Word of Mass: The Relationship between Mass Media and Word-of-Mouth

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Literature review

- **Theoretical:**
  - Goyal and Galeotti (2009) strategic diffusion with network externalities in adoption decision.
  - Candogan et al. (2010) assumes knowledge of complete structure of the network and decide how much each consumer should pay for the product.
  - Campbell (2013) studies the optimal pricing in the presence of word-of-mouth communication.

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  - Campbell (2013) studies the optimal pricing in the presence of word-of-mouth communication.
- **Empirical:**
  - Leskovec et al. (2008) study recommendation network of online book store.
  - Iribarren and Moro (2011) formulate what they call diffusion rules.

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- The innovator knows degree distribution of the network $\mathbf{p}(\mathbf{k})$ and chooses optimally price $\mathbf{P}$ and amount of advertising $\mathbf{s}$.

Model cont'd

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  - Direct advertisement from the producer.
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  - Direct advertisement from the producer.
  - Observing a neighbor who has acquired the product.
- No information asymmetry - once consumer knows about the product she knows immediately its quality.

Model cont'd

Demand function:

$$D(s, v, P) = s(v - P) + (1 - s)(v - P) \sum_{k=0}^{\infty} p(k)(1 - (1 - w)^k)$$

$$= (v - P)\left(1 - (1 - s)e^{-\lambda w}\right)$$

- where w is the probability that a randomly chosen consumer buys the product and $p(k) = \frac{\lambda^k e^{-\lambda}}{k!}$

Model cont'd

Demand function:

$$w = s(v-P) + (1-s)(v-P)\sum_{k=1}^{\infty}\xi(k)(1-(1-w)^{k-1})$$

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- where $\xi(k) = \frac{kp(k)}{\sum_{j=1}^{\infty} jp(j)} = \frac{kp(k)}{z_1}$ is the degree distribution of a neighbor.

Monopolist problem

$$\max_{s,P} \; wP - \frac{c}{1-s}$$

$$s.t. \; w = (v - P)\left(1 - (1-s)e^{-\lambda w}\right)$$

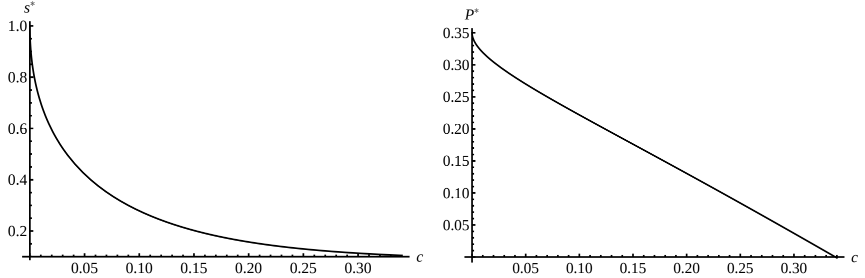
- Solution:

$$s^* = 1 - \frac{2\sqrt{c}e^{\frac{\lambda w^*}{2}} - \lambda c}{v}; \;\; P^* = \frac{v}{2}\left(1 - \frac{\lambda\sqrt{c}}{2e^{\frac{\lambda w^*}{2}} - \lambda\sqrt{c}}\right),$$

$$\text{where } w^* = \frac{v}{2} - \frac{\sqrt{c}}{2}\left(\frac{2}{e^{\frac{\lambda w^*}{2}}} - \frac{\lambda v}{2e^{\frac{\lambda w^*}{2}} - \lambda\sqrt{c}}\right)$$

The effect of advertising cost.

