Price Wars in Two-Sided Markets: the Case of the UK Quality Newspapers in the '90s

Stefan Behringer*
Department of Economics, Universität Bonn

Lapo Filistrucchi
Department of Economics, University of Florence
CentER and TILEC, Tilburg University

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Abstract

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This paper investigates the price war in the UK quality newspaper industry in the 1990s We show that the evidence brought forward at the time is not sufficient to establish a case of predatory pricing as it has neglected the critical two-sidedness of the markets. We show that the empirical evidence is instead in accordance with a substantial change in the optimal finance mix of newspapers as the advertising market grows and advertising becomes the dominant source of newspaper revenues. The finding holds under weak theoretical assumptions.

1 Introduction

In this paper we investigate the 'price war' in the UK weekly *quality broadsheet newspaper industry* in the 1990s. The public and regulatory discussion of this period has portrayed it as being a case of presumed *predatory pricing*. Recent theoretical advances in economics suggest that the discussion at the time should have been framed within the theory of *two-sided markets*. Investigating this price war using the tool of this theory we look at possible (not necessarily exclusive) candidate explanations.

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A two-sided market (see Parker & Van Alstyne (2005), Armstrong (2006), Rochet & Tirole (2006)) involves two groups of agents who interact via "platforms", where one group's benefit from joining a platform depends on the size of the other group that joins the platform. In two-sided markets there may therefore be critical network effects due to externalities not only from the group on the same side but also from that on the other side.

Such complex network effects are known to give rise to multiple equilibria making robust predictions about comparative statics hard to obtain. A solution concept that substantially simplifies this problem is that of *insulating equilibrium* as postulated in Weyl (2010) extending an idea found in Shaked & Sutton (1982) and others that when choosing prices the other firm's quality choice i.e. *vertical* product differentiation (here its share of participants) is taken as given. An application of this concept to *asymmetric* settings can be found in Behringer (2010).

The media market is a typical two-sided market (see Anderson and Gabszewicz (2008)), as a media firm sells content to consumers i.e. readers, viewers, or listeners and advertising space to advertisers. The firm knows that the number (and characteristics) of consumers influence the demand for advertising space while, vice versa, depending on the media product, the number (or concentration) of advertising spaces may influence the demand from consumers. Weyl's (2010) monopoly analysis is also accompanied by a motivation from the newspaper industry.

In the case of newspapers, clearly the advertisers are concerned with the reach of a newspaper and hence a newspaper with a higher market share will face a higher demand for its advertising slots for any given advertising tariff. Whether instead readers like or dislike advertising is a sometimes a debated issue and may depend on the particular publication.

Some previous theoretical work has modelled newspaper competition as taking place on the political line using the *Hotelling (1929) Model* of *horizontal* product differentiation. Among them Gabszewicz, Laussel, and Sonnac (2001, 2002), who endogenise the location choice in a first stage, while in most models location is only exogenous. Such endogenous political locations represent as a crucial factor to understand the UK 'price war' and is investigated in our companion paper Behringer & Filistrucchi (2010a) using a simulation technique based on Götz (2005).

Due to the complexity of the theoretical modelling and the substantial data requirements, *structural econometric work* on the media as two-sided markets is still quite scarce. Rysman (2004) analyses the market for yellow pages in the U.S. and shows that network effects between advertisers and readers are indeed present. He also considers whether the market benefits from monopoly (which takes advantage of network effects) or oligopoly (which reduces market power)

and finds that a more competitive market is preferable. While the markets analysed are different, we use the specification for the advertising demand he proposed.

Kaiser and Wright (2006) estimate an adapted version of Armstrong's (2006) model of competition in a two-sided market where magazines compete as Hotelling duopolists and find that, due to the presence of indirect network effects, in Germany the readers' side of the market is subsidized by the advertisers. Argentesi & Filistrucchi (2007) test for market power in the national daily newspaper market in Italy, concluding that the four main national daily newspapers have been colluding on the cover price but not on the advertising one. Fan (2010) analyses the market for daily newspapers in the U.S. and simulates some proposed mergers among them.

The candidate explanation for the observed price war we look at in this paper is a change in the optimal financing mix of newspapers that followed a steady increase in the demand for advertising. Our model encompasses demand for products on both sides of the platforms and profit maximization in a monopolistic and a duopolistic setting with newspaper editors who recognize the existence of indirect network effects between the two sides. We show that the observed empirical pattern of a constant decline in readership revenue relative to advertising revenue can be explained by noting that this is a fairly *robust prediction* for monopolistic and oligopolistic behaviour once newspapers are properly modelled as two-sided markets following an exogenous increase in advertising demand.

Our finding implies that the publicly suggested "predatory pricing" candidate explanation warrants further analysis again fully taking into account the two-sidedness of the platforms. In Behringer & Filistrucchi 2010c we estimate the relevant markups for the UK Quality Newspaper industry during this period.

2 The UK newspaper industry in the 1990s

The labour force of the UK newspaper industry when still located at Fleet Street in London was heavily unionized when in February 1981 News International Newspaper Ltd. (NIN) owned by Rupert Murdoch purchased The Times newspaper. During the 1980s, NIN therefore clandestinely equipped a new printing facility for its UK newspapers in the London district of Wapping where newspapers could be composed electronically rather than using the hot-metal and labour-intensive linotype method.

At the time NIN owned The Times, the Sunday Times, the Sun and the News of the World. When the print unions announced a strike, NIN activated this new

plant with the assistance of the Electrical, Electronic, Telecommunications, and Plumbing Union (EETPU). This led to the "Wapping dispute" from January 1986 to February 1987 which changed the history of UK industrial relations and of the newspaper industry in the UK. By 1988 nearly all the national newspapers had abandoned Fleet Street for the Docklands and started to change their printing practices to those employed by NIN.

Despite these events during the early 1990s the UK quality broadsheet newspaper industry composed of the The Times, the Independent, the Guardian, and the Daily Telegraph, had seen a relatively homogenous and stable pricing pattern for weekly editions. Then, on the 6. September 1993 NIN decided to cut the price for The Times from 45p to 30p, thereby undercutting the Guardian at 45p, The Independent at 45p and the Daily Telegraph at 48p. Public perception had it that a "price war" in the quality newspaper industry had begun.

The Independent, quoting a media analyst conjectured that the price cut was directed against its market share. "When the Independent was launched in 1986, it took more readers from The Times than the Guardian or the Telegraph' (...) It has been the Independent holding back The Times ever since".[1] Immediately after the announcement, Robin Cook, then the Labour party's trade and industry spokesman wrote to the Office of Fair Trading demanding an inquiry into possible unfair competition. The Independent estimated that at the current level of circulation of around 350,000 (August 1993) this price cut came at a cost to The Times of about £ 50,000 per day.

Bryan Carsberg, director general of the Office of Fair Trading (OFT) observed "with interest" the alleged newspaper "price war" that Rupert Murdoch ignited. His office's definition of predatory pricing - the deliberate acceptance of losses in the short term with the intention of eliminating competition so that enhanced profits may be achieved in the long term - looks prima facie as if it may indeed apply to the battle between the loss-making Times and the struggling Independent.

Because of its substantial financial difficulties, the Independent decided to raise its price from 45p to 50p on the 12. October 1993 but then came under even more pressure as the Telegraph under Conrad Black also decided to drop its price from 48p to 30p on 1. August 1994.

On 24. June 1994 The Times decreased is price again from 30p to 20p. By this time the issue has received strong political attention. Tam Dalyell, Labour MP said it was an issue of "the quality of democracy", and Tony Wright, Labour MP said that the use of monopoly power to drive out competitors was "offensive" to the public interest. A plurality of opinion was vital. Robin Cook demanded that the OFT should come up with a decision in favour of predatory

[1] Independent, 3. September, 1993, "Media analysts say 'Times' cut is commercial madness".

behaviour since Bryan Carsberg had been talking about a thin dividing line between normal and aggressive competition and with the new price cut this line now surely had been crossed.

The Independent quotes Dalyell's estimates that of the 20p The Times received for each copy, 17.5p went to wholesalers and retailers and the cost of printing a copy was 15p. "This is a £ 30m a year subsidy". The Independent reacted on the 1. August 1994 and reduced its price from 50p to 30p permanently in order to stop the decline of its circulation that decreased by 20% since The Times had first reduced its price. Its financial situation was known to be severe. In the beginning of 1994 a substantial refinancing had to take place which prevented the paper from being taken over from Carlo de Benedetti, another newspaper tycoon.

On 21. October 1994, the OFT issued a decision in the case. Bryan Carsberg said that his inquiry into the price cuts had not established a case for formal action under the competition legislation. Subsequently there was a period of increase in cover prices as the costs of news printing were rising for all firms. The Times decided to increase its prices from 20p to 25p on the 3. July 1995 and at the same date The Telegraph also increased from 30p to 35p. The Independent followed on the 17. July and increased its price to 35p. Another wave of price increases was initiated by The Times and The Telegraph on the 20.November 1995 who raised their prices to 30p and 40p respectively. The Independent leapfrogged on the 22. January 1996 ending a period of rapid price fluctuations that lasted for 29 months.

The exact consequences of the alleged price war period are a matter of vigorous public disagreement. In fact no consensus emerged even as to who the alleged predator The Times was preying against. The data shows the following picture between August 1993 and January 1996: The Times has increased circulation market share from about 17% to 28%. The Independent has moved from 16% to 12% and the Daily Telegraph has moved from 49% to 43%. The market share of the Guardian has decreased a little. Looking at these figures one has to keep in mind that the prices of The Times are still 15p, that of the Independent and the Telegraph 5p lower than in 1993.

3 An empirical finding

We set out to shed some light on issues of this price war using a model of a *two-sided market*. We first make an important empirical observation, namely that the share of readership revenue over advertising revenue for all firms is steadily declining during the 1990s. For the Independent this ranges from over 70% to just above 20%, and even for the Guardian who did not adjust cover prices to readers from over 70% to 30%.

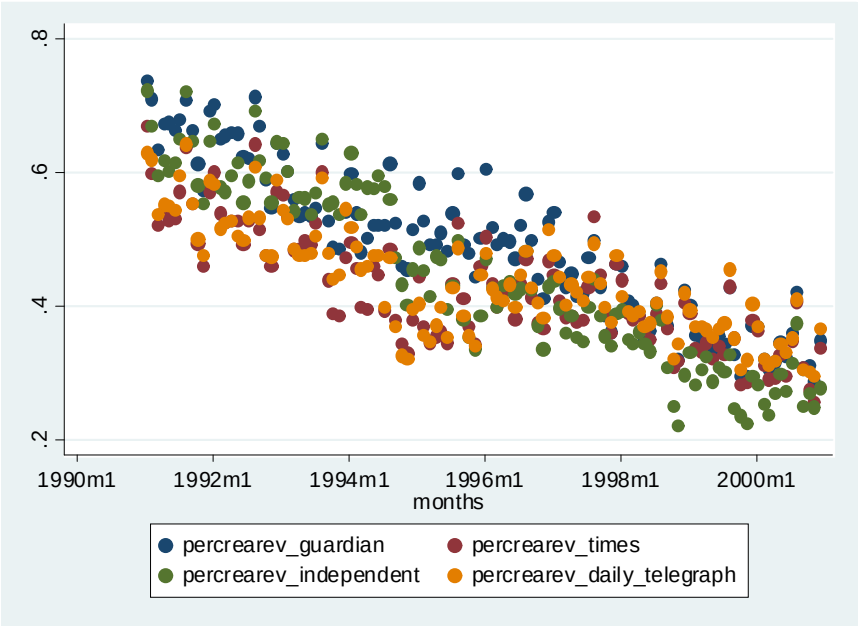

Figure 1: Figure 0 - Percentage of revenues from readers over total revenues

Hence a candidate explanation of the observed 'price war' is that The Times was first to react to this increase in advertising demand and was willing to sacrifice readership revenue thereby generating even higher indirect network benefits for advertisers. How general is this finding theoretically, i.e. what are the assumptions needed to translate a higher demand for advertising into a lower reader price on the other side of the platforms?

