In Two-sided Markets

- Two groups of agents interact through a platform.
- Each group cares about the presence of agents on the other side, and thus the decisions of agents on one side a¤ect the utility of agents on the other side.
- Platforms account for these cross-group externalities in making strategic decisions (e.g. setting prices).

Examples

- Payment systems
  - Merchants and consumers interact through credit cards.
- Video game systems
  - Game developers and game players interact through video consoles.
- Advertising in newspapers/magazines/websites
  - Advertisers and readers interact through media platforms.

- I show how to estimate agents' demand (preferences) for platforms using data on (two) membership prices, the number of agents on platforms, and other platform attributes.
  - The presence of agents from the other side is an important platform attribute and this variable is an endogenous variable.
- Given demand estimates, one can recover platforms' costs of serving agents and measure their markups (market power).
  - Price elasticity does not have a closed form because of the so-called feedback loop e¤ect.
  - There are two demand equations, one for each group, and both should be used simultaneously to recover the costs.

Literature

- Numerous theory papers on two-sided markets.
  - The most cited ones are Rochet and Tirole (*JEEA* 2003; *RAND* 2006) and Armstrong (*RAND* 2006).
  - My paper is closely related to Armstrong (2006).
- Relatively few empirical papers but the number is growing fast.
  - Rysman (*RESTUDS* 2004) on the Yellow Page market - zero price for consumers.
  - Argentesi and Filistrucchi (*JAE* 2007) on the Italian newspaper market - consumers do not care about advertising.

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- Assuming $\#_{ij}$ is distributed the type I extreme value, platform $j's$ market shares are

$$S_j^A\left(\mathrm{p}^A,\mathrm{s}^B,x^A|\mathrm{W}\right) = \frac{\exp\left(m_j^A + a^A s_j^B - I^A p_j^A + x_j^A\right)}{1+\mathring{a}_{m=1}^{J}\exp\left(m_m^A + a^A s_m^B - I^A p_m^A + x_m^A\right)}$$

$$S_j^B\left(\mathrm{p}^A,\mathrm{s}^B,x^A|\mathrm{W}\right) = \frac{\exp\left(m_j^B + a^B s_j^A - I^B p_j^B + x_j^B\right)}{1+\mathring{a}_{m=1}^{J}\exp\left(m_m^B + a^B s_m^A - I^B p_m^B + x_m^B\right)}$$

- I follow Armstrong (2006) to model group B agents' membership decision. I assume that she makes a decision to join one platform independently from her decision to join another. She joins a platform as long as its net bene…t is positive.
- Given the …xed membership fee, say p_j^B, a type-a_i^B agent will join platform j if

$$a_i^B w_j n_j^A \geq p_j^B .$$

- Suppose platforms only know the distribution of a_i^B. Since each group B agent is ex ante identical, a platform will charge a single price p_j^B and the number of group B agents joining platform j is determined by

$$S_j^B\left(\mathrm{p}^B, s^A|\mathrm{w}\right) = \left(1 - F\left(\frac{p_j^B}{w_j n_j^A}|q\right)\right)$$

Computing price elasticities

- Because of the cross-group externalities

$$\frac{\P S_j^A\left(\mathrm{p}^A,\mathrm{s}^B,x^A|\mathrm{W}\right)}{\P p_k^A}\neq\frac{\P s_j^A}{\P p_k^A}$$

- This makes elasticity computation an implicit function problem. Treating share equations as an implicit function, the elasticity can be computed using the Implicit Function Theorem.
- For example, in the competitive bottleneck model,

$$\begin{aligned}F_j^A\left(\mathrm{s},\mathrm{p}\right) &\equiv \frac{\exp\left(m_j^A+a^A s_j^B M^B-l^A p_j^A+x_j^A\right)}{1+\mathring{a}_{m=1}^J\exp\left(m_m^A+a^A s_m^B M^B-l^A p_m^A+x_m^A\right)}-s_j^A=0\\ F_j^B\left(\mathrm{s},\mathrm{p}\right) &\equiv \left(1-G\left(\frac{p_j^B}{w_j s_j^A M^A}|q\right)\right)-s_j^B=0\end{aligned}$$

for $j=1,...,J$. where s are endogenous variables and p are control variables.

