry, and Section 4 concludes.

2 Model

O'Brien and Shaffer (2005) analyze a setting with oligopoly upstream and monopoly downstream, with two-part tariffs between upstream and downstream firms. In the particular successive oligopoly we investigate, there are unobservable non-linear contracts between upstream and downstream firms. These features are identical with the assumptions made in O'Brien and Shaffer, except for their assumption of a downstream monopoly with observable contracts. It is therefore natural to extend the model in O'Brien and Shaffer (2005) to a successive oligopoly with unobservable contracts, and apply this model to predict the price effects of an upstream merger in this particular market.[9]

2.1 The model and pre-merger equilibria

Let $N \geq 2$ single-product producers each supply a differentiated product to a set of $M \geq 1$ differentiated retailers. If every retailer carries every product, the consumers must choose how much to buy of product i $(i = 1, ...N)$ at retailer r $(r = 1, ...M)$, meaning that they choose between $N \cdot M$ prod-

[9]The model and results presented are borrowed from Ulsaker (2012).

uct/retailer combinations. The demand for product i at retailer r is given by

$$q_{ir} = Q_{ir}(\mathbf{p}), \tag{1}$$

where $\mathbf{p}$ is a vector of all retail prices. Let the demand functions be symmetric, and assume that demand for product i at retailer r is a negative function of the price of i at r, and a positive function of all other consumer prices.[10] Own-price effects dominate cross-price effects, that is, $-\frac{\partial Q_{ir}}{\partial p_{ir}} > \sum_{j=1,j\neq i}^{N} \frac{\partial Q_{jr}}{\partial p_{jr}} + \sum_{s=1,s\neq r}^{M} \sum_{k=1}^{N} \frac{\partial Q_{ks}}{\partial p_{ks}}$.

The structure of the game is as follows: In the first stage, each producer negotiates with each retailer over a supply contract. The contract between producer i and retailer r takes the following form: $T_{ir}(q_{ir}) = w_{ir}q_{ir} + f_{ir}$. All $N \cdot M$ negotiations are assumed to take place simultaneously and independently, and each party in a given negotiation takes the outcome of the other $N * M - 1$ negotiations as given.[11] In the second stage, the multi-product retailers compete in prices, demands are satisfied and payments are made in accordance with contracts. Assume that for every vector of wholesale prices $\mathbf{w}$, there exists a unique equilibrium of retail prices, $\mathbf{p} = \mathbf{P}(\mathbf{w})$. This makes

[10] Symmetry is assumed for expositional convenience. The main results would hold also with asymmetric demand.

[11] The assumption of simultaneous and independent negotiations is also made in Inderst and Wey (2003) and in Milliou and Petrakis (2007). One interpretation is that each firm sends one representative to each of the negotiations the firm participates in, and that representatives are not able to coordinate their actions.

it possible to write the demand at retail level as $q_{ir} = Q_{ir}(\mathbf{w})$ As on consumer level, let wholesale own-price effects dominate cross-price effects. Let the contracts of rival retailers be unobserved throughout the game. This means that the price of the products set by retailer r is independent of the outcome of the negotiations between the producers and the rival retailers. On the other hand, the quantity q_{ir} actually sold depends on all wholesale prices.

The outcome of the negotiations between producer i and retailer r is assumed to be the solution to the following problem:

$$\max_{w_{ir}, f_{ir}} N_{ir} = \gamma^{ir} \ln\left(\pi_i - \nu_i^r\right) + \left(1 - \gamma^{ir}\right) \ln\left(\pi_r - \nu_r^i\right), \tag{2}$$

where $\gamma^{ir} \in (0, 1)$ represents the bargaining power of the producer in this particular negotiation. π_i and π_r are the profits of the producer and retailer, respectively, and ν_i^r and ν_r^i their disagreement payoffs. In this negotiation, it is not the profit that stems from the sale of product i at retailer r that a firm seeks to maximize, but the firm's total profit. The profits in the objective function are therefore:

$$\pi_i = Q_{ir}(\mathbf{w})\left(w_{ir} - c\right) + f_{ir} + \sum_{s=1, s\neq r}^{M} \left(Q_{is}(\mathbf{w})\left(w_{is} - c\right) + f_{is}\right) \tag{3}$$

and

$$\pi_r = Q_{ir}(\mathbf{w})\left(P_{ir}(\mathbf{w}) - w_{ir}\right) - f_{ir} + \sum_{j=1, j\neq i}^{N} \left(Q_{jr}(\mathbf{w})\left(P_{jr}(\mathbf{w}) - w_{jr}\right) - f_{jr}\right). \quad (4)$$

The 'disagreement profits' are the profit the firms can expect to earn through the other negotiations if the current negotiation breaks down. Assume that if the parties fail to agree on a contract, f_{ir} is set to zero and w_{ir} to infinity, meaning that retailer i will choose not to stock product i. The disagreement profits can then be written as:

$$\nu_i^r = \sum_{s=1, s\neq r}^{M} Q_{is}(w_{ir} = \infty, \mathbf{w}_{-ir})\left(w_{is} - c\right) + f_{is} \quad (5)$$

and

$$\nu_r^i = \sum_{j=1, j\neq i}^{N} Q_{jr}(w_{ir} = \infty, \mathbf{w}_{-ir})\left(P_{jr}(w_{ir} = \infty, \mathbf{w}_{-ir}) - w_{jr}\right) - f_{jr}, \quad (6)$$

where $\mathbf{w}_{-ir}$ is shorthand for the remaining wholesale prices.

A bargaining equilibrium is a set of contracts that solves (2) for every pair of producer and retailer, and where in each negotiation the equilibrium outcomes of the other negotiations are treated as given. This equilibrium concept focuses on pairwise deviations. Since the parties in a given negotiation take the outcomes of the $N \cdot M - 1$ other negotiations as given, they will have a common interest in maximizing their joint profits and distributing

them through the fixed fee. The following proposition applies:

Proposition 1 *When $N \geq 2$ producers and $M \geq 1$ retailers negotiate simultaneously and pairwise over a two-part tariff, each negotiation yields an effective solution, in the sense that the marginal wholesale prices facilitate maximization of the joint profit of the negotiating parties, given the expected outcome of the other negotiations. This again implies that the marginal wholesale prices are equal to marginal cost in equilibrium.*

Proof. *See appendix.* ■

Since marginal wholesale prices equal marginal cost in equilibrium, the profit of the producers must stem only from the fixed fees. In equilibrium, the fixed fee paid by retailer r to producer i is:

$$f_{ir}^{*} = \gamma^{ir} \left(\begin{array}{c} Q_{ir}(w^{*}) \left(P_{ir}^{*}(w^{*}) - c \right) + \sum\limits_{j=1, j \neq i}^{N} Q_{jr}(w^{*}) \left(P_{jr}(w^{*}) - c \right) \\ - \sum\limits_{j=1, j \neq i}^{N} Q_{jr}(w_{ir} = \infty, \mathbf{w}_{-ir}^{*}) \left(P_{jr}(w_{ir} = \infty, \mathbf{w}_{-ir}^{*}) - c \right) \end{array} \right) \quad (7)$$

As the bargaining power of the producer (γ^{ir}) approaches zero, this fixed fee approaches zero. As γ^{ir} approaches one, the fixed fee approaches the difference between retailer r's profit (gross of fixed fees) when selling product i and when not selling product i. This difference will be strictly positive given that products or retailers are not perfect substitutes.

2.2 Post-merger equilibrium

Assume now that producers 1 and 2 merge. Let the merged firm be denoted u. The two-product merged firm negotiates with retailer r over the terms in a contract of the form $T_{ur}(q_{1r}, q_{2r}) = w_{1r}q_{1r} + w_{2r}q_{2r} + f_{ur}$. The non-merging producers negotiate with the retailers as they did before the merger, and the timing of the game is as in the previous subsection. Let the merged firm and retailer r solve:

$$\max_{w_{1r}, w_{2r}, f_{ur}} N_{ur} = \gamma^{ur} \ln\left(\pi_u - \nu_u^r\right) + \left(1 - \gamma^{ur}\right) \ln\left(\pi_r - \nu_r^u\right). \tag{8}$$

The profit functions in the objective function are given by:

$$\pi_u = \sum_{i=1}^{2} Q_{ir}(\mathbf{w}) \left(w_{ir} - c\right) + f_{ur} + \sum_{s=1, s\neq r}^{M} \left(\sum_{i=1}^{2} Q_{is}(\mathbf{w}) \left(w_{is} - c\right) + f_{us} \right) \tag{9}$$

and:

$$\pi_r = \sum_{i=1}^{2} Q_{ir}(\mathbf{w}) \left(P_{ir}(\mathbf{w}) - w_{ir}\right) - f_{ur} + \sum_{j=3}^{N} \left(Q_{jr}(\mathbf{w}) \left(P_{jr}(\mathbf{w}) - w_{jr}\right) - f_{jr}\right). \tag{10}$$

The disagreement profits are now given by:

$$\nu_u^r = \sum_{s=1,s\neq r}^{M} \left(\sum_{i=1}^{2} Q_{is}(w_{1r} = w_{2r} = \infty, \mathbf{w}_{-1r,2r}) \left(w_{is} - c\right) + f_{us} \right) \tag{11}$$

and:

$$\nu_r^u = \sum_{j=3}^{N} \left(Q_{jr}(w_{1r} = w_{2r} = \infty, \mathbf{w}_{-1r,2r}) \left(P_{jr}(w_{1r} = w_{2r} = \infty, \mathbf{w}_{-1r,2r}) - w_{jr}\right) - f_{jr}\right). \tag{12}$$