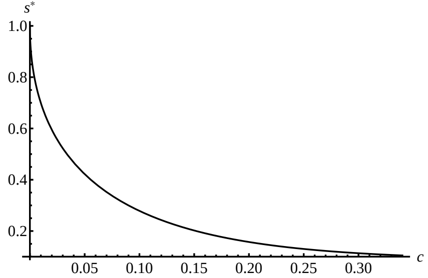
The effect of cost on price and advertising

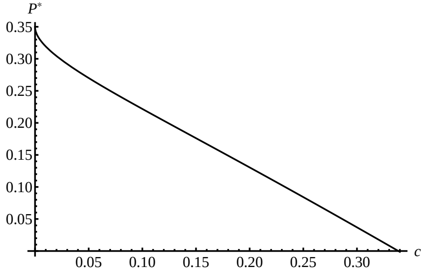


Proposition

The optimal price P^* and amount of advertising s^* decrease in the cost of advertising c. The same is true about awareness of the product and diffusion perimeter.

The effect of cost on price and advertising





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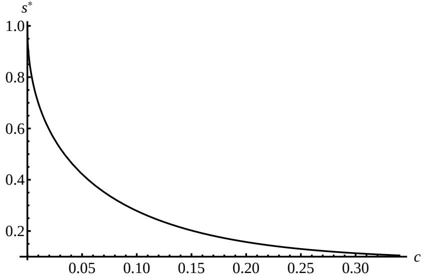

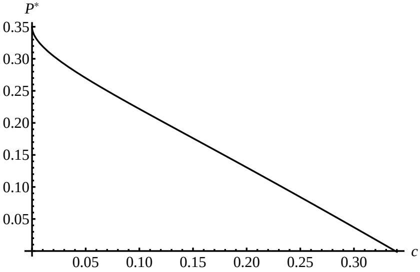

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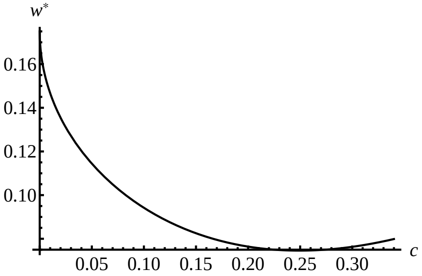
The optimal price P^* and amount of advertising s^* decrease in the cost of advertising c. The same is true about awareness of the product and diffusion perimeter.

- The monopolist substitutes more expensive advertising with word-of-mouth by lowering the price.
- However, word-of-mouth substitutes advertising only partially and the overall awareness of the product falls.

The effect of cost on sales



Proposition

In general, sales of the product is non-monotone function in advertising cost c. More precisely, if $1 < \lambda v < 4$ then sales of the product first decrease, but after some level increase in c. If $\lambda v < 1$ sales are decreasing in c on the whole range, while if $\lambda v > 4$ sales always increase in c.

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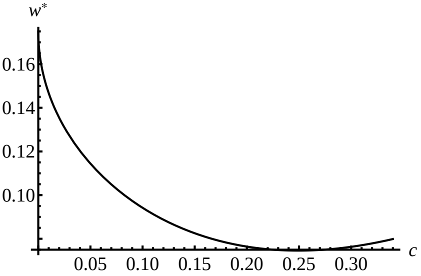

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- When advertising cost is small a price decrease makes existing advertising more efficient, but doesn't add much to product awareness.

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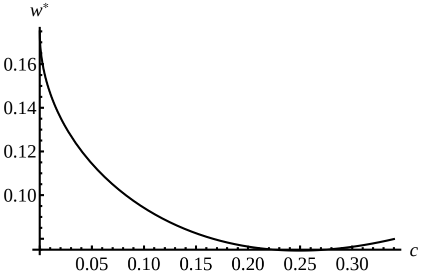

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- When advertising cost is small a price decrease makes existing advertising more efficient, but doesn't add much to product awareness.
- When cost is high, a price decrease increases both advertising efficiency and awareness.

The effect of cost on sales

- Can sales be higher in the case of incomplete information?