4 Monopoly

As noted above, the existence of direct and indirect network effects on two-sided platforms gives rise to theoretical complications. Demand for advertising will depend on the vector of all advertising prices and all readership demands and vice versa for demand from readers. Such a system is generically non-linear and does not allow for closed form solutions.

Instead we chose to *monetize the disutility* to the reader of some quantity of advertising a with a scalar $\gamma > 0$ so that the total utility of reading a newspaper with cover price p is

$$U = \bar{U} - p - \gamma a \tag{1}$$

On the revenue side we assume that the *per copy revenue* from advertising is some function $R(a, m)$ where $m > 0$ is an advertising scaling parameter.

As readership revenue is multiplicative in the number of readers the empirical finding implies that the Revenue Ratio:

$$RR = \frac{pN}{R(a,m)N} = \frac{p^*(m)}{R(a^*,m)} \tag{2}$$

has to decline in equilibrium as m increases.

A firm's objective is then:

$$\max_{p,a} \Pi = [R(a,m) + p - c]N(p + \gamma a) \tag{3}$$

for some decreasing general demand form $N(.)$ with $N' < 0$.

Assumption A1: $\frac{\partial^2 R}{\partial a^2} < 0$, (i.e. R is strictly concave in a) and $\frac{\partial^2 R}{\partial a \partial m} > 0$ (i.e. marginal revenue from ads is increasing in the exogenous shift parameter m). Also, to comply with the interpretation of m we assume that $\frac{\partial R}{\partial m} > 0$.

Hence we assume that if there is too much advertising in the newspaper, readers will stop buying the paper and thus lower the revenues that can be collected from advertisers (or there is a crowding effect between advertisements).

The problem can be simplified by a change of variables:

$$\max_{a} \Pi = [R(a,m) + f - \gamma a - c]N(\underbrace{p + \gamma a}_{=f}) \tag{4}$$

where $f > 0$ is a constant, but we one has to check that prices remain positive. Optimizing over a this implies that for each reader marginal costs (the nuisance of advertising) and benefits are equalized at the first order necessary condition w.r.t. a

$$F_a \equiv \frac{\partial R(a,m)}{\partial a} - \gamma = 0 \tag{5}$$

which implicitly defines the optimal advertising level a^*.

Optimizing over the cover price p we find the respective first order necessary condition from $\max_p \Pi$ as

$$F_p \equiv N(p + \gamma a) + [R(a,m) + p - c]\frac{\partial N(p + \gamma a)}{\partial p} = 0 \tag{6}$$

which implicitly defines the optimal paper price p^*.

In order to determine the behaviour of these optimal levels w.r.t. to the exogenous shift parameter we make use of the implicit function theorem as:

$$\frac{\partial a^*}{\partial m} = -\frac{\partial F_a}{\partial m} \Big/ \frac{\partial F_a}{\partial a^*} = -\frac{\partial^2 R(a,m)}{\partial a \partial m} \Big/ \frac{\partial^2 R(a,m)}{\partial a^2} > 0 \tag{7}$$

i.e. is positive by Assumption A1.

Similarly

$$F_p \equiv N(p + \gamma a^*(m)) + [R(a^*(m), m) + p - c] \frac{\partial N(p + \gamma a^*(m))}{\partial p} = 0 \tag{8}$$

implies that from the implicit function theorem

$$\begin{aligned}
\frac{\partial p^*}{\partial m} &= -\frac{\partial F_p}{\partial m} \Big/ \frac{\partial F_p}{\partial p^*} = -\frac{\frac{\partial F_p}{\partial a}\frac{\partial a^*}{\partial m} + \frac{\partial F_p}{\partial m}}{2\frac{\partial N(p+\gamma a)}{\partial p} + [R(a,m) + p - c]\frac{\partial^2 N(p+\gamma a)}{\partial p^2}} \qquad (9) \\
&= -\frac{\begin{array}{c}\left(\frac{\partial N(p+\gamma a)}{\partial a} + \frac{\partial R(a,m)}{\partial a}\frac{\partial N(p+\gamma a)}{\partial p} + [R(a,m) + p - c]\frac{\partial^2 N(p+\gamma a)}{\partial p \partial a}\right)\frac{\partial a^*}{\partial m} + \\ \frac{\partial R(a,m)}{\partial m}\frac{\partial N(p+\gamma a)}{\partial p}\end{array}}{2\frac{\partial N(p+\gamma a)}{\partial p} + [R(a,m) + p - c]\frac{\partial^2 N(p+\gamma a)}{\partial p^2}} \\
&= -\frac{\frac{\partial R(a,m)}{\partial m}\frac{\partial N(p+\gamma a)}{\partial p}}{2\frac{\partial N(p+\gamma a)}{\partial p} + [R(a,m) + p - c]\frac{\partial^2 N(p+\gamma a)}{\partial p^2}} \\
&\quad - \left(\frac{\frac{\partial N(p+\gamma a)}{\partial a} + \frac{\partial R(a,m)}{\partial a}\frac{\partial N(p+\gamma a)}{\partial p} + [R(a,m) + p - c]\frac{\partial^2 N(p+\gamma a)}{\partial p \partial a}}{2\frac{\partial N(p+\gamma a)}{\partial p} + [R(a,m) + p - c]\frac{\partial^2 N(p+\gamma a)}{\partial p^2}}\right)\frac{\partial a^*}{\partial m}
\end{aligned}$$

The underlying economics of the above finding can be best seen by looking at a *(log) linear example* with quadratic advertising revenue:

$$\Pi = [\underbrace{-\frac{1}{2}(a-m)^2 + m}_{R(a,m)} + p]\,\underbrace{[1 - (p + \gamma a)]}_{N(p+\gamma a)} \tag{10}$$

A larger advertising demand scale m will both shift the revenue function outwards (consumers are less "ad-adverse") and increases revenue (more ads revenue from each consumer).

The optimal advertising levels are found from:

$$F_a \equiv \frac{\partial R(a,m)}{\partial a} - \gamma = 0 \tag{11}$$

or

$$a^*(m) = m - \gamma \tag{12}$$

Hence

$$\frac{\partial a^*(m)}{\partial m} = 1 > 0 \tag{13}$$

and the optimal level is strictly increasing in m.

Optimal newspaper prices are found from:

$$F_p \equiv N(p + \gamma a^*(m)) + [R(a^*(m), m) + p]\frac{\partial N(p + \gamma a^*(m))}{\partial p} = 0 \tag{14}$$

Using (9) we find:

$$\begin{aligned}
\frac{\partial p^*}{\partial m} &= -\frac{\left(\frac{\partial N(p+\gamma a)}{\partial a} + \frac{\partial R(a,m)}{\partial a}\frac{\partial N(p+\gamma a)}{\partial p} + [R(a,m) + p - c]\frac{\partial^2 N(p+\gamma a)}{\partial p \partial a}\right)\frac{\partial a^*}{\partial m} + \frac{\partial R(a,m)}{\partial m}\frac{\partial N(p+\gamma a)}{\partial p}}{2\frac{\partial N(p+\gamma a)}{\partial p} + [R(a,m) + p - c]\frac{\partial^2 N(p+\gamma a)}{\partial p^2}} \\
&= -\frac{(-\gamma + (m - a^*)(-1) + 0)\frac{\partial a^*}{\partial m} + (a^* - m + 1)(-1)}{2(-1) + 0} = \\
&= -\frac{(-\gamma + (m - (m - \gamma))(-1) + 0)(1) + ((m - \gamma) - m + 1)(-1)}{2(-1) + 0} = \\
&= -\frac{1}{2}(\gamma + 1) < 0
\end{aligned}$$

as $\gamma > 0$, i.e. as consumers dislike advertisings.

Note that at equilibrium prices the effect of advertising scale on revenue, i.e.

$$\frac{\partial R(a^*, m)}{\partial m} = a^* - m + 1 = 1 - \gamma \lesseqgtr 0 \tag{15}$$

is ambiguous. Hence in order to comply with the original motivation of this scale parameter and A1 we need $\gamma < 1$.

Now the parameters m and γ have to be chosen, such that both prices and demand is non-negative in equilibrium.

An example for this is $m = 0.9$ and $\gamma = 0.8$ where the cover price is

$$p^* = -\frac{1}{4}\left(2m(1 + \gamma) - 3\gamma^2 - 2\right) = 0.17 > 0 \tag{16}$$

the advertising price is

$$a^* = m - \gamma = 0.9 - 0.8 = 0.1 > 0 \tag{17}$$

and demand is

$$N = (1 - (p^* + \gamma a^*)) = \frac{1}{4}\gamma^2 - \frac{1}{2}m\gamma + \frac{1}{2}m + \frac{1}{2} = 0.75 > 0 \tag{18}$$

Here derivative of the revenue ratio w.r.t. m is

$$\frac{dRR}{dm} = \frac{d(\frac{p^*(m)}{R(a^*,m)})}{dm} = \frac{\gamma^3 - 2\gamma^2 - 2}{(\gamma^2 - 2m)^2} \tag{19}$$

the sign of which does not depend on m. Given our parameter choice we find this as

$$\frac{dRR}{dm} = -2.057\,1 \tag{20}$$

i.e. negative as implied by the data.

Given our restriction on γ, the sign of (9):

$$\begin{aligned}\frac{\partial p^*}{\partial m} &= -\frac{\frac{\partial R(a,m)}{\partial m}\frac{\partial N(p+\gamma a)}{\partial p}}{2\frac{\partial N(p+\gamma a)}{\partial p} + [R(a,m) + p - c]\frac{\partial^2 N(p+\gamma a)}{\partial p^2}} \\ &\quad - \left(\frac{\frac{\partial N(p+\gamma a)}{\partial a} + \frac{\partial R(a,m)}{\partial a}\frac{\partial N(p+\gamma a)}{\partial p} + [R(a,m) + p - c]\frac{\partial^2 N(p+\gamma a)}{\partial p \partial a}}{2\frac{\partial N(p+\gamma a)}{\partial p} + [R(a,m) + p - c]\frac{\partial^2 N(p+\gamma a)}{\partial p^2}} \right) \frac{\partial a^*}{\partial m}\end{aligned}$$

is necessary and sufficient for RR to comply with the empirical findings.

Assumption A2: The second order condition for profit maximization (SOC) is satisfied.

Given A1, and A2 the sign of the first term in (9) is negative. If p and a are strategic substitutes in demand, (i.e. $\frac{\partial^2 N(p+\gamma a)}{\partial p \partial a} < 0$) (**A3**) (sufficient but not necessary) then the second term is also unambiguously negative and so is $\partial p^*/\partial m$.

5 Competition

The profit of a firm in *oligopolistic competition* (with differentiated products) is:

$$\max_{p_i,a_i} \pi_i = [R_i(a_i, m) + p_i - c_i]N_i(\mathbf{p} + \gamma\mathbf{a}) \tag{21}$$

where

$$N_i(\mathbf{p} + \gamma\mathbf{a}) = N_i((\bar{p_i}, \overset{+}{\mathbf{p}_{-i}}) + \gamma(\bar{a_i}, \overset{+}{\mathbf{a}_{-i}})) \tag{22}$$

and firm $i's$ (residual) demand depend on prices and advertising quantities of *all* n firms.