The maximization problems in the negotiations are analogous to the ones analyzed in the previous section (Section 2.1). The parties of a given negotiation still take the outcome of the other negotiations as given, and still have a common interest in maximizing joint profit. The following applies:

Proposition 2 *When two of the producers merge, each negotiation still yields an effective solution. The marginal wholesale prices will not be affected.*

Proof. See appendix. ■

The equilibrium fixed fee paid by retailer r to the merged firm is given by:

$$f_{ur}^* = \gamma^{ur} \left(\begin{array}{c} \sum_{i=1}^{2} Q_{ir}(\mathbf{w}^*) \left(P_{ir}(\mathbf{w}^*) - c\right) + \sum_{j=3}^{N} q_{jr}(\mathbf{w}^*) \left(P_{jr}(\mathbf{w}^*) - c\right) \\ - \sum_{j=3}^{N} Q_{jr}(w_{1r} = w_{2r} = \infty, \mathbf{w}_{-1r,2r}^*) \left(P_{jr}(w_{1r} = w_{2r} = \infty, \mathbf{w}_{-1r,2r}^*) - c\right) \end{array} \right). \tag{13}$$

The expression in the parentheses on the right-hand side of (13) is the incremental revenue (gross of fixed fee) that the retailer r earns by selling product 1 and 2, compared to not selling any of them, or equivalently, the loss of gross profit that retailer r would suffer if product 1 and 2 were simultaneously made unavailable. Prior to the merger, the merged firms earned $f_{1r}^* + f_{2r}^*$ through sales at retailer r. f_{1r}^* corresponds to the fraction γ^{1r} of the loss in gross profit incurred by retailer r in the case that product 1 became unavailable at the retailer, given that product 2 is still available at retailer r.

The merger is profitable for the merging firms if $f_{ur}^* > f_{1r}^* + f_{2r}^*$. Assuming that $\gamma^{1r} = \gamma^{2r} = \gamma^{ur}$, this would be the case if the loss (in terms of gross profit) for the retailer is greater when products 1 and 2 are simultaneously made unavailable than the sum of the losses of not being able to stock product 1 (when product 2 is available) and of not being able to stock product 2 (when product 1 is available). Since the products are substitutes, this condition will be met.

In this model, an upstream merger leads to no changes in the marginal wholesale price, but only in a change in the fixed wholesale fee for the merging parties. It implies that the average wholesale price will increase for the merging parties. Since there are no changes in the marginal wholesale prices, the model predicts no change in consumer prices. The prediction which can be taken to data is, then, the following:

Proposition 3 *The upstream merger is expected to lead to (i) higher average*

wholesale prices and (ii) no changes in consumer prices.

Several assumptions might be crucial for the results reported in Proposition 3. First, we assume that after the merger, the merging firm bargains with the downstream firms over both products at the same time (bundling). If the firms instead negotiate separately over each of the merged firm's two products (no bundling), then it can be shown that the upstream merger could lead to higher marginal wholesale prices.[12] Second, we assume unobservability. If contracts were observable, marginal wholesale prices could differ from marginal costs both before and after the merger to dampen competition.

As far as we know, there are no studies analyzing an upstream merger in such a setting with differentiated products and Bertrand competition downstream.[13] This suggests that, though the prediction in Proposition 3 is natural given how the contract between upstream and downstream firms will change following an upstream merger in this particular industry, we can in other settings expect that an upstream merger might affect consumer prices. Hence, it is an empirical question whether consumer prices increase or not following an upstream merger.

[12]This is shown in O'Brien and Shaffer (2005) in a setting with monopoly downstream, and in Ulsaker (2012) in a similar setting except for oligopoly downstream.

[13]Milliou and Petrakis (2007) show that with Cournot competition downstream, in their basic model marginal wholesale prices are below marginal costs and are even more so after an upstream merger. However, in an alternative model they find that the marginal wholesale prices are identical to marginal costs both before and after the merger. This is in line with our results.

3 An illustrative example

In the previous section we showed that the presence of non-linear, unobservable contracts between upstream and downstream firms may eliminate any price effects for final consumers of an upstream merger. To illustrate that this may happen in a particular case, we describe and test empirically the price effects of an upstream merger in the Norwegian egg industry.

3.1 Institutional setting for the upstream merger

Eggs in Norway are produced by many farmers. Each farmer delivers eggs to a firm that packs and processes the eggs, and that sells them to the retail chains in Norway. These firms are denoted the 'upstream firms,' and the retail chains the 'downstream firms.' At the retail level, four chains controlled almost 100 % of the domestic food market in 2005. There are high duties on imports of eggs to Norway, to protect Norwegian farmers and allow them to receive higher revenues.[14]

The largest upstream firm, Prior, is a farmer-owned cooperative.[15] Prior has had a role as a non-governmental market regulator. Its role has been to influence total supply in the industry in such a way that a target aver-

[14]The information in this Section builds on the public decision letter of September 29 2005 by the Norwegian Competition Authority (Konkurransetilsynet) concerning Prior's acquisition of Norgården in the Norwegian egg market.

[15]In the theoretical model we did not take into account that the producer was a cooperative. However, it does not matter for our theoretical predictions, since a cooperative can be regarded as a firm that is integrated upstream. Prior later merged with the meat producer Gilde, which was also a cooperative; the merged entity was named Nortura.

age wholesale price is reached (the 'målprisen'). For example, Prior could propose exports of egg products, and measures that dampened the farmers' incentives to increase egg production. However, Prior had no direct control over other upstream firms' total production, nor over the prices they offered to downstream firms.

Prior, with 61 % of the total supply in the Norwegian market, announced on March 31 2005 that they would acquire Norgården, the second largest supplier with 14 % of total supply. In their 'efficiency defense' for the acquisition, they claimed that the acquisition would enable them to regulate the market more efficiently. [16]:

'The parties claim that it is crucial that Prior as a market regulator control the supply from a sufficiently large number of upstream firms to ensure an efficient control over the total supply in Norway (our translation).'[17]

This indicates that a motivation for the acquisition was to strengthen the market power in order for the upstream firm to extract a higher average price from the downstream firms. In Figure 1 Prior's market share before and after the merger is shown.

[Figure 1 about here]

[16]Note that Norway uses a 'total welfare' standard in merger control, which means that all kinds of efficiency gains should be taken into account. In addition to the argument put forward here, they also claimed that the acquisition would lead to savings in fixed costs.

[17]See the Norwegian Competition Authority's decision letter from September 29 2005 on Prior's acquisition of Norgården, page 32.

As seen from the figure, Prior's market share was decreasing before the merger. After the merger the market share suddenly increased by approximately 10 percentage points, but then gradually decreased again. Prior's market share in 2012 was above its share when the merger took place. The fall in the market share before the merger indicates a potential competitive problem, where Prior as the market regulator is not able to control the quantity supplied by other upstream firms. In Figure 2 both 'målpris' (target price) and actual price are shown, as a solid and a dotted line respectively. The first is the target for the average wholesale price, while the second is the actual average wholesale price.

[Figure 2 about here]

Figures 1 and 2 seen in combination suggest that Prior as a market regulator did have problems before the merger problems in achieving the set goal. In a situation with excess supply in the industry, Prior as a market regulator had to receive deliveries from other producers of egg products. For example, in 2004 it received deliveries from other producers that amounted to approximately 4% of total production.[18] This indicates that Prior had problems controlling total egg supply. In 2004 and 2005 the market regulator did implement measures, including exporting at a loss, that probably

[18]See Omsetningrådet (2004), page 16. They received 2,100 tonnes of egg from other producers that year; total domestic production was slightly less than 50,000 tonnes.

helped to reduce the divergence between the target price and the actual price in the domestic market during that particular period. We ask whether the acquisition made it possible to increase the target price and the actual price in the long run.

The Norwegian Competition Authority disapproved the merger, claiming that it would be anti-competitive:

'The Norwegian Competition Authority has found that the acquisition will lead to a substantial lessening of competition in the relevant markets. ... We therefore find that the acquisition will lead to higher prices, to the detriment of consumers (Our translation).'[19]

However, in their decision letter there is no discussion of the vertical structure in this market. They thereby imply that an upstream merger will lead to higher wholesale prices that are - at least to some extent - passed on to the final consumers.

The merging parties appealed the decision to the Ministry of Government Administration and Reform. In their February 6 2006 decision, the Ministry supported the analysis of the Norwegian Competition Authority, and found that the acquisition would lead to a substantial lessening of competition. Despite this, the Ministry overturned the decision and approved the acquisition. They took into consideration the goals of the government's agricultural policy:

[19]See the Norwegian Competition Authority's decision letter from September 29 2005 on Prior's acquisition of Norgården, page 31.

'The Ministry finds that the acquisition of Norgården is of importance for the goal of the agricultural policy to protect the Norwegian production of eggs and revenues for the producers of eggs.'[20]

The disapproval was therefore overturned, even though the Ministry found it likely that the merger would lead to anti-competitive effects. On the contrary, they allowed the acquisition because it was expected to increase producer revenues.