The effect of cost on sales

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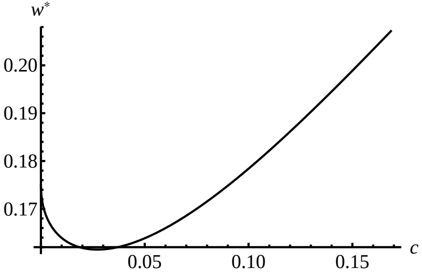
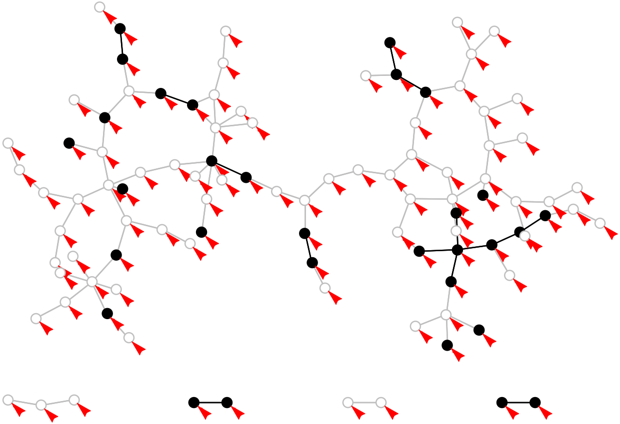


Proposition

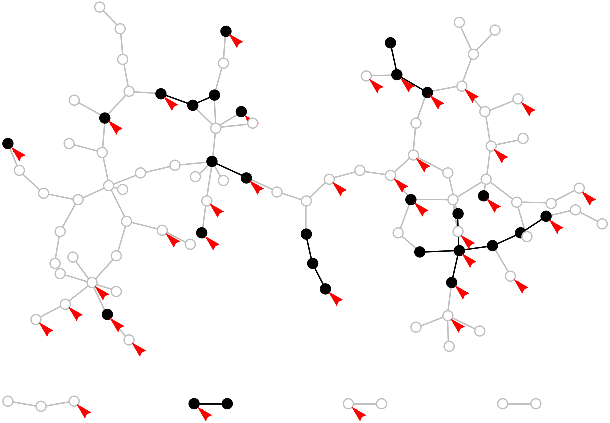
For sufficiently high cost c and $\lambda v > 2$ the sales in the case of incomplete information are higher than in the case of complete information. The statement is also true for sufficiently high connectivity λ.

The effect of advertising cost c ($\lambda = 1.85$, $v = 0.7$)



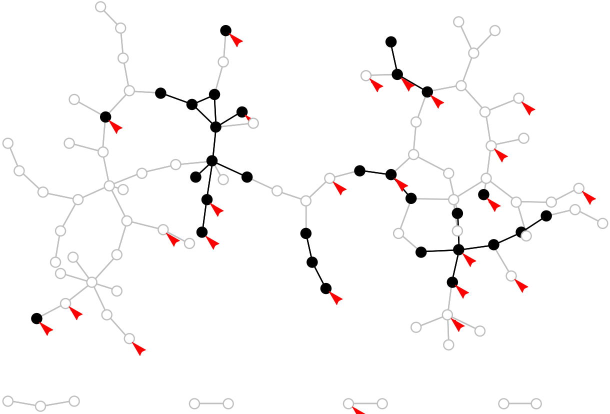
Induced network of buyers: $c = 0$, $s^* = 1$, $P^* = 0.35$

The effect of advertising cost c ($\lambda = 1.85$, $v = 0.7$)



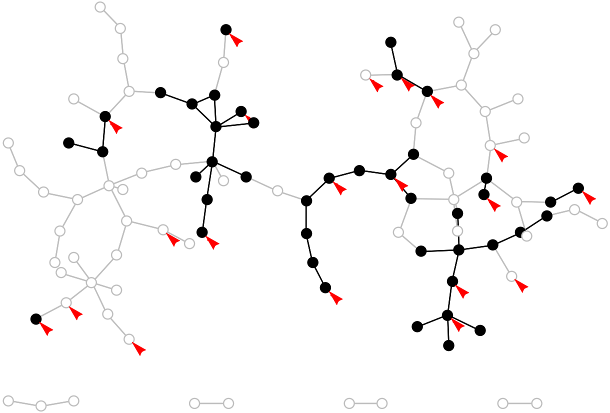
Induced network of buyers $c = 0.1$, $s^* = 0.28$, $P^* = 0.22$