Again we make a change of variables $p_i + \gamma a_i = f$ to find

$$\max_{p_i,a_i} \pi_i = [R_i(a_i, m) + f - \gamma a_i - c_i]N_i(\mathbf{p}_{-i} + \gamma\mathbf{a}_{-i}) \tag{23}$$

and use the Nash assumption to find that the FOC w.r.t. advertising quantity a_i :

$$F_{a_i} \equiv \frac{\partial R_i(a_i, m)}{\partial a_i} - \gamma = 0 \tag{24}$$

implicitly defines optimal quantity as

$$a_i^* = a_i^*(m, \gamma) \tag{25}$$

The FOC w.r.t. cover price p_i :

$$F_{p_i} \equiv N_i(\mathbf{p} + \gamma\mathbf{a}) + [R_i(a_i, m) + p_i - c_i]\frac{\partial N_i(\mathbf{p} + \gamma\mathbf{a})}{\partial p_i} = 0 \tag{26}$$

implicitly defines

$$p_i^* = p_i^*(a_i^*(m, \gamma), c_i, \gamma, m, \mathbf{p}_{-i}, \mathbf{a}_{-i}) \tag{27}$$

Note $\frac{\partial a_i}{\partial c_i} = -\frac{\partial F_{a_i}}{\partial c_i} / \frac{\partial F a_i}{\partial a_i} = 0$, i.e. equilibrium ads quantity is *independent* of own marginal costs and $\frac{\partial p_i}{\partial c_i} = -\frac{\partial F_{p_i}}{\partial c_i} / \frac{\partial F_{p_i}}{\partial p_i} = -\frac{-N'}{SOC}$ given that $SOC < 0$ equilibrium cover prices are *increasing* in own marginal cost.

Similar to the monopoly case the implicit function theorem yields:

$$\begin{aligned}
\frac{\partial p^*}{\partial m} &= -\frac{\frac{\partial F_p}{\partial m}}{\frac{\partial F_p}{\partial p^*}} = -\frac{\frac{\partial F_p}{\partial m}}{SOC^*} = -\frac{\frac{\partial F_p}{\partial a}\frac{\partial a^*}{\partial m} + \frac{\partial F_p}{\partial m}}{\frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p^*} + \frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i} + [R_i(a_i,m)+p_i-c_i]\frac{\partial^2 N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i \partial p^*}} \\
&\quad \left(\frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial a} + \frac{\partial R_i(a_i,m)}{\partial a}\frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i} + [R_i(a_i,m)+p_i-c_i]\frac{\partial^2 N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i \partial a}\right)\frac{\partial a^*}{\partial m} + \\
&= -\frac{\frac{\partial R_i(a_i,m)}{\partial m}\frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i}}{\frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p^*} + \frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i} + [R_i(a_i,m)+p_i-c_i]\frac{\partial^2 N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i \partial p^*}} \\
&= -\frac{\frac{\partial R_i(a_i,m)}{\partial m}\frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i}}{\frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p^*} + \frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i} + [R_i(a_i,m)+p_i-c_i]\frac{\partial^2 N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i \partial p^*}} \\
&\quad -\frac{\left(\frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial a} + \frac{\partial R_i(a_i,m)}{\partial a}\frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i} + [R_i(a_i,m)+p_i-c_i]\frac{\partial^2 N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i \partial a}\right)}{\frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p^*} + \frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i} + [R_i(a_i,m)+p_i-c_i]\frac{\partial^2 N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i \partial p^*}}\frac{\partial a^*}{\partial m}
\end{aligned}$$

Proposition 1 *If assumptions A1-A3 hold, then $\partial p^*/\partial m < 0$ as in the monopoly case.*

For two firms a plausible demand specification is

$$N_1 = p_1^{-\alpha} p_2^{\beta} = \frac{p_2^{\beta}}{p_1^{\alpha}}$$

with own-price elasticity $\varepsilon^1_{p_1} = \alpha$ and cross price elasticity $\varepsilon^1_{p_2} = \beta$. Log linearizing and adding a constant $C > 0$ (which does not affect elasticities) we find

$$\ln N_1 = C - \alpha \ln p_1 + \beta \ln p_2$$

or given we add a monetized disutility from advertising and normalize

$$N = q = 1 - \alpha(p_1 + \gamma a_1) + \beta(p_2 + \gamma a_2)$$

with $\alpha > \beta > 0$.

A *log linear demand example* with *differentiated* products:

$$\pi_1 = [\underbrace{-\frac{1}{2}(a_1 - m)^2 + m}_{R(a,m)} + p_1][\underbrace{1 - \alpha(p_1 + \gamma a_1) + \beta(p_2 + \gamma a_2)}_{N \text{ log linear}}]$$

with $\alpha > \beta > 0$ as own and cross-price elasticities.

A change of variables again yields

$$a_1^* = m - \gamma$$

the same as in monopoly.

$$\begin{aligned}
\frac{\partial p^*}{\partial m} &= -\frac{\left(\frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial a} + \frac{\partial R_i(a_i,m)}{\partial a}\frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i}\right)\frac{\partial a^*}{\partial m} + \frac{\partial R_i(a_i,m)}{\partial m}\frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i}}{\frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p^*} + \frac{\partial N_i(\mathbf{p}+\gamma\mathbf{a})}{\partial p_i}} \\
&= -\frac{(\gamma(\beta-\alpha) + (m-a^*)(-\alpha))\frac{\partial a^*}{\partial m} + (a^* - m + 1)(-\alpha)}{\beta - \alpha - \alpha} \\
&= -\frac{(\gamma(\beta-\alpha) + (m-(m-\gamma))(-\alpha))(1) + ((m-\gamma) - m + 1)(-\alpha)}{\beta - 2\alpha} \\
&= \frac{\gamma(\alpha-\beta) + \alpha}{\beta - 2\alpha} < 0
\end{aligned}$$

as $\alpha > \beta > 0$ and $\gamma > 0$ by assumption.

The relevant parameters underlying this comparative statics result can be estimates.

6 Empirical Analysis: Data

The dataset on the reader's side contains market level data on circulation, cover prices, and content characteristics of the four daily quality national newspapers in the UK (Guardian, The Times, Independent, and Daily Telegraph), with monthly observations from 1990 to 2000. Data on circulation come from the Audit Bureau of Circulation (ABC). Data on prices were collected from newspaper publishers themselves.

Data on the results of the political elections and on the political position of the newspapers were collected from the British Election Surveys (BES) in 1992 and 1997 and from the British Panel Election Survey (BPES) for the years 1992-1997 and 1997-2001. In particular, the relative political position of the newspaper was calculated as the percentage of readers of a given newspaper who a) voted for the conservative (or alternatively the labour) party b) felt closer to the conservative (or alternatively to the labour) party c) thought their newspaper favoured the conservative (or alternatively the labour) party.

On the advertising side of the market we acquired market level data on advertising quantity and revenues of the same newspapers with monthly observations for 1991 to 2000 from Nielsen Media Research UK. The latter directly collects data on quantities and applies list prices in order to calculate advertising revenues. In doing so, however, Nielsen also applies an estimate of the discounts with respect to the posted list prices. We recovered nominal advertising tariffs dividing revenues by quantity. Finally, we deflated cover prices and advertising tariffs by the Consumer Price Index.

6.1 The price war

We proceed to analyse how the price war discussed above affected the two-sides of the newspaper market. The analysis at this stage is only *descriptive*. We plan to run a full econometric analysis once we have identified and collected suitable instruments for cover prices on the readers' and both advertising tariffs and circulation on the advertisers' side of the market. Suitable instruments could include other exogenous or pre-determined characteristics of the newspapers on the reader's side (such as featured content sections) and on the advertiser's side (such as demographics of the readers) or measures of the marginal costs (identified as the cost of the paper, the ink, and the distribution).

For The Times, Figure 2c reveals that, as The Times cut its price for the first time in September 1993, circulation of The Times immediately picked up. It increased even more as The Times cut its price again in June 1994. However it didn't drop when the price was raised again first in July 1995, then in November 1995 and finally in November 1999. Rather it first picked up again in

1997 and then stabilized at a much higher level than before the price war. Figure 3c shows that advertising quantity always increased, while Figure 4c shows that advertising tariffs first declined up to December 1994 and then increased. According to Figures 6i-ii The Times moved substantially to the political Left. In particular, Figure 6i depicts the change in the percentage of readers of The Times who voted conservative for both the 1992 and the 1997 elections: However, as the Labour party won the elections in 1997, one would expect a fall in the percentage of readers voting Conservatives in all newspapers. To control for that, Figure 6ii graphs the percentage increase in the percentage of readers of The Times who voted Conservative with respect to the percentage of readers in the market who voted Conservative.

For the Independent, Figure 2b shows that the initial decision of the Independent in October 1993 to react to The Times by raising its price lead to the loss of even more circulation. As circulation continued to drop it was forced to lower its price in August 1994. However circulation dropped further until January 1996. In the meantime the Independent raised its price again in July 1995. It then stabilized despite the price being first raised in January 1996 and again in October 1997 and cut again later on. Figure 3b shows that advertising quantity has increased from August 1994, while according to Figure 4b advertising tariffs dropped sharply during 1995 and started to increase again only in 1997. Figure 6 shows that the Independent moved slightly to the political Left.

For the Daily Telegraph, Figure 2d shows that circulation dropped up to May 1994 then increased, dropped again as of October 1994 to February 1996, and peaked again in January 1997. According to Figure 3d advertising quantity increased from August 1994 while advertising tariffs always increased as shown in Figure 4d. According to Figure 6 the Daily Telegraph may have moved to the political Right contrary to the overall trend.

For the Guardian, Figure 1a shows that it never changed its nominal price, i.e. it never took part in the cover price war. According to Figure 4a however, it did lower its nominal advertising price during the price war and then raised it substantially from November 1996 after the price war had ended. As shown in Figure 2b circulation of the Guardian initially dropped a little but then stabilised. According to Figure 3b advertising volumes always increased. Figure 6 shows that also the Guardian moved to the political Left.

The investigation of the total quality newspaper market in Figures 5-i and 5-ii reveals that before the price war total circulation was decreasing, it increased during the price war and up to 1998 then dropped and stabilised. in the last two years. Advertising volume instead always increased in the period under consideration.

Overall, comparing 1992-1993 (before the beginning of the price war) and 1996-1997 (after the end of the price war), we find the following: Cover prices

were much lower for The Times, slightly lower for the Independent and the Daily Telegraph, unchanged for the Guardian. The circulation of quality newspapers was in general much higher; in particular it was slightly lower for the Guardian, much lower for The Independent, much higher for The Times and higher, though later again lower, for the Daily Telegraph. The advertising volume on quality newspapers was much higher for each of the four newspapers. Advertising tariffs were unchanged for the Guardian (though later increasing), lower for the Independent (though later increasing but not back to the level before the price war), much higher for The Times (and increasing further afterwards); much higher (and always increasing) for the Daily Telegraph.

Finally, looking at the data on political position, we find that: The Guardian, the Independent, and The Times all moved to the political Left. The move to the political Left of The Times was substantial and started during the price war, well before the public endorsement of Tony Blair by Rupert Murdoch on the occasion of the UK general elections of 1997. The Daily Telegraph may have moved slightly to the political Right against the overall trend.

6.2 Demand estimation

More generally we need the structural model in order to estimate the parameters and comment on the comparative statics prediction of our model. [...]

7 Predatory pricing

The standard empirical test for predatory pricing in a single-sided market is the Areeda & Turner rule, according to which a price is predatory if it is below the short-run marginal cost. Such a condition is however necessary but not sufficient: it is also necessary to check whether the pricing strategy is likely to lead to the exit from the market of the targeted competitor and whether the predator can expect to recoup the short run losses in the long run.