A survey done by the Norwegian Competition Authority in 2005 found that fixed fees and various kinds of rebates were quite common in contracts between retail chains and their suppliers.[21] This strongly suggests that fixed fees are also present in this particular industry, as assumed in the theoretical model. The Competition Authority also found that both upstream and downstream firms treat each contract as confidential information, so that rivals cannot observe, for example, rebates and fixed fees in other firms' contracts.[22] In line with this, it is no surprise that it is hard to find exact knowledge about the specific contract between upstream and downstream firms in this industry. In all, this suggests that in this particular the firms

[20]See the decision made by the Ministry February 6 2006, page 23.

[21]In 2005 the Norwegian Competition Authority investigated the use of slotting allowances in the grocery sector in Norway, and their findings were reported in Konkurransetilsynet (2005). There is no public information about specific industries, but they state the following concerning fixed fees in general: *'Our survey shows that fixed fees are used to a large extent in the markets we have investigated.*' (our translation) (p. 45)

[22]See Konkurransetilsynet (2005), p. 55. They found that in some particular industries the rival firms have knowledge about what they call 'the main elements of the contract'. But even in this case the contract could be regarded as unobservable, since for example the rival firm does not exactly observe the marginal wholesale price.

use non-linear contracts, including fixed fees, that are unobservable. This motivates our chosen modeling approach.

3.2 Empirical specification and results

The empirical analysis is based on two sets of price indices: Consumer prices and average wholesale prices.[23] The indices are published by the Norwegian Agricultural Economics Research Institute (NILF). The consumer price index is produced by Statistics Norway (SSB). The indices come out monthly. Figure 3 shows both of these indices (1998 = 100).

[Figure 3 about here]

The average wholesale price index is for the acquiring firm Prior before and after the merger; the consumer price index is for consumer prices in the grocery stores. The basket of eggs in each of those two price indices also differs slightly.[24] These two price indices should therefore not be directly compared. However, it is interesting to check whether there are corresponding structural breaks in those two price indices.

The primary focus of this paper is the possible effects of the 2005 merger

[23] Again, average wholesale price is total payment divided by quantity paid by retail chains to upstream producers.

[24] 'Average wholesale price' is a weighted average of all types of eggs, except for organic eggs, delivered from two of Prior's plants. 'Consumer price' is the average price of all eggs sold in grocery stores. For details, see https://www.slf.dep.no/no/produksjon-og-marked/kjott-og-egg/marked-og-pris/priser/eggmarked-i-forandring.

on average wholesale prices and consumer prices. We therefore focus on the period between January 2003 and and December 2007.[25] This makes it possible to compare the development in the price series in the years leading up to the merger with development after the merger, without having to take into account changes and shifts in the price series occurring several years before or after the merger, which are unlikely to be directly related to the merger.

As a first empirical exercise, we examine the consumer price and fit it using a simple regression model where an exponential time trend is included, *i.e.* allowing for constant price growth from one month to the next.

$$\ln P_t^{consum} = \beta^{consum} + \gamma^{consum} \cdot t + u_t^{consum} \tag{14}$$

The model is estimated using OLS on data from the period January 2003 - December 2007. The reported standard errors are robust to heteroskedasticity and of possible autocorrelation of order 1 (Newey-West standard errors).[26,27] The results are reported in Column (1) of Table 1.

[25]Looking at the years from 2008-2009 on, there are significant jumps and variations. Part of this variation is due to composition effects. New types of eggs, such as organic eggs, enter and are given more weight in the egg price index (see Statens Landbruksforvaltning, 2010). We also observe a large shift in the consumer price in July 2008. This large shift is due to a general agreement between the farmers and the authorities (see Statens Landbruksforvaltning, 2009). In June-July 2009, we observe a shift in the average wholesale price.

[26]We also tested the model for higher-order serial correlation in the error terms, with only marginal changes in the significance of the estimated coefficients.

[27]Note that monthly dummies are include in all the models shown in Table 1 to capture possible seasonal effects.

[Table 1 about here]

The estimate of $\gamma^{consum} = 0.00265$ means a monthly growth in prices of 0.26%, which corresponds to a yearly growth rate of 3.2%. The exercise is then repeated for the wholesale prices by estimating the following model:

$$\ln P_t^{wholesale} = \beta^{wholesale} + \gamma^{wholesale} \cdot t + u_t^{wholesale} \tag{15}$$

This regression, with results reported in Column (2) of Table 1, yields an estimate of the growth rate in the average wholesale prices of 0.09% per month, that is a yearly growth of 1.1%.

Now to the main question of the empirical analysis: Are prices at the wholesale and consumer level affected by the merger? If, for example, the merger affected consumer prices, a structural break in the consumer price process would be expected. Looking at Figure 3, there is no obvious break in the consumer price series around the time of the merger, while there definitely seems to be something happening around the time of the merger for the wholesale price.

The standard way to test for structural breaks is to split the sample under consideration into two subsamples, estimate the parameters of an economic model for each subsample, and then test the equality of the parameters in the two subsamples using a Chow-statistic (see Hansen 2001). When one cannot tell *a priori* when the possible break occurred, one splits the sample at each

possible breakdate and finds the highest Chow-statistic. This value is called a Quandt-statistic. A high enough Quandt-statistic indicates that there is in fact a structural break in the time series. Critical values are provided in Andrews (1993).

Allowing for changes in the intercept and growth rate, the Quandt-statistic is 181.26. There is, in other words, a strong indication of a break in the wholesale price process. The least squares estimator of the breakpoint is January 2005.[28] The timing of the structural break seems consistent with it being caused by the 2005 merger. That the merging parties were able and willing to coordinate their behavior a few months before the announcement of the merger seems perfectly plausible.

Given the apparent break in the wholesale prices, the following model is estimated, allowing for one exponential trend until January 2005, then a shift and a new exponential trend.[29]

[28]Bai (1997) describes a method for sequentially testing for multiple structural breaks. Note however, given that the samples used for analyses include 60 observations, search or multiple breaks would leave each subperiod with few observations, and therefore very few degrees of freedom. Thus, the analyses of detecting structural breaks are limited to looking for one break only in each of the two-price series. Hansen (1999) establishes a method for obtaining confidence intervals for the breakpoint estimate. Following this method, it is found that only January 2005 is within the 95 percent confidence interval, *i.e.* the location of the breakpoint to January 2005 is very precisely estimated.

[29]In all the models in which a structural shift is included, we include a transformed time trend t that is equal to zero at the actual break point and growing (reducing) with unity for each subsequent (prior) month, instead of the initial time trend. This transformation means that one can observe directly the vertical shift and its statistical significance in the actual breakpoint.

$$\begin{aligned} \ln P_t^{wholesale} &= \beta_0^{wholesale} + \beta_1^{wholesale} \cdot D\left(t \geq 2005m1\right) \\ &+\gamma_0^{wholesale} \cdot t + \gamma_1^{wholesale} \cdot D\left(t \geq 2005m1\right) \cdot t + u_t^{wholesale} \end{aligned} \tag{16}$$

The results are summarized in Column (3) of Table 1. The regression results show a negative trend before the merger ($\gamma_0^{wholesale} = -0.00185$). This monthly growth rate of -0.19 %, corresponds to a yearly growth rate of -2.2 %. The estimate of $\gamma_1^{wholesale}$ is highly significant and positive, indicating increased growth rate after the break. Looking at the general trend post-merger, it is found that this trend is $\gamma_0^{wholesale} + \gamma_1^{wholesale} = 0.00316$. This corresponds to a annualized growth rate of 3.9%, which is statistically larger than both the pre-merger growth rate of wholesale prices and the growth rate of the consumer prices. A higher growth rate suggests that prices increased gradually after the merger, which can be explained by contracts not all being renegotiated at the same time.

It is of course of great interest whether a corresponding structural break is found for consumer prices. Allowing for changes in β_0^{consum} and γ_0^{consum} while assuming the other parameters are constant, a Quandt-statistic of 7.11 is obtained, which is below the critical values at a 5 percent significance level (11.79). There is, in other words, no indication of a structural break in the consumer price equation around the time of the merger. The results reported

in Table 1, column (4) are the ones after estimating the following model.

$$\begin{aligned} \ln P_t^{consum} &= \beta_0^{consum} + \beta_1^{consum} \cdot D\left(t \geq 2005m1\right) \\ &\quad + \gamma_0^{consum} \cdot t + \gamma_1^{consum} \cdot D\left(t \geq 2005m1\right) \cdot t + u_t^{consum} \end{aligned} \tag{17}$$

Here we observe a small but statistically insignificant change in the time trend. Thus, the structural break found for the wholesale prices is not reflected in the consumer prices. This lack of significant effects on the downstream firms' consumer prices is consistent with the model's theoretical prediction.

The actual and predicted consumer prices and average wholesale prices based on the models reported in Table 1, columns (3) and (4) are given in Figure 4.

[Figure 4 about here]

The fit of predicted to actual prices is good.

3.3 Robustness checks and discussion

We have conducted a series of robustness checks on these results.[30] In the first robustness check, the break point is set to be May, the official point of the merger, instead of January as found for the results reported in Table 1. Thus, an otherwise identical model as described by equations (16) and (17) with $D\left(t \geq 2005m1\right)$ replaced by $D\left(t \geq 2005m5\right)$ are estimated. The results of these exercises are almost identical.