Estimation: Two-sided Single-home Model

- With observed market shares treated as one of equilibria, I estimate the following system of equations

$$\begin{aligned}\log\left(s_j^A\right) - \log\left(s_0^A\right) &= m_j^A + a^A s_j^B - I^A p_j^A + x_j^A \\ \log\left(s_j^B\right) - \log\left(s_0^B\right) &= m_j^B + a^B s_j^A - I^B p_j^B + x_j^B\end{aligned}$$

$j = 1, ..., J$. The model parameters are $W = \left(m_j^A, m_j^B, I^A, I^B, a^A, a^B\right)$.

- The demand-side model can be consistently estimated by the GMM with IVs.
  - In addition to the price variable, the other group's share variable is also an endogenous variable.
  - This variables is correlated with $\left(x_j^A, x_j^B\right)$ for all js because of the feedback loop.

Estimation: Competitive Bottleneck Model

- For group A agents we have the following equation to estimate

$$\log\left(s_j^A\right) - \log\left(s_0^A\right) = m_j^A + a^A n_j^B - I^A p_j^A + x_j^A$$

- For group B agents w_j is recovered by inverting following equation to es

$$\log\left(\right.$$

Recovering marginal costs and markup

- Demand estimates are used to recover platforms' costs using the pro…t maximization condition. Assuming the constant marginal cost, platform j's pro…t is

$$p_j = \left(p_j^A - c_j^A\right) s_j^A M_A + \left(p_j^B - c_j^B\right) s_j^B M_B$$

  where M_A and M_B denote the total number of agents for each group respectively.
- The pro…t maximizing …rst order conditions are

$$\begin{aligned}
\frac{\P p_j}{\P p_j^A} &= s_j^A M_A + \left(p_j^A - c_j^A\right) \frac{\P s_j^A}{\P p_j^A} M_A + \left(p_j^B - c_j^B\right) \frac{\P s_j^B}{\P p_j^A} M_B = 0 \\
\frac{\P p_j}{\P p_j^B} &= s_j^B M_B + \left(p_j^B - c_j^B\right) \frac{\P s_j^B}{\P p_j^B} M_B + \left(p_j^A - c_j^A\right) \frac{\P s_j^A}{\P p_j^B} M_A = 0
\end{aligned}$$