Yet, as discussed in Evans (2003), in a two-sided market the Areeda & Turner rule is not even a necessary condition and therefore cannot be applied. The reason is that a firm in a two-sided market acts as a platform and sells two products or services to two distinct groups of consumers and recognises that the demand from one type of consumers depends on the demand from the other type of consumers and vice versa. It is therefore conceivable that by pricing below marginal cost on one side of the market a firm is increasing demand on that side and thus boosting demand on the other side, with an overall positive effect on its profits. Indeed, depending on the size of the own price elasticity on the two-sides of the market and on the size of the network effects, even a monopolist platform might find it profitable to lower the price below marginal cost on one side of the market. Testing for predatory pricing in two-sided markets should therefore take into account the presence of the critical network effects between the two sides.

In a two-sided market, as pointed out by Armstrong (2006) and Rochet & Tirole (2006), one can distinguish a price level (roughly the sum of the two prices paid on the two sides of the market) and the price structure (roughly the ratio of the prices). Indeed one can argue that a more appropriate necessary condition for predatory pricing in a two-sided market is that the price level is below the marginal cost.

In our case one can calculate the per-copy revenues from advertising and readers and compare it to the marginal cost of a newspaper copy (arguably the cost of the paper, the ink and the cost of the distribution).

We do not have at this stage independent estimates of these costs for The Times. However, we here use the estimate of 32.5 pence for the marginal cost reported by the Independent in July 1994 (see above), which we would expect, if anything, to be biased upward, We can then calculate the two-sided per-copy price-cost margin in the period under consideration as

$$PCM_T = p_T^N + p_T^A \frac{q_T^A}{q_T^N} - c_T^N \tag{28}$$

under the assumptions of constant marginal cost, which as reported in Argentesi & Filistrucchi (2007) roughly holds for (Italian) daily newspapers, and the assumption that printing ads is not more expensive then printing news.

Then Figure 7a below shows that the two-sided price cost margin for The Times never fell below zero, supporting the view that The Times was not necessarily attempting to predate against the Independent but was rather trying to boost its circulation in order to gain advertising revenues and indeed seems to have been successful.

This is not denying however that as a result of the price war the Independent was undoubtedly in financial difficulties. Figure 7b shows that indeed the variable profits of the Independent, calculated as

$$Var\Pi_I = p_I^N q_I^N + p_I^A q_I^A - c_I^N q_I^N \tag{29}$$

decreased during the price war, so that the Independent might have been unable to cover its fixed costs (including the cost of labour).

Interestingly, after the price war, the (nominal) two-sided price-cost margins for all newspapers appear to increase substantially. The increase is mainly due to the increase in advertising quantity and prices and, even for the Independent, seems to have completely offset the loss in circulation revenues.

[...]

We estimate these markups for the UK Quality Newspaper industry during this period in order to comment on the issue.

8 Conclusion

In this paper we proposed a theoretical model encompassing demand on both sides of the market and profit maximization by monopoly and competing oligopolistic publishers who recognise the existence of indirect network effects between the two sides of the market as they simultaneously chose the cover prices and the advertising price.

Our candidate explanation is that the observed changes in market structure result from an (expected) positive *shock on the demand side for advertising*. This shock would lead to an adjustment process that finally implies lower equilibrium prices on the reader's side as the new optimal mix of newspaper finance has more of its revenue resulting from advertisers than from readers. It is conceivable that Rupert Murdoch, being first to spot this change in the market structure was also first to react.

Our model shows that this comparative statics results holds under very general conditions. Our empirical investigation will investigate if the empirical magnitudes such as price elasticities and advertising tolerance fit the predictions of the model.

We then discussed the price war among UK quality newspapers in the '90s in light of the model above. The observed changes in market structure in the UK newspaper industry in the 90s are clearly remarkable. However there appear to be other candidate explanations for these changes that are not necessarily exclusive.

An alternative explanation of the observed market changes is the *breakdown of a collusive agreement* on cover prices which was upset when Rupert Murdoch took over The Times and changed old habits. In this context further econometric investigation along the lines of Argentesi & Filistrucchi (2007) allowing for a Hotelling demand structure would be indicated.

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10 Appendix A - Tables and Figures

Descriptive Statistics

	Mean	St.Dev
Readers' Demand		
reacir_guardian	405528,5	14457,9
reacir_independent	298231,8	66010,32
reacir_daily_telegraph	1056225	30975,74
reacir_times	593208,6	162086,9
cpiadj_reapri_guardian	0,3823	0,0299
cpiadj_reapri_independent	0,3485	0,0419
cpiadj_reapri_daily_telegraph	0,3749	0,0467
cpiadj_reapri_times	0,2887	0,0570
adv_concen_guardian	0,1536	0,0190
adv_concen_independent	0,1742	0,0285
adv_concen_daily_telegraph	0,2374	0,0236
adv_concen_times	0,2094	0,0285
avg_pages_guardian	126,5581	31,6927
avg_pages_independent	72,0812	18,7351
avg_pages_daily_telegraph	85,5755	10,9882
avg_pages_times	92,4695	20,9148
cpiadj_mc_guardian	0,2922332	0,0613275
cpiadj_mc_independent	0,1696636	0,0518308
cpiadj_mc_daily_telegraph	0,2016308	0,0440404
cpiadj_mc_times	0,2152427	0,0480854

t

Descriptive Statistics

	Mean	St.Dev
Advertising Demand		
avg_adv_pages_guardian	16,4308	6,5172
avg_adv_pages_independent	10,9573	4,1595
avg_adv_pages_daily_telegraph	19,3052	4,2513
avg_adv_pages_times	16,6632	5,4249
cpiadj_advpri_guardian	14691,36	1310,799
cpiadj_advpri_independent	16587,91	2360,037
cpiadj_advpri_daily_telegraph	19351,12	2946,768
cpiadj_advpri_times	36631,44	2502,955