The wholesale price series, in which we found a structural break around the time of the merger, could of course be caused by other factors than the merger, both on the input side and the output side. To control for the former, we include a series of controls. First, we include log-transformed price indices for soybeans and soybean oil, together with log-transformed prices indices for wheat and maize. All these factors are important ingredients in the feed of egg-laying poultry. We also include an index of electricity prices, since electricity is used to heat the farms. The results of the re-estimation of the wholesale price model with these additional controls are reported in column (1), Table 2. The Hansen/Bai procedure gives the same breakpoint as before, *i.e.*, January 2005. Holding the reported results in Table 2, column (1), together with the corresponding ones in Table 1, there are no obvious large differences between the two sets of results. Thus, the structural change found for the wholesale prices does not seem to be driven by cost factor

[30]Not all of the robustness checks are shown. These are still available from the authors on request.

changes.

[Table 2 about here]

A significant effect of the merger on the consumer price could have been offset by changes in other variables affecting consumer prices. To allow for this, we include a consumer food price index together with the electricity price index in a consumer price model corresponding to the model reported in Table 1, column (4). We also include the wholesale price, allowing for different effects of these before and after the merger. The results are reported in Table 2, column (2). Again, there is very little difference between these latter results and the ones in Table 1.[31] Most important, using the Hansen/Andrew method to reveal potential structural breaks, no such breaks are found in the consumer prices (the Quandt statistic is 7.06, well below the critical value of 11.79).

An additional robustness check allows for some dynamics by introducing a lagged dependent variable, lagged one month in the two models reported in Table 2, columns (1) and (2). The coefficient of the lagged dependent variable in the consumer price model is 0.265. This means that there is some inertia in the consumer prices. Most importantly, no structural break is found in this dynamic model of consumer prices. We conducted a corresponding

[31] Admittedly, the coefficient of the wholesale price has a negative sign before the merger, and a positive sign after the break. Note however that they are both statistically insignificant. This should not be interpreted as a rejection of a pass-through hypothesis or as a sign of mis-specification of the model, given that the wholesale prices are average prices and and therefore do not reflect marginal costs.

exercise for the average wholesale price. Here, the coefficient of the lagged dependent variable was 0.140. But again, the model shows no other breaks than the structural break already identified. Thus, the results reported in Tables 1 and 2 are unlikely to be caused by some hidden price dynamics.[32]

We have also compared the wholesale price of eggs and the wholesale price of chicken. Figure 5 shows that the two prices develop quite differently over time.

[Figure 5 about here]

The similar input costs of eggs and chicken meat, and the likelihood that these products have similar demand conditions, makes the price of chicken meat a potential comparison group when analyzing the price effects of the merger in a difference-in-differences estimation framework (see for instance Ashenfelter and Hosken, 2010). Figure 5 seems to support our hypothesis that the merger resulted in increased wholesale prices for eggs: There seems to be a break in the wholesale price of eggs around the time of the merger, a break that is not found in the corresponding price series for chicken. The results of a difference-in-difference analysis indicate that the merger did indeed have a statistically significant positive effect on average wholesale prices of eggs. Note, however, that the assumption of a common underlying trend in

[32]The models reported in Table 1 are also estimated with a Cochrane-Orcutt AR(1) procedure. The results are almost identical to the reported OLS results. In addition, the models are also tested for non-stationarity in the log-transformed consumer price and average wholesale price, using the procedure outlined in Perron (1989, 1990). There is no sign of non-stationarity.

the prices of the treated group (eggs) and the control group (chicken) treatment (*i.e.* the merger) may be violated. In our interpretation it is exactly the negative trend in the average wholesale prices that in part motivated the merger. Nevertheless, while certainly not bringing conclusive evidence of the effect of the merger, the analysis is consistent with our main result. Since both markets are part of the Norwegian agricultural sector, the results suggest that there was no general change in agricultural policy that can explain the structural break in average wholesale prices on eggs.[33]

It might be argued that the lack of a structural break in the consumer prices is driven by changes in the market structure at the retail level. In particular, a reduction in retail concentration starting in 2005 could explain why the structural break in the wholesale prices are not passed on to the consumer prices. Monthly data capturing such changes are hard to get. However, Figure 6 reports annual changes in retail concentration, suggesting that it does not seem to be an issue. On the contrary, we observe an increase in concentration on the retail level after 2005.

[Figure 6 about here]

An alternative way to test the prediction from theory is to look at quantity sold. Since the model predicts no changes in the marginal price on inputs for

[33]We also have average wholesale prices for various meat products that also came under overall agricultural policy. Again, there is no indication of any structural break in those prices at the time of the egg merger.

the retailers, we expect that the retailers do not change their prices to final consumers following the merger. One implication of this is that we should observe no change in quantity sold at the time of the merger. Figure 7 shows annual sales.

[Figure 7 about here]

There seem to be no changes in annual sales at the time of the merger. If anything, sales volume increased after the merger. This is the opposite of what would be expected if the merger had led to higher prices to final consumers. This piece of evidence is in line with there being no structural break in the final consumer prices, and is also consistent with a shift in the average wholesale prices caused by a shift in non-marginal payment from downstream to upstream firms.

The structural break in the trend in average wholesale price might also be explained by measures implemented by the market regulator Prior. Each year, costly efforts ensure high prices, like exporting eggs at a price that leads to a loss for the producers. In Figure 8, we show the annual cost of such measures.

[Figure 8 about here]

Figure 8 shows that the costs associated with market regulation increased in 2004 and 2005, and then dropped again after that. Unfortunately, we do

not have monthly data and cannot use this as a control variable in our regressions, where we use monthly data. Note, though, that the cost of market regulation drops after 2005. This indicates that market regulation as such cannot explain the long run trend in prices, where there was a positive shift in the average wholesale price trend after 2005. On the contrary, this indicates that the acquisition made it possible to increase the average wholesale price without extra efforts to regulate the market.

Annual producer prices (prices paid by the upstream firm to the farmers) are shown in Figure 9.

[Figure 9 about here]

Since the upstream acquiring firm is a cooperative, this means that the producer price can be seen as a payment to the farmers and therefore as a measure of the profits generated by the upstream firm. Since upstream firms incur costs with market regulation, the producer price would then capture the combined effect of the acquisition on average wholesale prices and the costs associated with market regulation. We also have access to monthly data on producer prices.[34] Using monthly data, we found a structural break in the producer price in February 2005. This indicates that the acquisition led to a combination of higher average wholesale prices and fewer resources

[34]These monthly producer prices are confidential. Somewhat more details may be given by the authors on request.

spent on market regulation.

We have considered average wholesale prices of the acquiring firm before and after the acquisition. Ideally, we should then compare that with the changes in consumer prices for the acquiring firm's products. However, the large size of the acquiring firm implies that if there were any change in the acquiring firm's consumer price, it would also be expected to show up in the general consumer price index for eggs we are using.

It would also be of interest to check the average wholesale price for the non-merging firms. In theory, this acquisition should not affect the average prices of non-merging firms. However, there have been some acquisitions among the remaining firms in the industry. Due to this, the prediction would be that the average wholesale price has risen also for these firms. Unfortunately, we do not have access to detailed wholesale price data for these other firms.

The empirical models in this article are all estimated using price indices. Some might argue that a proper analysis should be based on micro data, such as scanner data, for the products. Note however, scanner data for the transaction between upstream and downstream firms are hard to get, or non-existent. With scanner data only available at the consumer level one has to make (non-testable) assumptions concerning the price tariff between the upstream and the downstream firms. Furthermore, scanner data are used to estimate a system of demand equations such that one can simulate the effects of a merger. Note however, with our data we can observer the price-effects of

the merger directly and do not have to rely on all the necessary assumptions being made when doing merger simulations. These arguments have therefore convinced us not to investigate this path further.

The set of robustness checks buttress our initial findings reported in Section 3.2; there is a structural break in the wholesale prices which is most likely related to the 2005 merger. There are no effects of the upstream merger on consumer prices. The structural break in the wholesale prices, with no corresponding structural break in the consumer prices, lends support to our theoretical model.

4 Conclusion

In this paper, we develop a theoretical model of a successive oligopoly with a non-linear tariff between upstream and downstream firms, and use it to analyze the possible anti-competitive effects of an upstream merger. We apply the model to predict the price effects of an upstream merger in the Norwegian egg market. We find that the empirical results of this particular upstream merger are consistent with the predictions from the theoretical model. The upstream merger led to higher average prices to upstream firms, while the prices to final consumers did not change.

We do not claim that these results are unique to this particular model, or to this particular case. We have reason to believe that the mechanism at work can be quite general. The crucial element is the non-linear contract

between the upstream and the downstream firms. With a non-linear price, an increase in market power due to an upstream merger may affect mainly the fixed element and have no, or only a limited, effect on the price on the last unit. If that is the case, we can expect few if any price effects on final consumers. Given that non-linear contracts between upstream and downstream firms are common in many industries, we expect that upstream mergers may often have quite limited or zero price effects on final consumers.

Ashenfelter and Hosken (2010) report the results of *ex post* evaluation of five US mergers. They consider those mergers that seem most likely to be problematic, and therefore they present their results as an upper bound on the likely price effects on final consumers of mergers. However, all five mergers are upstream mergers and they investigate the price effect for final consumers. Our model and results indicates that non-linear contracts can dampen the pass-through rate. In that respect their study is probably not an upper bound on the price effect for final consumers following a horizontal merger between firms that sell directly to final consumers.