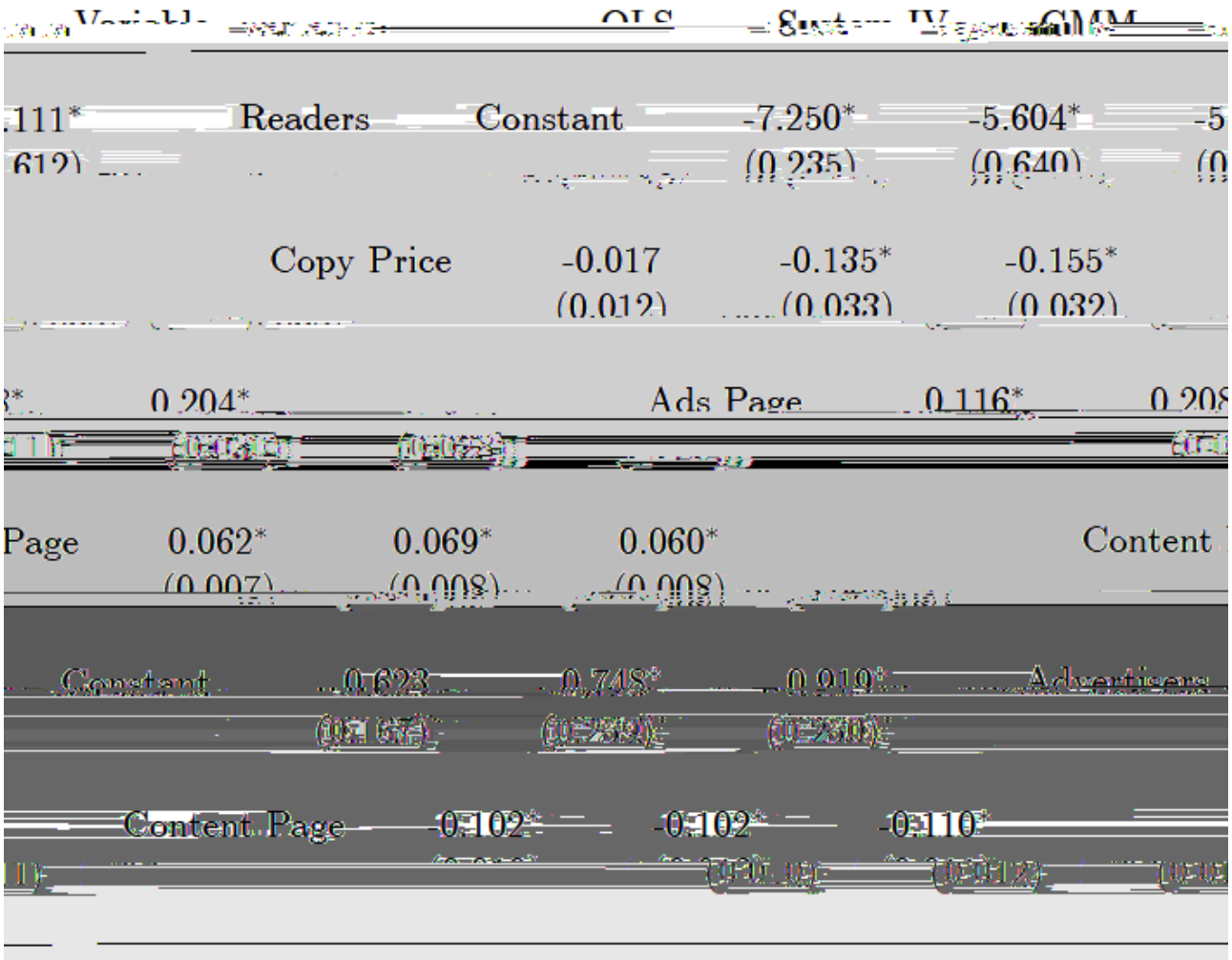
- The two marginal costs should be searched simultaneously. This search process involves numerical computation of the own- and cross-price elasticities as derivatives of the implicit function for each set of trial values.
- Platform's markup from one group is a function of its markup from the other group.