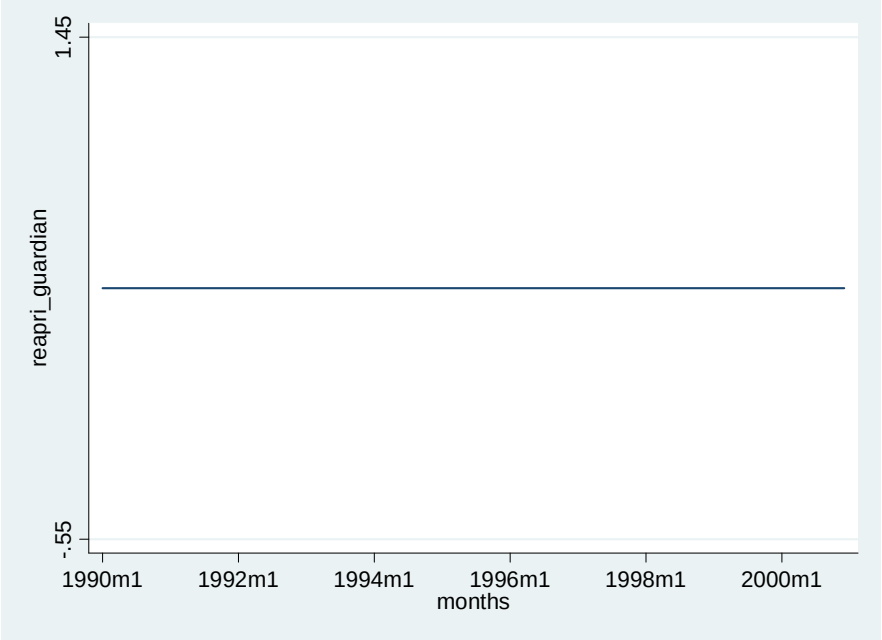


Figure 1a- Nominal Cover Prices of the Guardian

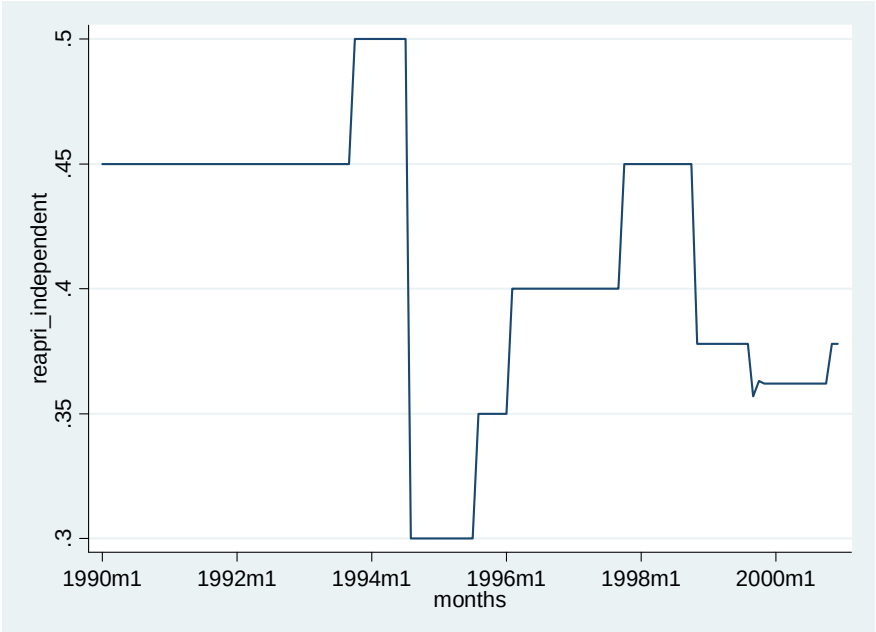


Figure 1b - Nominal Cover Prices of the Independent

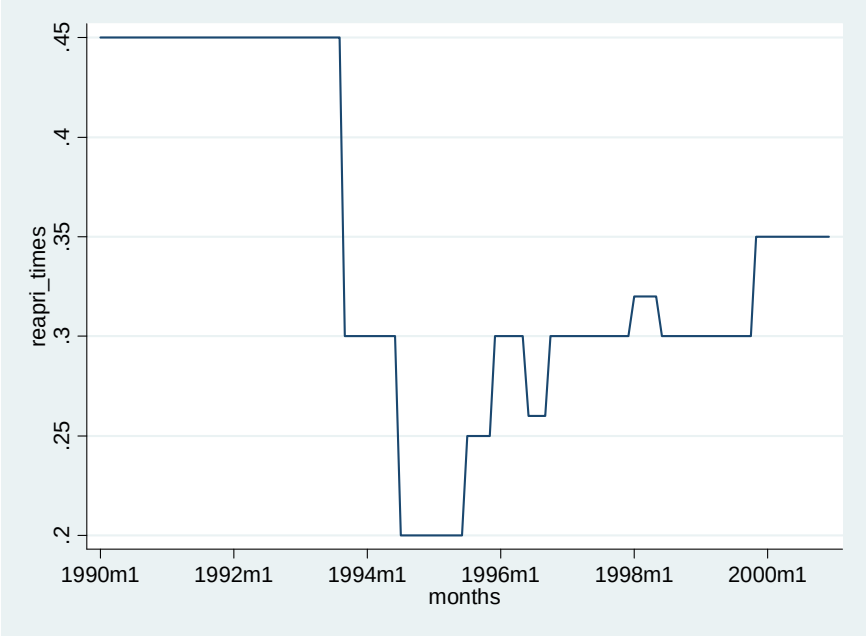


Figure1c- Nominal Cover Prices of the Times

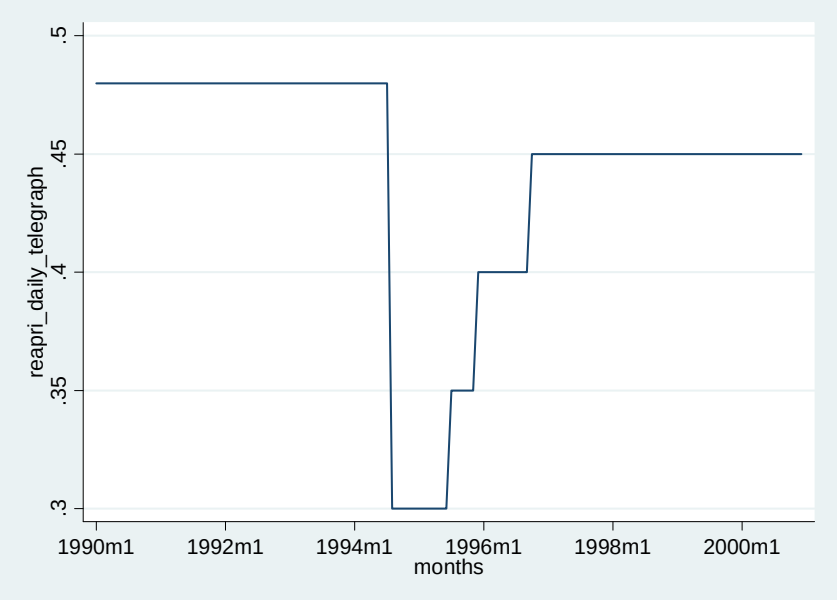


Figure 1d - Nominal Cover Prices of the Daily Telegraph

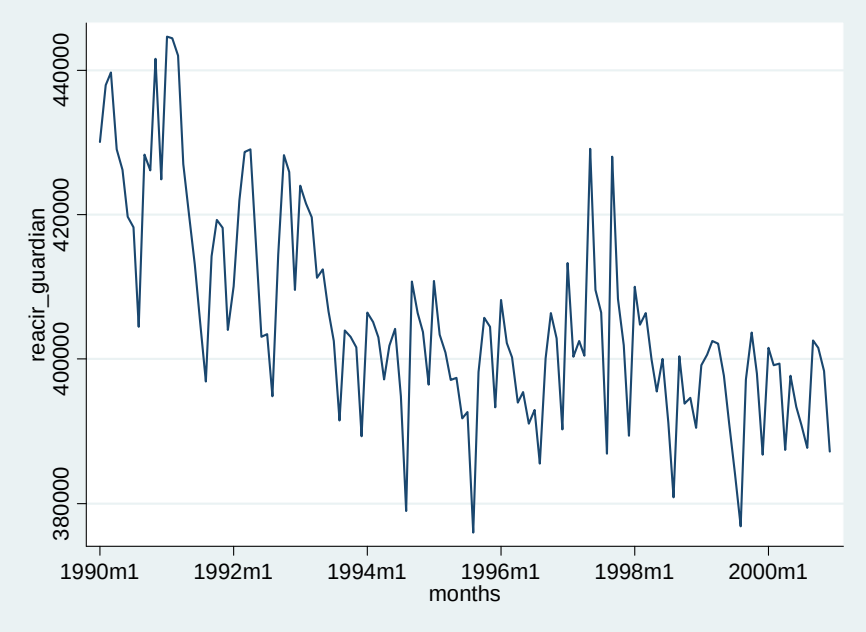


Figure 2a - Circulation of the Guardian

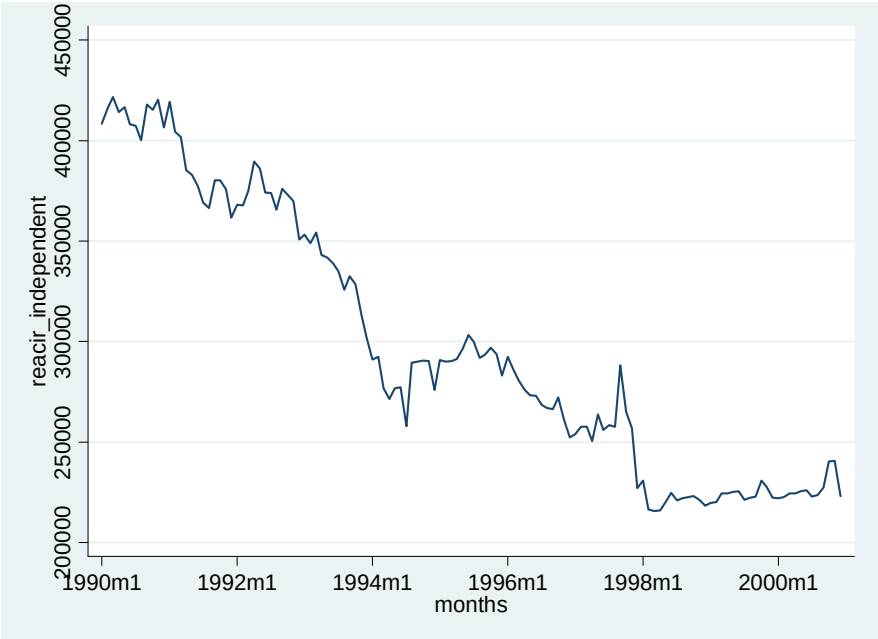


Figure 2b - Circulation of the Independent

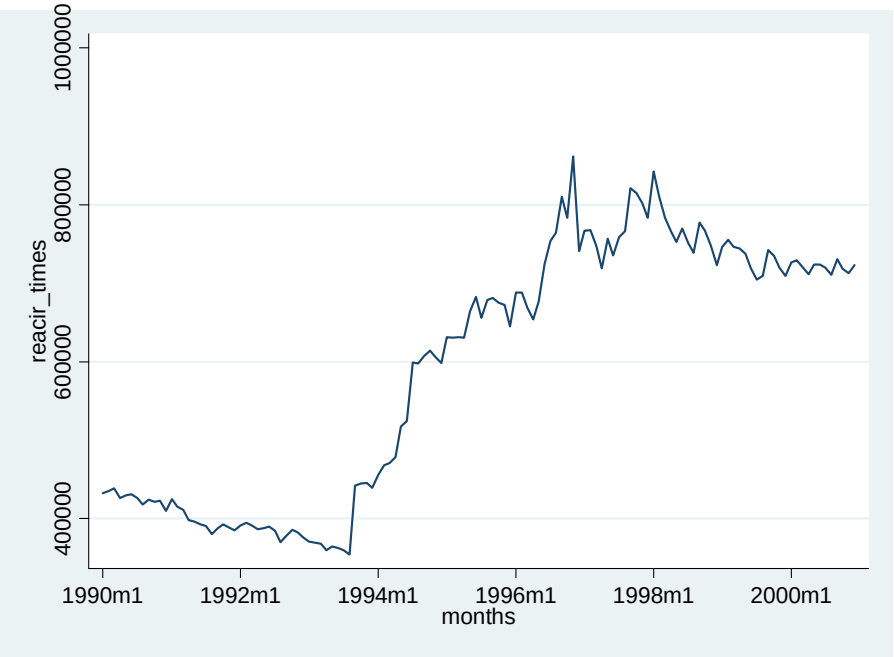


Figure 2c - Circulation of The Times

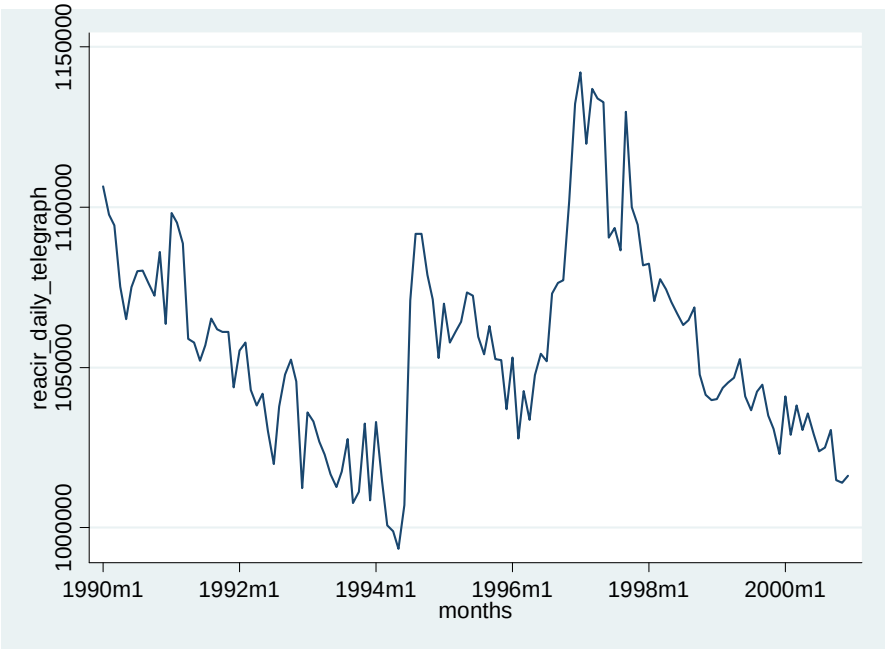


Figure 2d - Circulation of the Daily Telegraph