In 2010 the EU Commission cleared a merger between Unilever and Sara Lee, subject to structural remedies. Some brands owned by Sara Lee were sold. According to the Commission, this was '*a strong and clear-cut remedy, .. to ensure that the transaction would not lead to higher prices for consumers.*'[35] This was an upstream merger. Unilever and Sara Lee sold their

[35]See case COMP/M.5658 – Unilever/Sara Lee. The quote is from the press release from the EU Commission IP/10/1514 from 17 November 2010.

products to retailers which, in turn, sold to final consumers. One important piece of evidence concerning price effects seems to be the results from a merger simulation model.[36] However, the vertical structure of the market is not taken into account in the merger simulation. They use scanner data on the consumer level to estimate demand, and this demand system is applied to estimate the price increase after the merger. This is the standard approach for merger simulations, but it nevertheless ignores the vertical dimension we are concerned about. As far as we understand it, contracts between upstream and downstream firms in this particular industry are not observed by rivals and they might include non-linear elements such as rebates and fixed fees. Our study suggests that in an industry with such a vertical structure there might not be any price increase for the final consumers following such a merger as the one between Unilever and Sara Lee. If so, the price increases estimated from the merger simulation model in this particular merger case may have been flawed.

The results of this analysis have important implications for merger assessment by competition authorities. Simply assuming that the price increase from an upstream merger will be passed on to final consumers can be misguided, as it apparently was in the upstream merger investigated in this paper. The Norwegian Competition Authority's disapproval decision claimed - among other things - that it would lead to higher consumer prices. This

[36] See the Technical Annex to the decision, where the merger simulation model is described.

turned out to be wrong. However, an upstream merger may have other effects not investigated here. For example, it may lead to less rivalry in R&D. This suggests that when assessing upstream mergers, competition authorities should be less concerned about the price effect on final consumers and more concerned about other effects, such as the effects on innovation.

5 Appendix A

5.1 Proof of Proposition 1

The negotiating parties solve:

$$\max_{w_{ir},f_{ir}} N_{ir} = \gamma^{ir} \ln\left(\pi_i - \nu_i^r\right) + \left(1-\gamma^{ir}\right) \ln\left(\pi_r - \nu_r^i\right)$$

The first order conditions are given by:

$$\begin{aligned} \frac{\partial N_{ir}}{\partial f_{ir}} &= 0 \Leftrightarrow \\ \gamma^{ir}\left(\pi_r - \nu_r^i\right) &= \left(1-\gamma^{ir}\right)\left(\pi_i - \nu_i^r\right) \end{aligned}$$

$$\begin{aligned} \frac{\partial N_{ir}}{\partial w_{ir}} &= 0 \Leftrightarrow \\ \gamma^{ir} \frac{\frac{\partial \overline{\pi}_i}{\partial w_{ir}}}{\pi_i - \nu_i^r} &= -\left(1-\gamma^{ir}\right) \frac{\frac{\partial \pi_r}{\partial w_{ir}}}{\overline{\pi}_r - \nu_r^i}. \end{aligned}$$

Combining the first order conditions yields:

$$\frac{\partial \pi_i}{\partial w_{ir}} + \frac{\partial \pi_r}{\partial w_{ir}} = 0.$$

Since rivals can not respond to changes in w_{ir}, changes in w_{ir} affect the bi-

lateral profit of producer i and retailer r only through the effects on the retail prices at retailer r. Maximizing $(\pi_i + \pi_r) = Q_{ir}(\mathbf{p})\,(p_{ir} - w_{ir}) + Q_{ir}(\mathbf{p})\,(w_{ir} - c) + \sum_{j=1,j\neq i}^{N} Q_{jr}(\mathbf{p})\,(p_{jr} - w_{jr}) + \sum_{s=1,s\neq r}^{M} Q_{is}(\mathbf{p})\,(w_{is} - c)$ with respect to w_{ir} gives us a first-order condition that can be written as:

$$\left(\frac{\partial Q_{ir}}{\partial w_{ir}}(p_{ir} - w_{ir}) + Q_{ir}(\mathbf{w})\frac{\partial P_{ir}}{\partial w_{ir}}\right) + \sum_{j=1,j\neq i}^{N}\left(\frac{\partial Q_{jr}}{\partial w_{ir}}\,(p_{jr} - w_{jr}) + Q_{jr}(\mathbf{w})\frac{\partial p_{jr}}{\partial w_{ir}}\right)$$
$$+ \frac{\partial Q_{ir}}{\partial w_{ir}}(w_{ir} - c) + \sum_{s=1,s\neq r}^{M}\frac{\partial Q_{is}}{\partial w_{ir}}\,(w_{is} - c)$$
$$= 0.$$

The first two terms of the left hand side can be written:

$$\frac{\partial P_{ir}}{\partial w_{ir}}\left[\frac{\partial Q_{ir}}{\partial p_{ir}}\,(p_{ir} - w_{ir}) + Q_{ir}(\mathbf{p}) + \sum_{j=1,j\neq i}^{N}\frac{\partial Q_{jr}}{\partial p_{ir}}\,(p_{jr} - w_{jr})\right] +$$
$$\sum_{j=1,j\neq i}^{N}\frac{\partial P_{jr}}{\partial w_{ir}}\left[\frac{\partial Q_{jr}}{\partial p_{jr}}\,(p_{jr} - w_{jr}) + Q_{jr}(\mathbf{p}) + \frac{\partial Q_{ir}}{\partial p_{jr}}\,(p_{ir} - w_{ir}) + \sum_{k=1,k\neq i,j}^{N}\frac{\partial Q_{kr}}{\partial p_{jr}}\,(p_{kr} - w_{kr})\right],$$

and are zero by the first-order conditions of the retailer in the retail price-setting stage. This leaves us with the following condition:

$$\frac{\partial Q_{ir}}{\partial w_{ir}}(w_{ir} - c) + \sum_{s=1,s\neq r}^{M}\frac{\partial Q_{is}}{\partial w_{ir}}\,(w_{is} - c) = 0.$$

In a symmetrical equilibrium with all wholesale prices equal to w^*,we must have $(w^* - c)\left(\frac{\partial Q_{ir}}{\partial w_{ir}} + \sum_{s=1,s\neq r}^{M} \frac{\partial Q_{is}}{\partial w_{ir}}\right) = 0$. Since own effects dominate cross effects, this can only be the case when $w^* = c$.

5.2 Derivation of Equation 7

The first-order condition for f_{ir} can be written as:

$$\frac{\partial N_{ir}}{\partial f_{ir}} = 0 \Leftrightarrow$$

$$f_{ir} = \gamma^{ir}\left(\begin{array}{c} Q_{ir}(\mathbf{w})\left(P_{ir}(\mathbf{w}) - w_{ir}\right) + \sum_{j=1,j\neq i}^{N} Q_{jr}(\mathbf{w})\left(P_{jr}(\mathbf{w}) - w_{jr}\right) \\ - \sum_{j=1,j\neq i}^{N} Q_{jr}(w_{ir}=\infty, \mathbf{w}^*_{-ir})\left(P_{jr}(w_{ir}=\infty, \mathbf{w}^*_{-ir}) - w_{jr}\right) \end{array}\right)$$

$$- \left(1-\gamma^{ir}\right)\left(\begin{array}{c} Q_{ir}(\mathbf{w})\left(w_{ir} - c\right) + \sum_{s=1,s\neq r}^{M} Q_{is}(\mathbf{w})\left(w_{is} - c\right) \\ - \sum_{s=1,s\neq r}^{M} Q_{is}(w_{ir}=\infty, \mathbf{w}^*_{-ir})\left(w_{is} - c\right) \end{array}\right)$$

In equilibrium, all marginal wholesale prices are equal to marginal cost, and the expression above is reduced to Equation 7.

5.3 Proof of Proposition 2

The parties of the negotiation solve:

$$\max_{w_{1r}, w_{2r}, f_{ur}} N_{ur} = \gamma^{ur} \ln\left(\pi_u - \nu_u\right) + \left(1-\gamma^{ur}\right) \ln\left(\pi_r - \nu_r^u\right).$$

The first-order conditions ($i = 1, 2$) are given by:

$$\frac{\partial N_{ur}}{\partial f_{ur}} = 0 \Leftrightarrow$$
$$\gamma^{ur} \left(\pi_r - \nu_r^u\right) = \left(1 - \gamma^{ur}\right) \left(\pi_u - \nu_u^r\right)$$

$$\frac{\partial N_{ur}}{\partial w_{ir}} = 0 \Leftrightarrow$$
$$\gamma^{ur} \frac{\frac{\partial \pi_u}{\partial w_{ir}}}{\left(\pi_u - \nu_u^r\right)} = -\left(1 - \gamma^{ur}\right) \frac{\frac{\partial \pi_r}{\partial w_{ir}}}{\left(\pi_r - \nu_r^u\right)}.$$

Combining the two gives us:

$$\frac{\partial \pi_u}{\partial w_{ir}} + \frac{\partial \pi_r}{\partial w_{ir}} = 0.$$

Differentiating $\pi_u + \pi_r$ with respect to w_{1r} and eliminating terms that are zero by the first-order condition of the retailer leaves us with:

$$\frac{\partial Q_{1r}}{\partial w_{1r}} \left(w_{1r} - c\right) + \sum_{s=1, s \neq r}^{M} \frac{\partial Q_{1s}}{\partial w_{1r}} \left(w_{1s} - c\right) + \frac{\partial Q_{2r}}{\partial w_{1r}} \left(w_{2r} - c\right) + \sum_{s=1, s \neq r}^{M} \frac{\partial Q_{2s}}{\partial w_{1r}} \left(w_{2s} - c\right) = 0.$$

In a symmetric equilibrium with $w_{1r} = w_{2r} = w_u^*$ for every r, we need

$$(w_u^* - c)\left(\frac{\partial Q_{1r}}{\partial w_{1r}} + \sum_{s=1,s\neq r}^{M} \frac{\partial Q_{1s}}{\partial w_{1r}} + \frac{\partial Q_{2r}}{\partial w_{1r}} + \sum_{s=1,s\neq r}^{M} \frac{\partial Q_{2s}}{\partial w_{1r}}\right) = 0.$$

Since own-price effects dominate cross-price effects, this implies that $w_u^* = c$. The non-merging producers negotiate as before with the M retailers, taking the outcome of the other negotiations as given. Hence in equilibrium all marginal wholesale prices are unchanged and are equal to marginal cost.