Empirical application

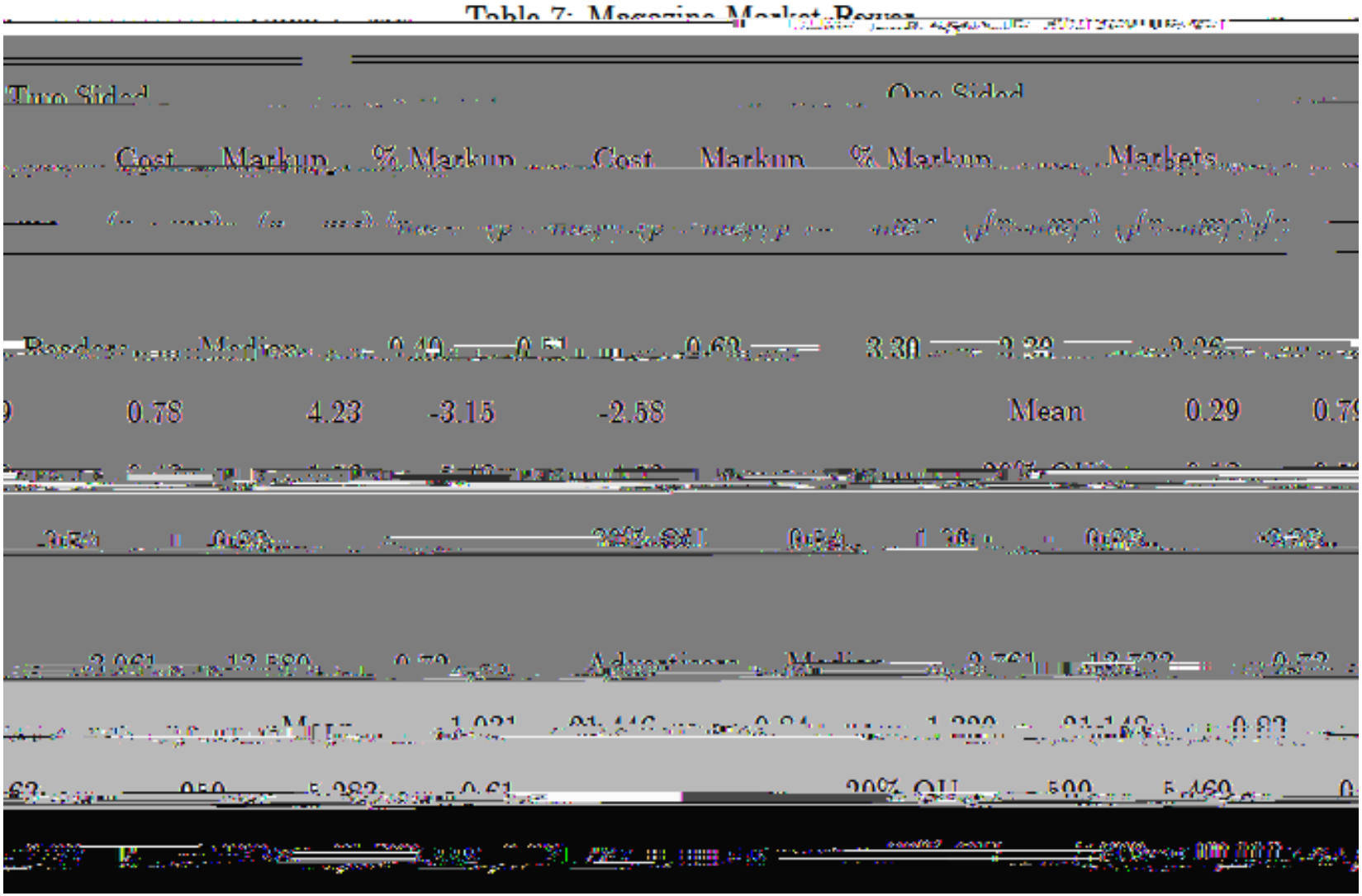
- Advertising in magazines. Magazines serve readers on one side and advertisers on the other side.
- Panel data (1992 to 2010) on TV magazines in Germany.
- Quarterly information on copy prices, advertising rates, advertising pages, content pages, and circulation are collected from a non-pro…t public institution equivalent to the US Audit Bureau of Circulation.
- Finding IVs from di¤erent magazine segments (Kaiser and Song, IJIO 2009).

Estimation results

Table 5: Demand Estimation Results



Magazine (Platform) markup



Merger Analysis

	One-Sided		Two-Sided	
	Single	Monopoly	Single	Monopol
Readers				
Magazine 1	1.42	1.45		
Magazine 2	0.99	1.04		
Magazine 3	1.00	1.03		
Magazine 4				
Magazine 5	1.42	1.47	1.42	1.48
Magazine 6	1.41	1.47	1.41	1.49
Magazine 7	1.41			
Magazine 8	1.03	1.05	0.98	1.00

Summary

- My structural model has two key features of the two-sided market.
  - Both groups care about the presence of the other group, so the cross-group externalities are present on both sides.
  - Platforms set di¤erent prices for each group to maximize joint pro…ts from both sides.
- The empirical results show that most magazines set copy prices below marginal costs to increase the reader basmgTRs.28(y)(ma)28(r33(the)-3