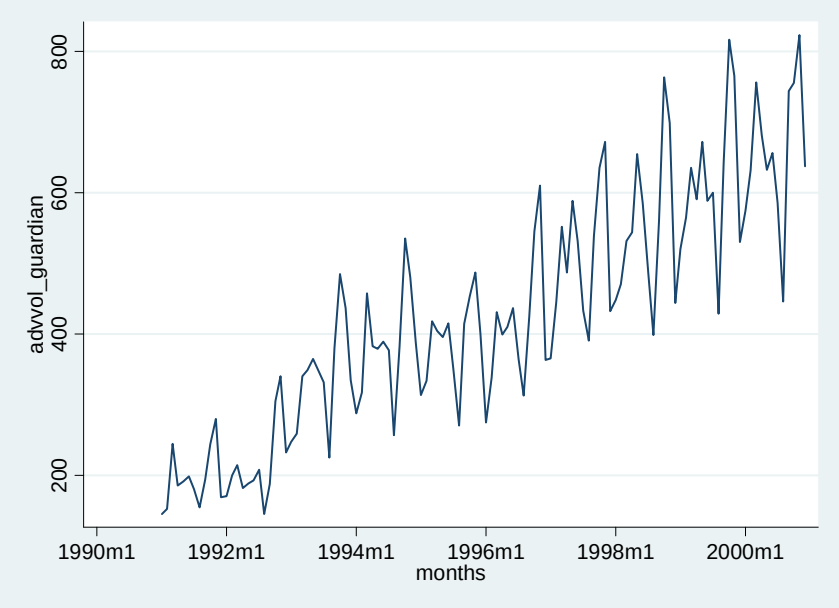


Figure 3a - Advertising Volume on the Guardian

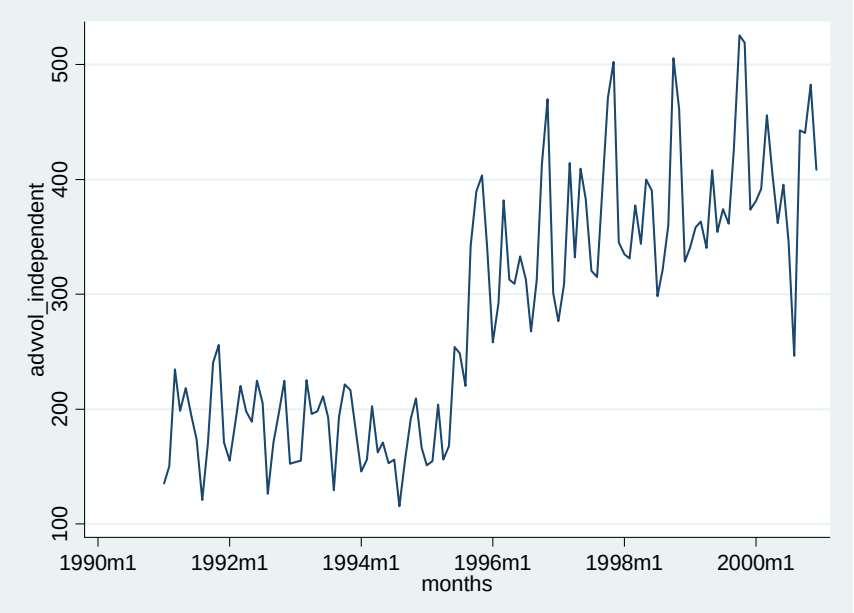


Figure 3b - Advertising Volume on The Independent

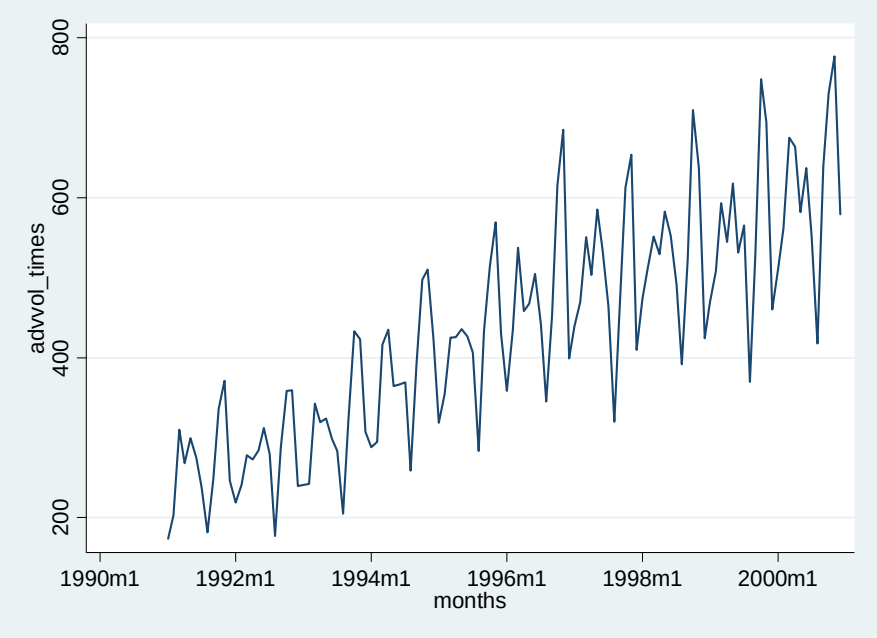


Figure 3c - Advertising Volume on The Times

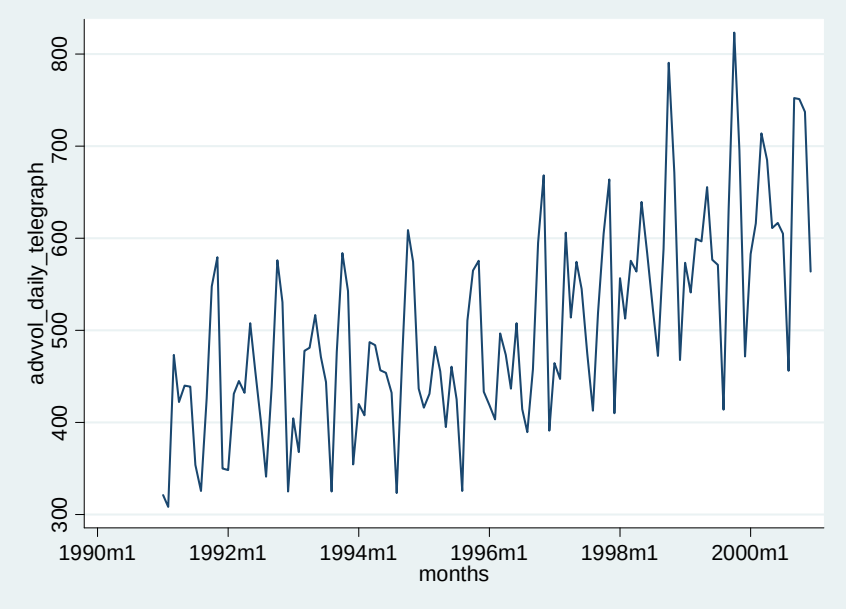


Figure 3d - Advertising Volume on the Daily Telegraph

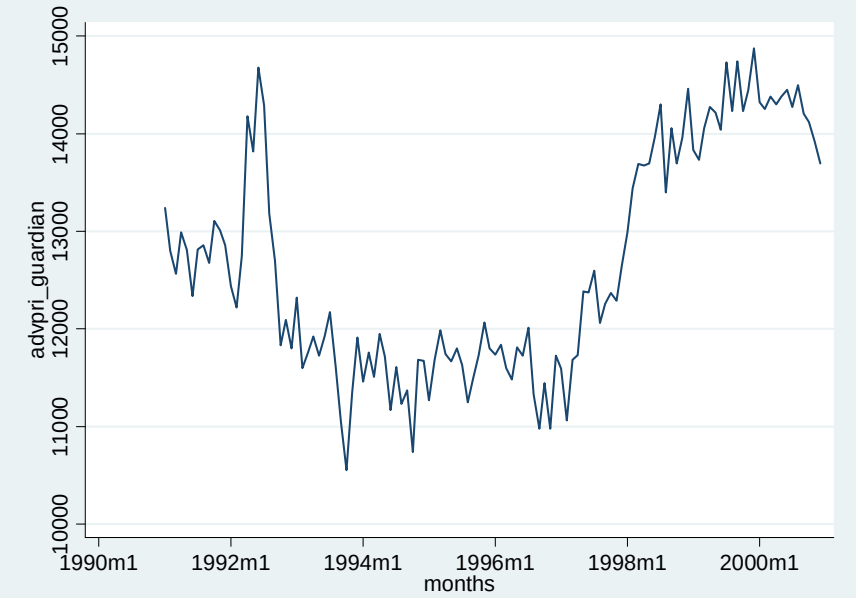


Figure 4a - Advertising Tariffs for the Guardian

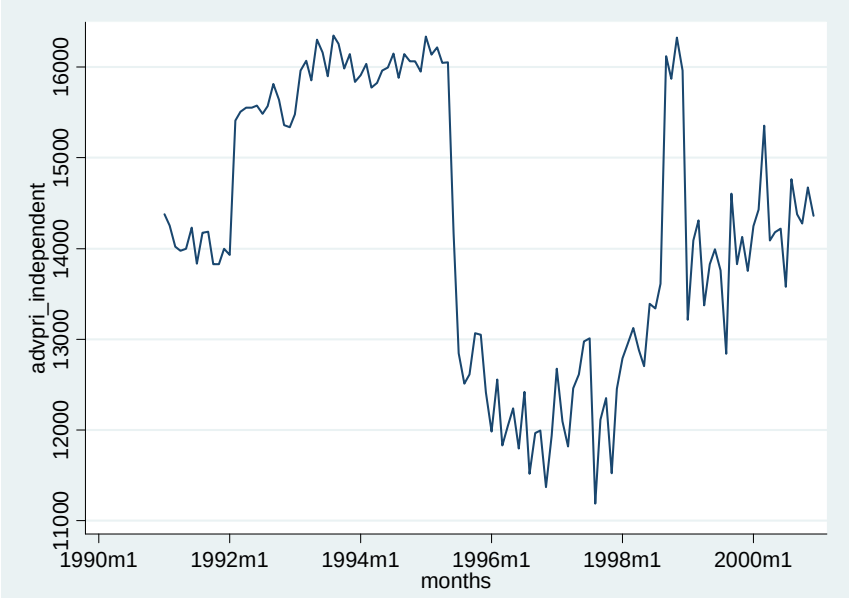


Figure 4b - Nominal Advertising Tariffs for the Independent

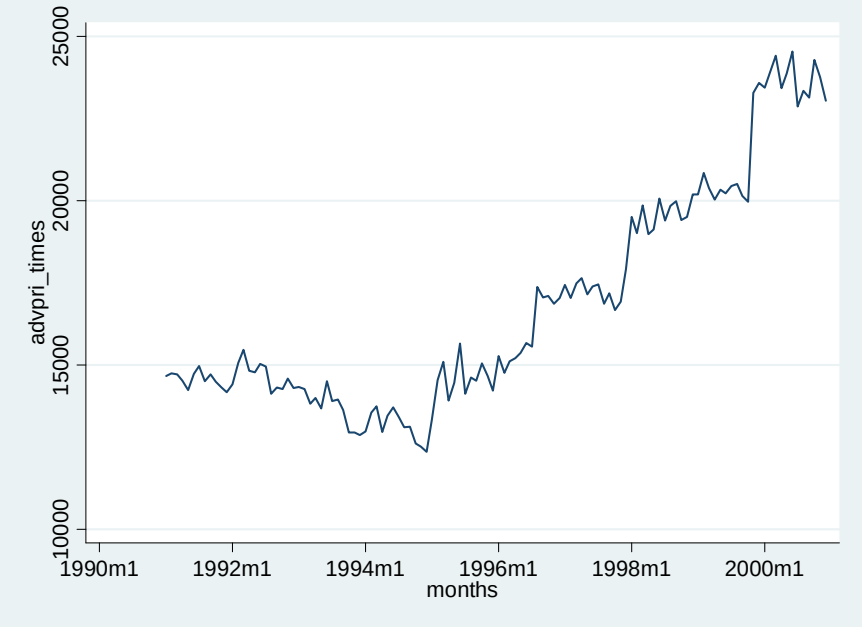


Figure 4c-Nominal Advertising Tariffs for the Times

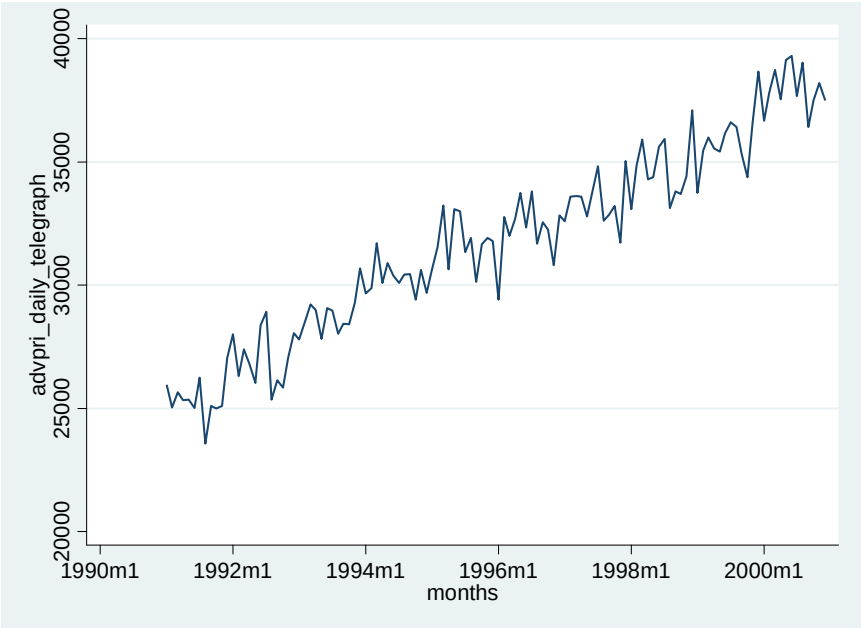


Figure 4d- Nominal Advertsing Tariffs for the Daily Telegraph