5.4 Derivation of Equation 13

$$\frac{\partial N_{ur}}{\partial f_{ur}} = 0 \Leftrightarrow$$

$$f_{ur} = \gamma^{ur}\left(\begin{array}{c} \sum_{i=1}^{2} Q_{ir}(\mathbf{w})\left(P_{ir}(\mathbf{w}) - w_{ir}\right) + \sum_{j=3}^{N} Q_{jr}(\mathbf{w})\left(P_{jr}(\mathbf{w}) - w_{jr}\right) - \\ \sum_{j=3}^{N} Q_{jr}(w_{1r} = w_{2r} = \infty, \mathbf{w}^*_{-1r,2r})\left(P_{jr}(w_{1r} = w_{2r} = \infty, \mathbf{w}^*_{-1r,2r}) - w_{jr}\right) \end{array}\right)$$

$$- (1 - \gamma^{ur})\left(\begin{array}{c} \sum_{i=1}^{2} Q_{ir}(\mathbf{w})\left(w_{ir} - c\right) + + \sum_{s=1,s\neq r}^{M}\sum_{i=1}^{2} Q_{is}(\mathbf{w})\left(w_{is} - c\right) \\ - \sum_{s=1,s\neq r}^{M}\sum_{i=1}^{2} Q_{is}(w_{1r} = w_{2r} = \infty, \mathbf{w}^*_{-1r,2r})\left(w_{is} - c\right) \end{array}\right)$$

In equilibrium, all marginal wholesale prices are equal to marginal cost, and the expression above is reduced to Equation 13.

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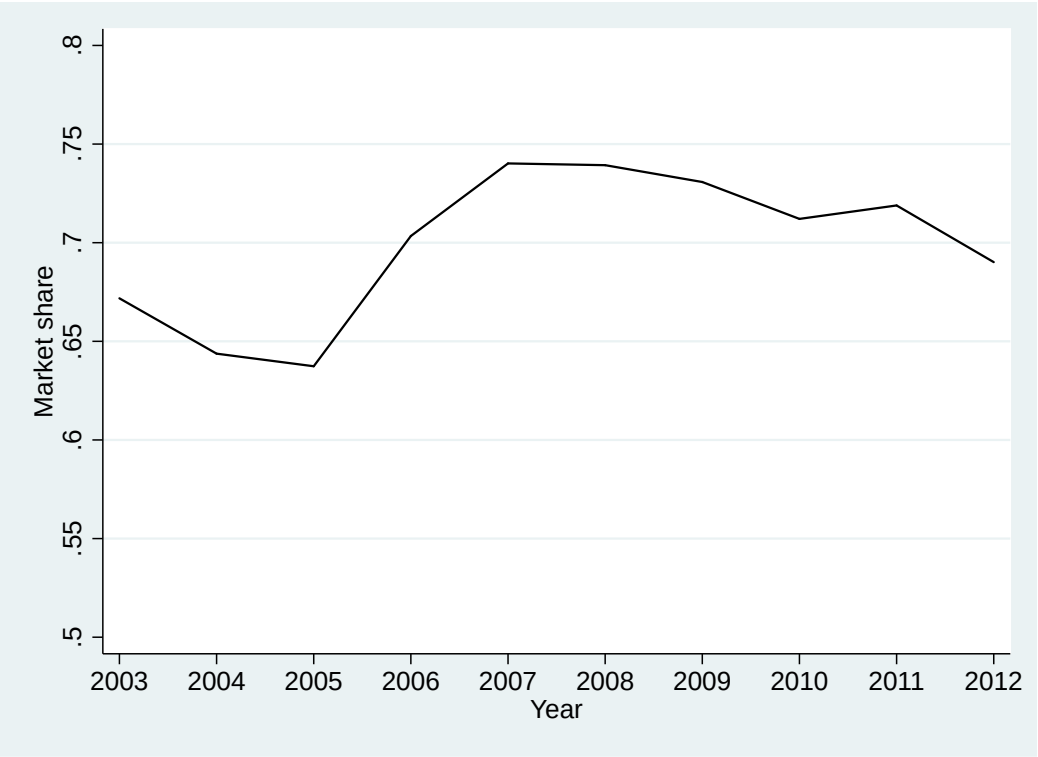

Figure 1: Prior's market share.
Source: Statens Landbruksforvaltning.

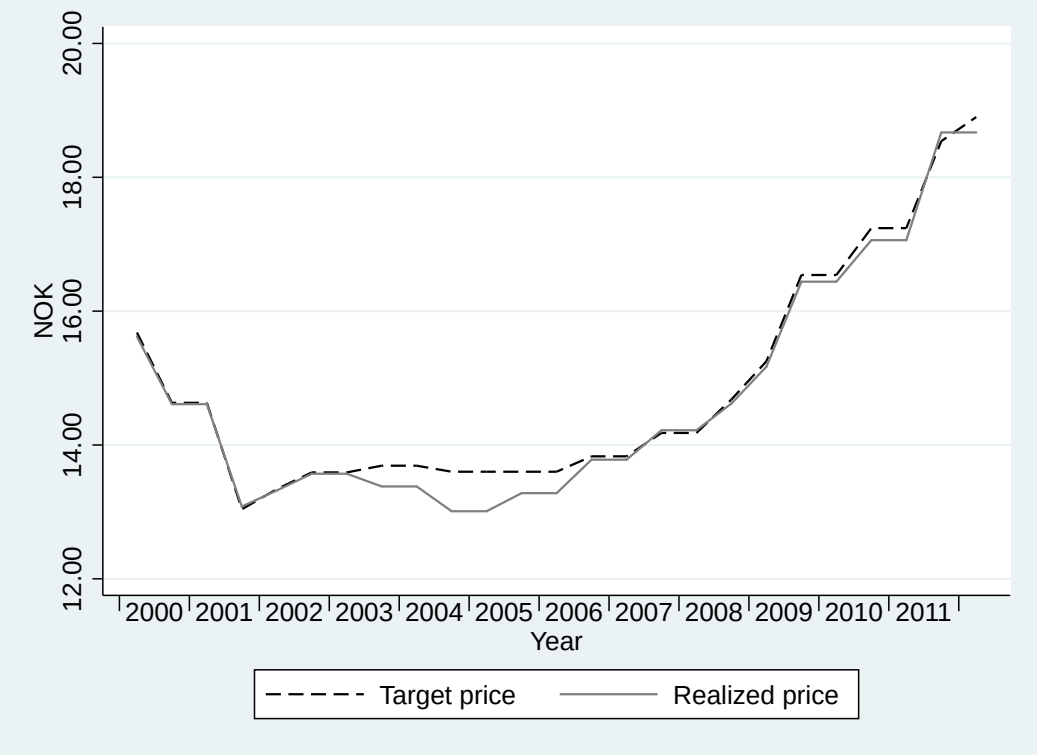

Figure 2: Target price and realized price.
Source: Statens Landbruksforvaltning.

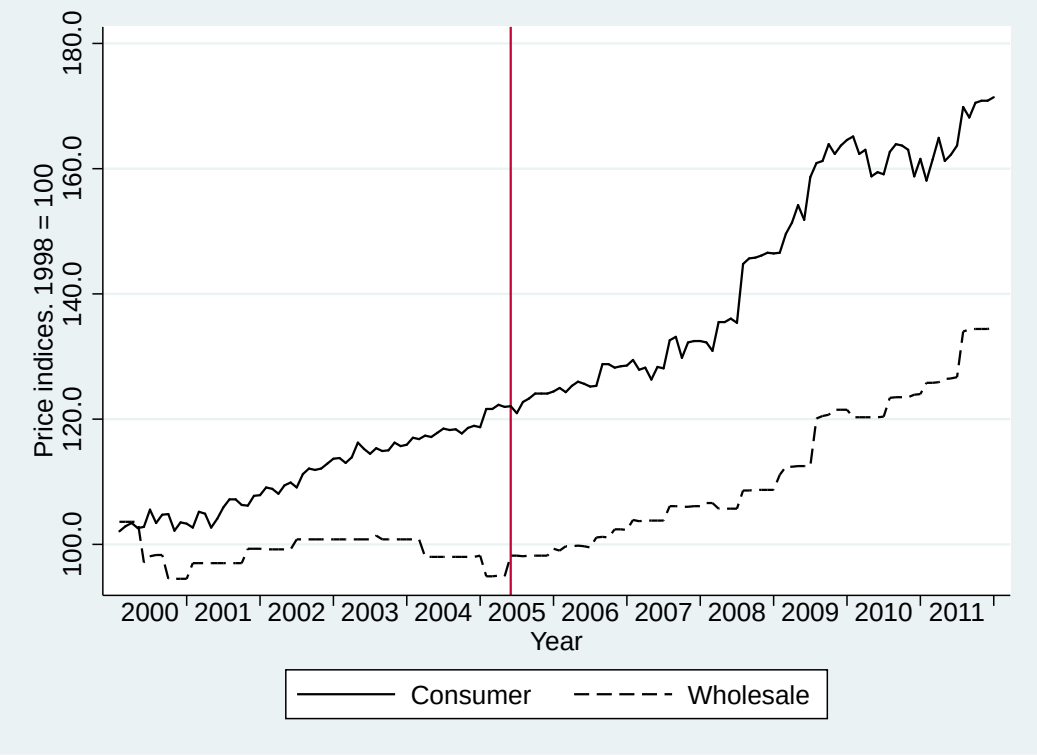

Figure 3: Price indices of consumer price and average wholesale price. 1998 = 100. Vertical line indicates time of merger (May 2005). Source: NILF.

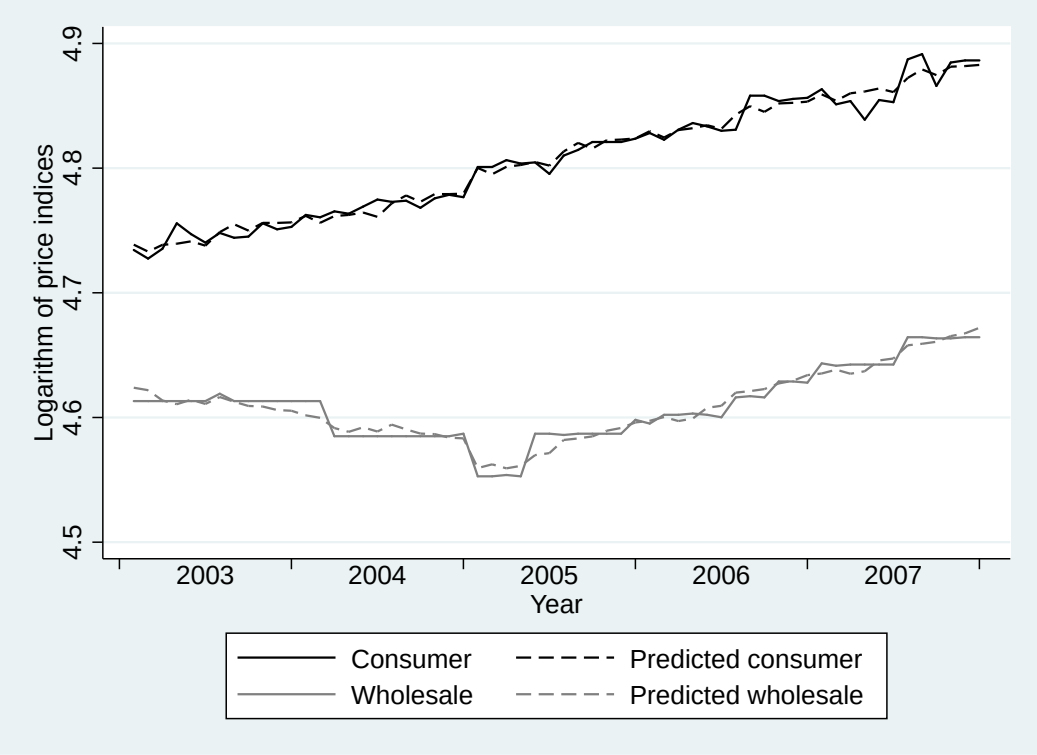

Figure 4: Actual and predicted values of consumer and average wholesale prices.
Log if index values. Vertical line indicates time of merger (May 2005). Source: NILF

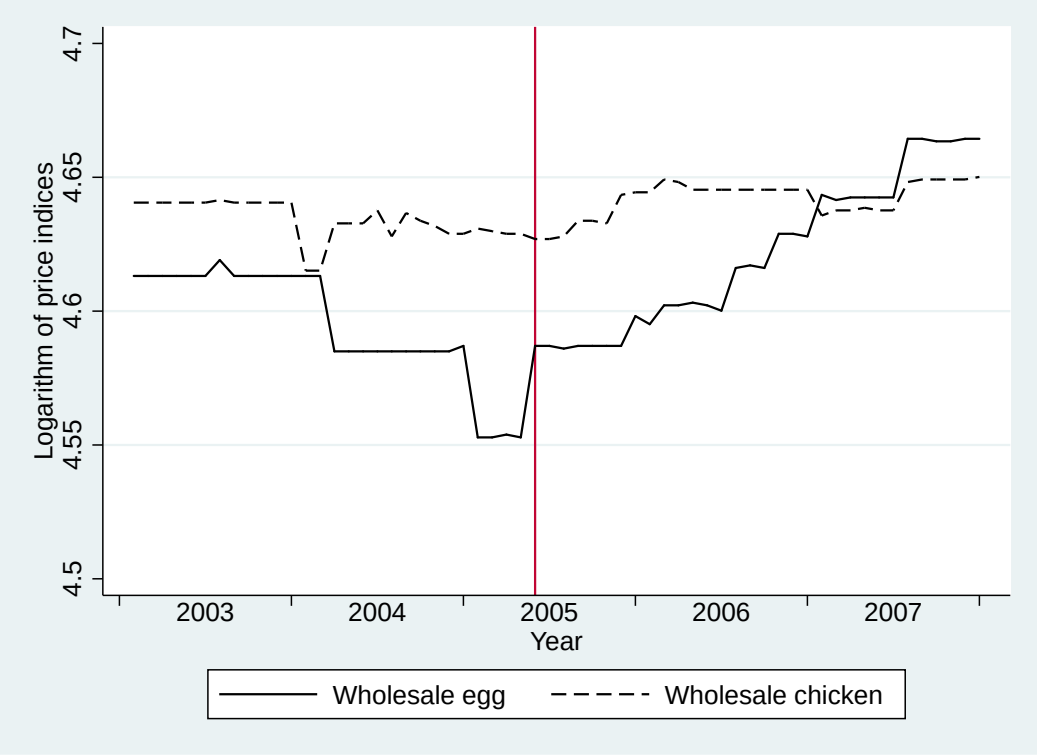

Figure 5: Wholesale prices chicken and egg.
Log of index values, 1998 = 100. Vertical line indicates time of merger (May 2005). Source: NILF

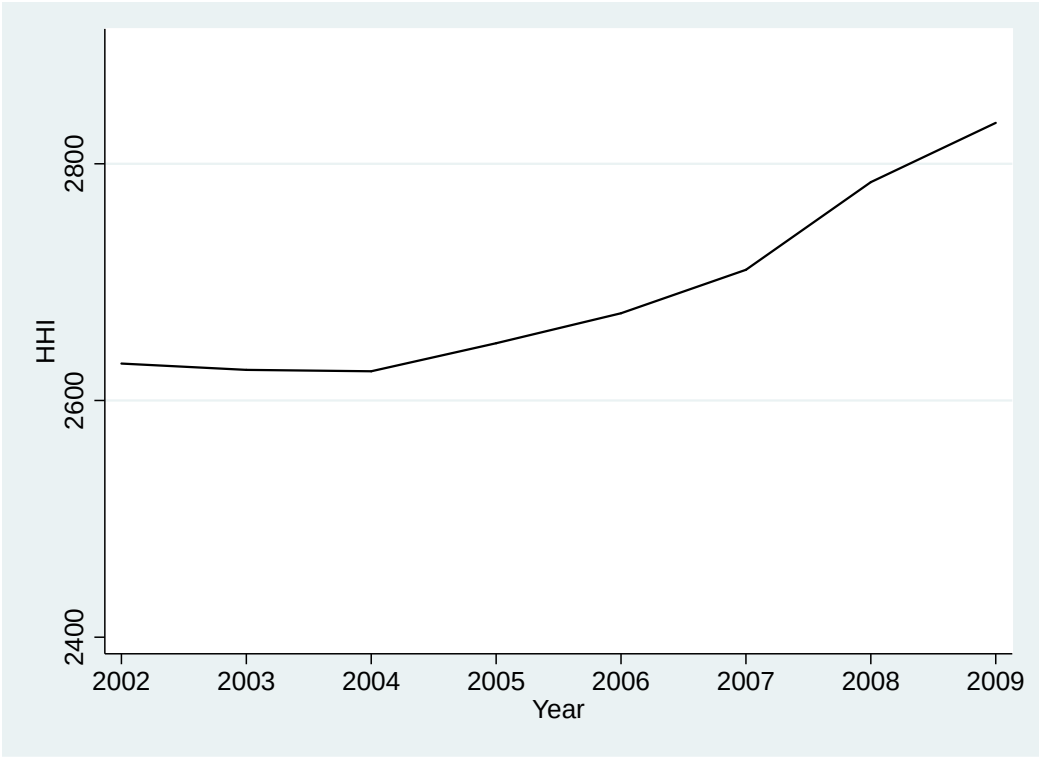

Figure 6: HHI retail sector.
Source: AC Nielsen.