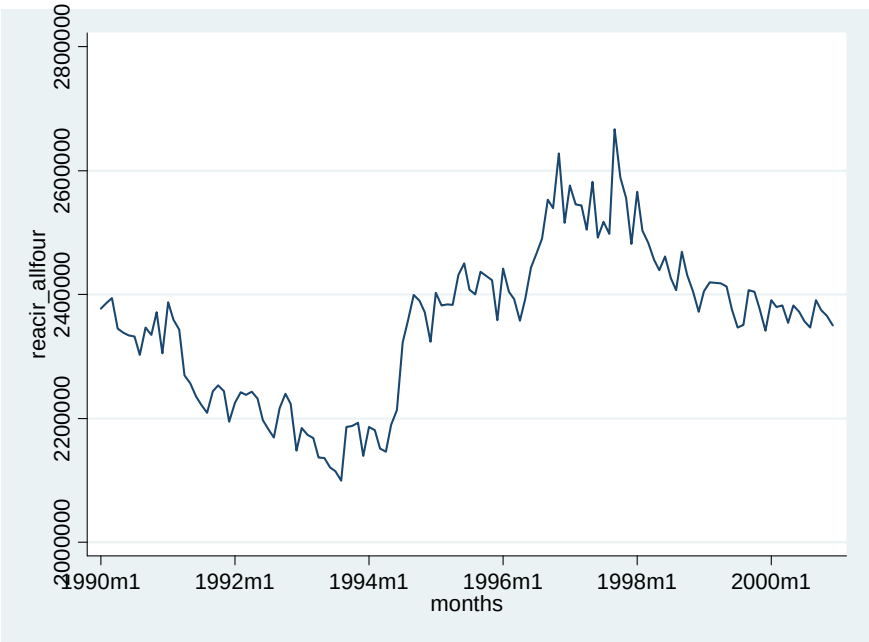


Figure 5 i- Circulation of all four quality newspapers

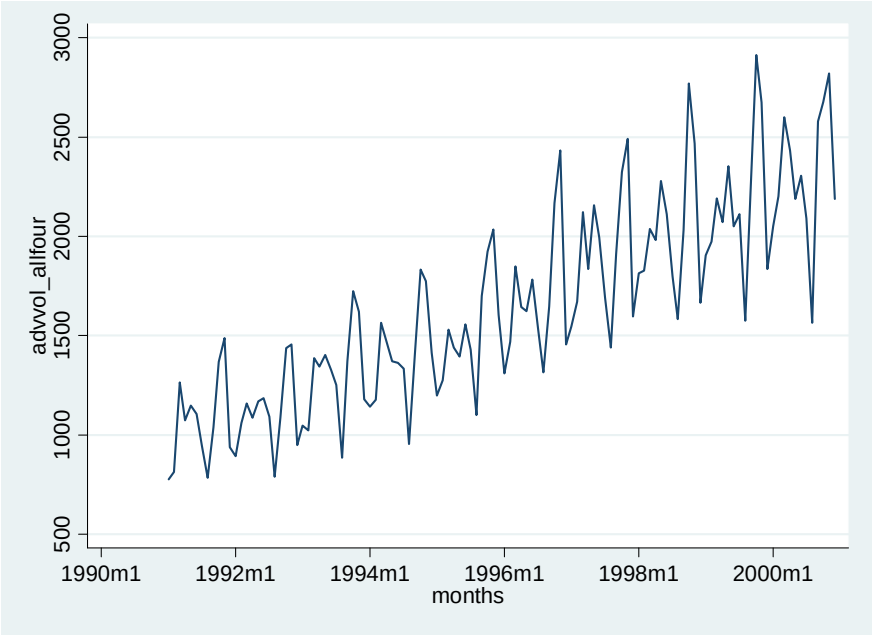


Figure 5ii - Advertising volume for all four quality newspapers

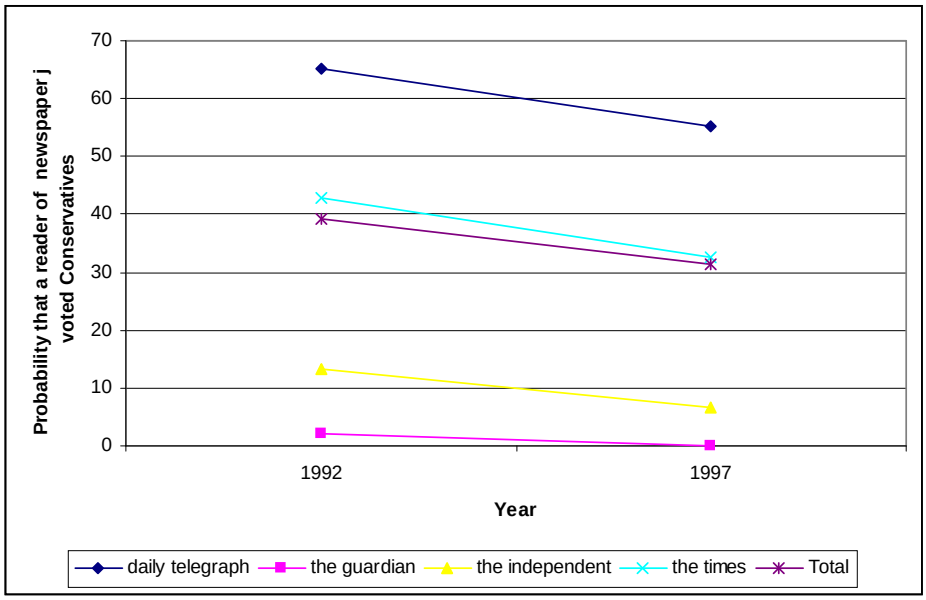


Figure 6i - Political position (percent readers voting Conservatives- absolute)

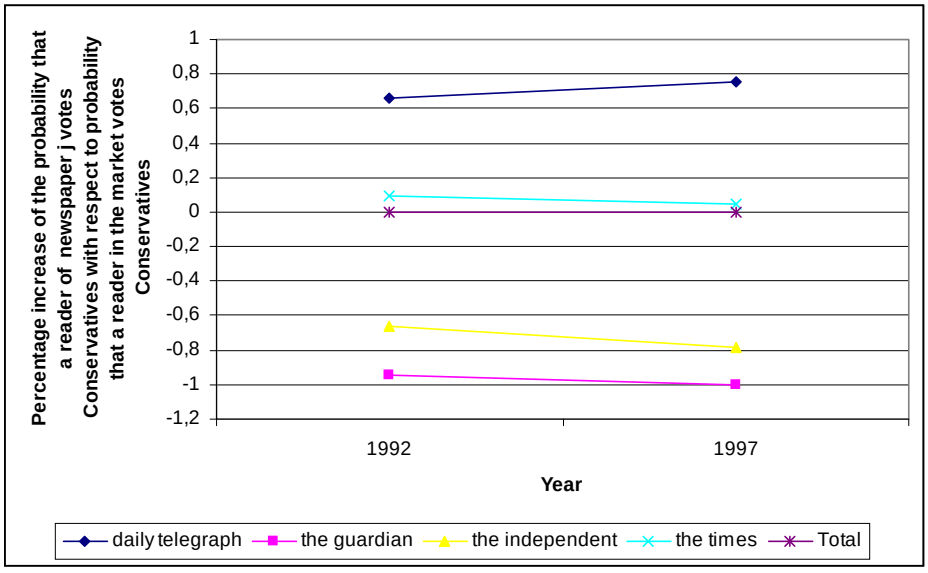


Figure 6ii - Political Position (percent readers voting Conservative - relative)

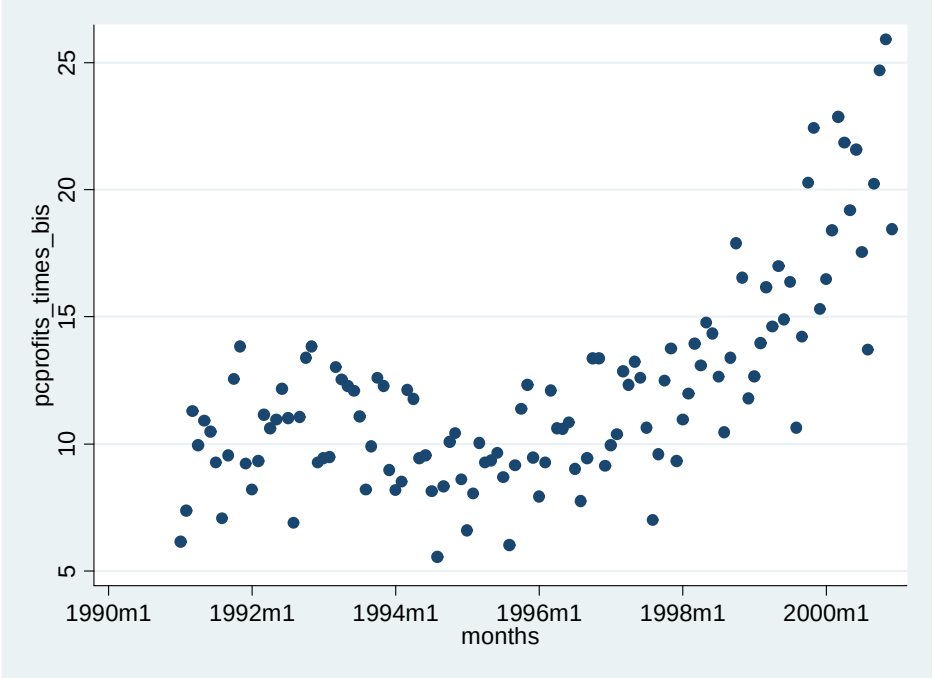
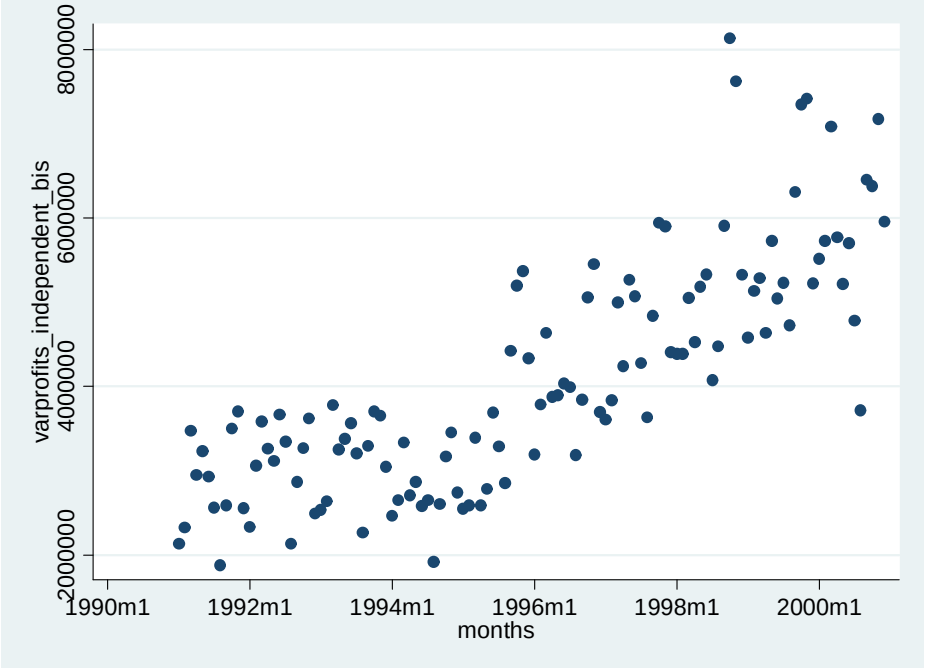


Figure 7a - Per copy profit margin of The Times (nominal)



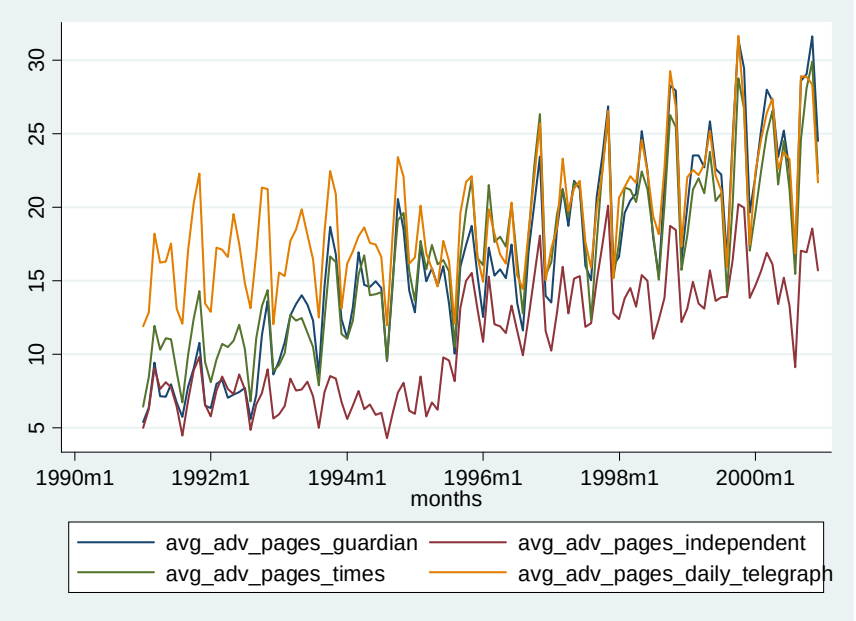


Figure 7b - Variable profits of the Independent (nominal)