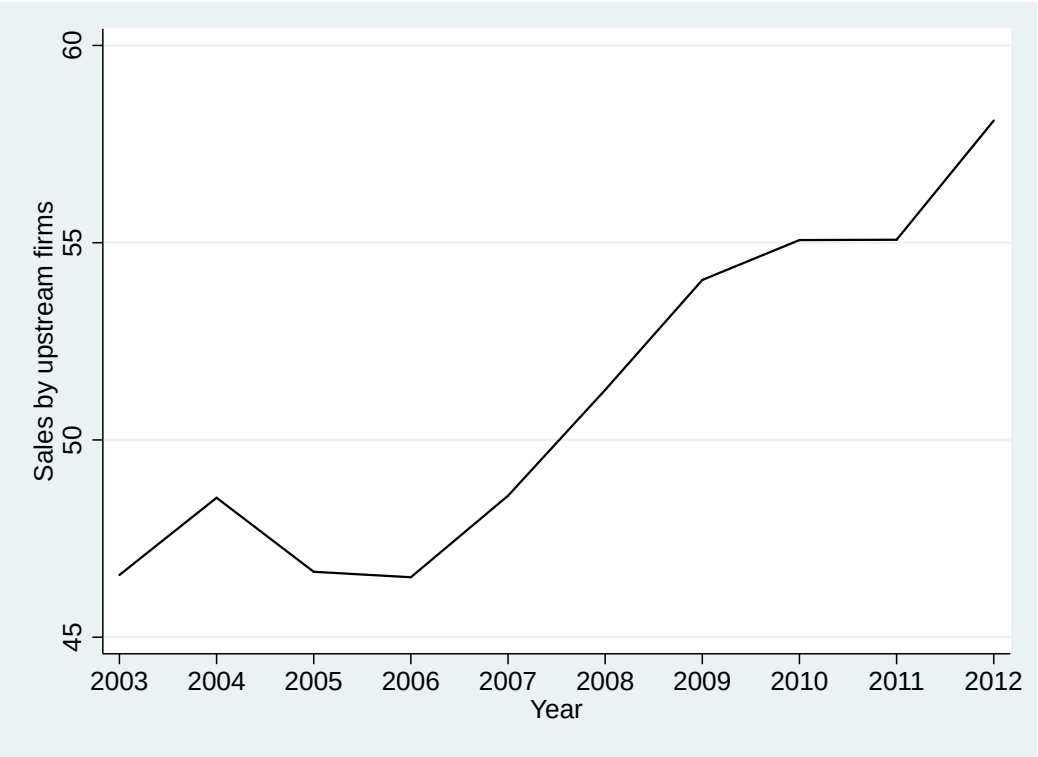

Figure 7: Yearly sales volume of eggs.
All upstream firms. Values in thousands of tonnes. Source: NILF

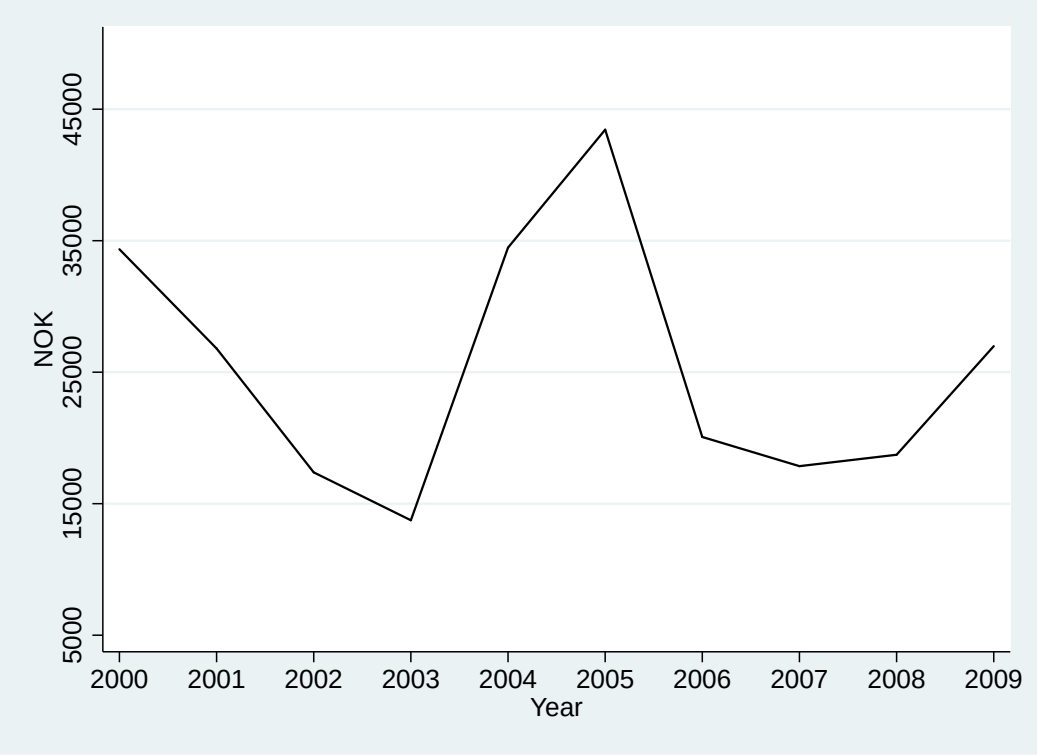

Figure 8: Cost of market regulation.
Values in thousands. Source: Annual reports, Omsetningsrådet.

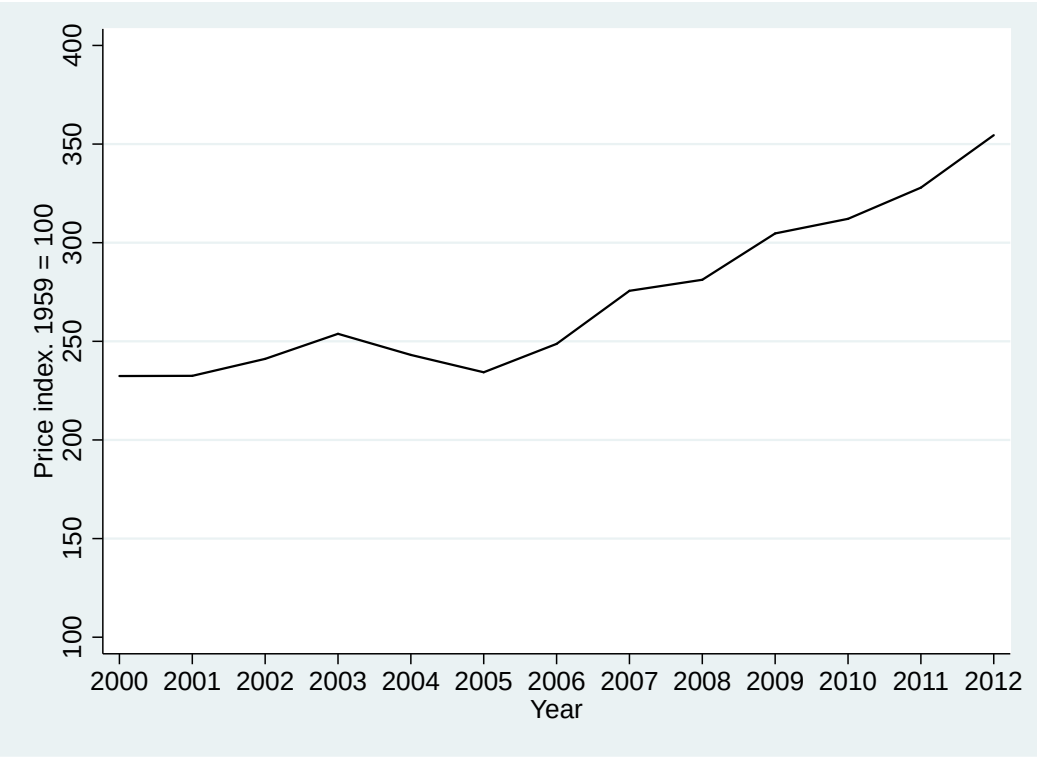

Figure 9: Price index of producer price.
1959 = 100. Source: NILF

VARIABLES	(1) lnP(consumer)	(2) lnP(wholesale)	(3) lnP(wholesale)	(4) lnP(consumer)
t	0.00265**	0.00084**	-0.00185**	0.00192**
	(0.00009)	(0.00028)	(0.00024)	(0.00025)
D(t>2005m1)			-0.02018**	0.01533**
			(0.00536)	(0.00414)
D(t>2005m1)*t			0.00501**	0.00053
			(0.00028)	(0.00028)
Control variables				
Monthly dummies	yes	yes	yes	yes
Observations	60	60	60	60

Standard errors in parentheses

** p<0.01, * p<0.05

Note: Standard errors are robust to heteroskedasticity and autocorrelation of order 1.

Table 1: Estimation results

VARIABLES	(1) lnP(wholesale)	(2) lnP(consum)
t	-0.00215**	0.00147**
	(0.00018)	(0.00052)
D(t>2005m1)	-0.02827**	-1.00523
	(0.00532)	(1.42564)
D(t>2005m1)*t	0.00614**	0.00093
	(0.00036)	(0.00077)
lnP(wholesale)		-0.21723
		(0.22726)
lnP(wholesale)*D(t>2005m1)		0.22293
		(0.31199)
Control variables		
lnP(soybean)	yes	no
lnP(soybean oil)	yes	no
lnP(wheat)	yes	no
lnP(maize)	yes	no
lnP(electricity)	yes	yes
Monthly dummies	yes	yes
Retail food price index	no	yes
Observations	60	60

Standard errors in parentheses

** p<0.01, * p<0.05

Note: Standard errors are robust to heteroskedasticity and autocorrelation of order 1.

Table 2: Robustness checks

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