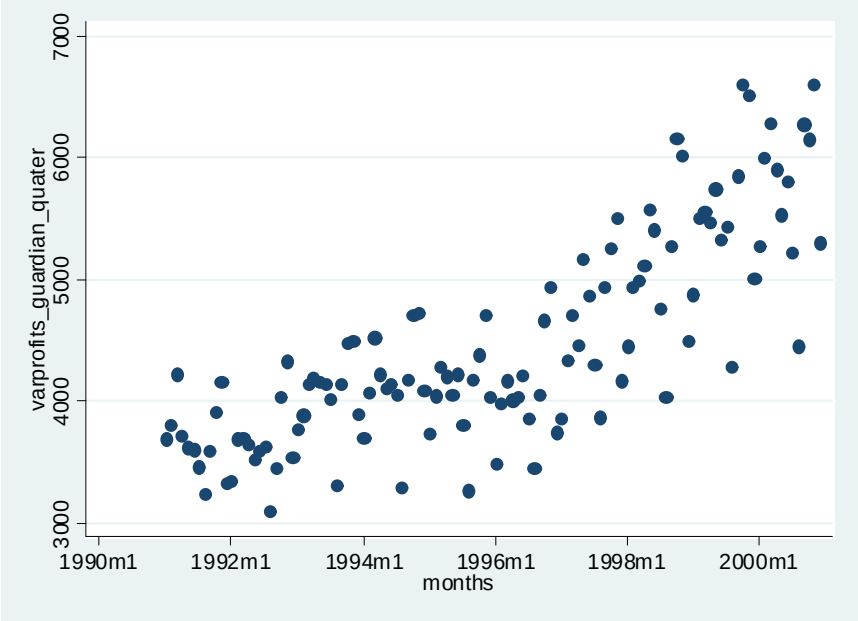


Figure 2: Fifure 7c - Variable profits the Guardian

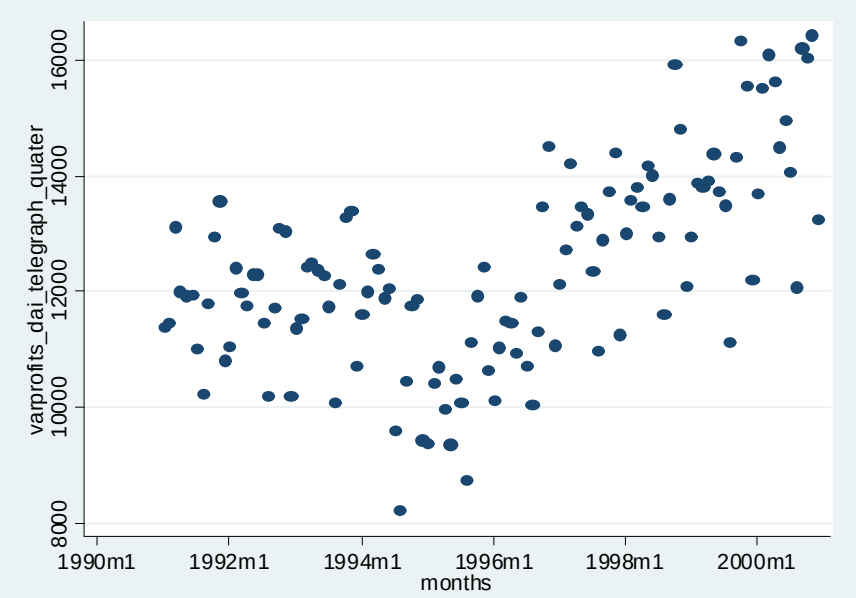


Figure 3: Figure 7d - Variable profits daily telegraph

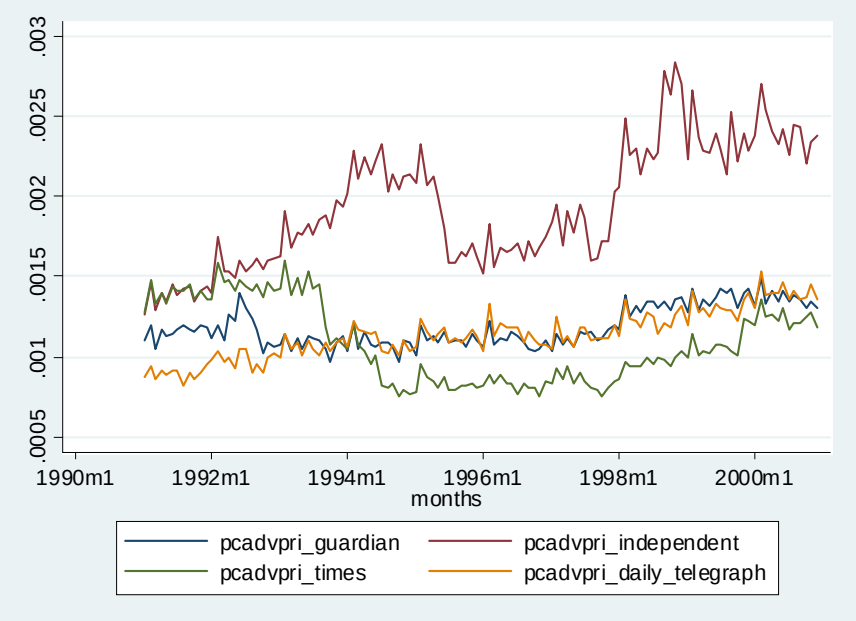


Figure 4: Figure 8 - Nominal advertising prices per copy

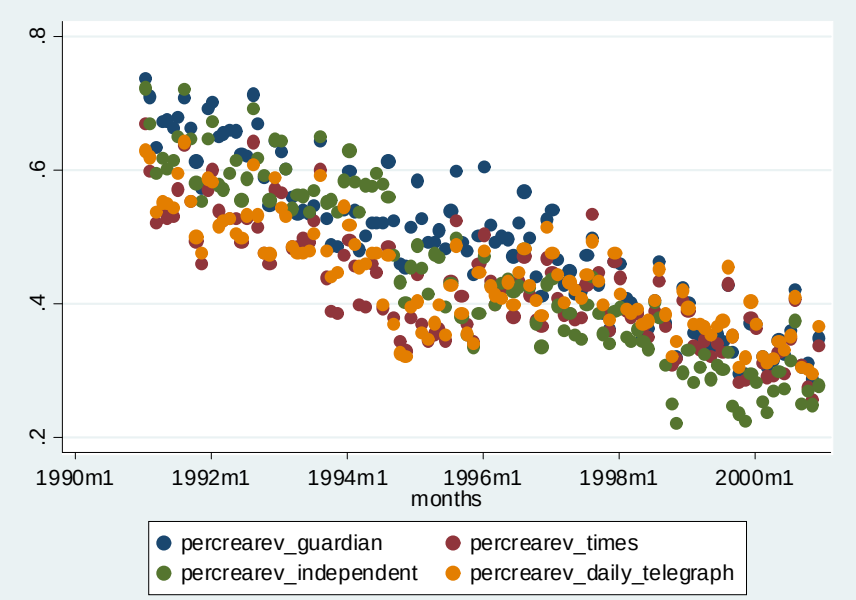


Figure 5: Figure 9 - Percentage revenues from readers over total revenues

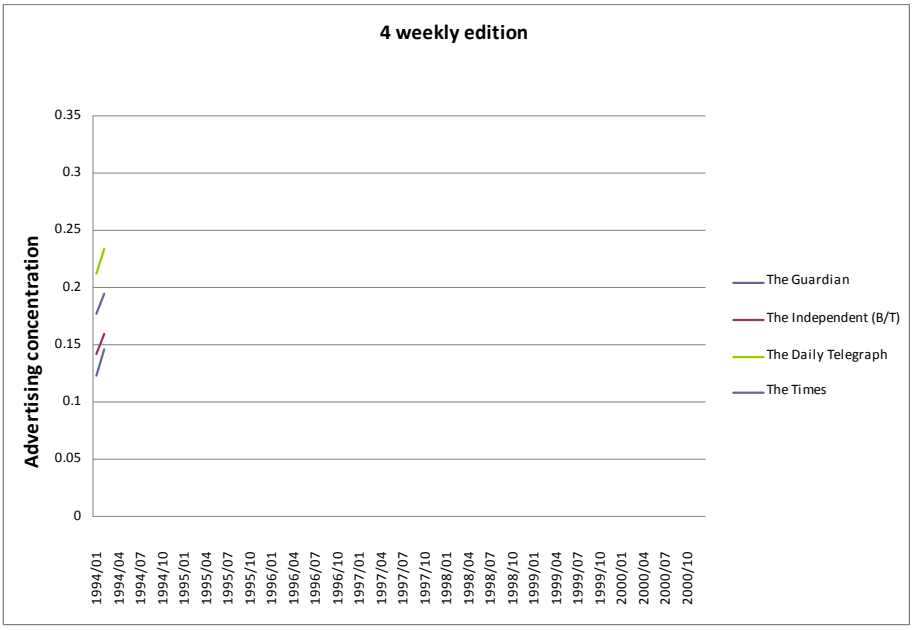


Figure 6: Figure 10 - Percentage advertising pages over total pages

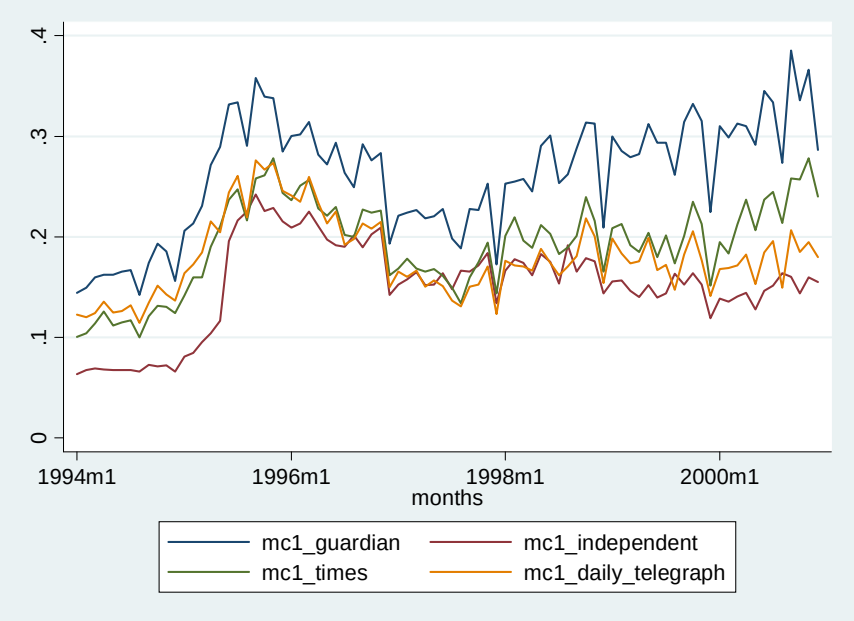


Figure 7: Figure 11-Marginal cost (paper only)