The effect of advertising cost c ($\lambda = 1.85$, $v = 0.7$)



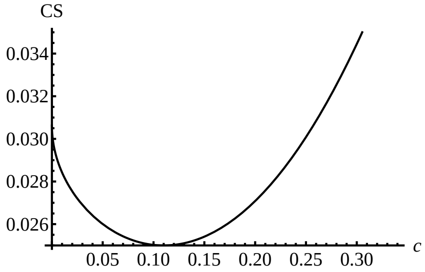
Induced network of buyers $c = 0.2$, $s^* = 0.16$, $P^* = 0.13$

The effect of advertising cost c ($\lambda = 1.85$, $v = 0.7$)



Induced network of buyers $c = 0.3$, $s^* = 0.11$, $P^* = 0.03$

Consumer Surplus



Proposition

If $\lambda v > 1$ the consumer surplus is non-monotone functions in advertising cost c. More precisely, first consumer surplus falls, but after some level consumers become better-off as the cost increases. When $\lambda v < 1$ consumer surplus decreases in the cost on the whole range.

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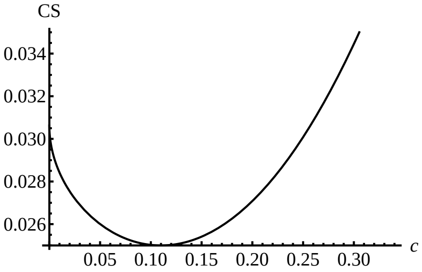

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- An increase in the advertising cost decreases product awareness, but price decrease is more than sufficient to offset this change.

Social Welfare

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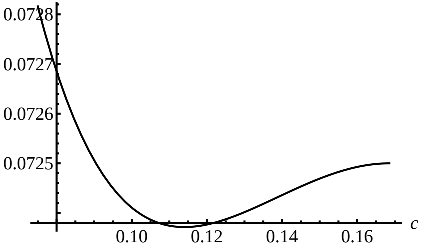
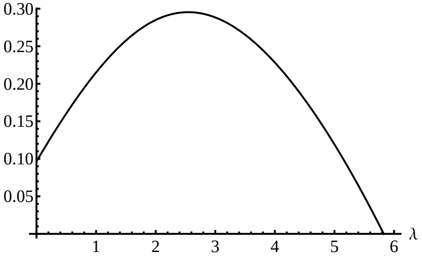


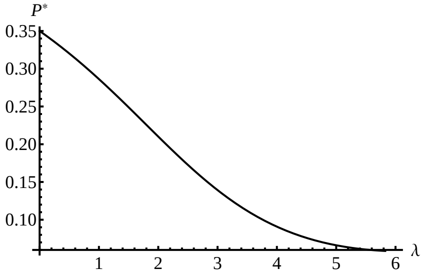
Proposition

If $2 < \lambda v < 6$ then social welfare first decreases in c up to the point where $c = \frac{1-\lambda v+\sqrt{1+4\lambda v}}{\lambda^2}$ and then increases. If $\lambda v < 2$ then social welfare always decreases while for $\lambda v > 6$ social welfare always increases in c.

The effect of connectivity.

The effect of λ on advertising level





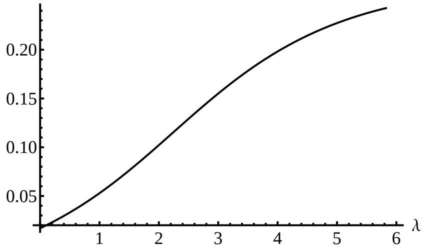
Proposition

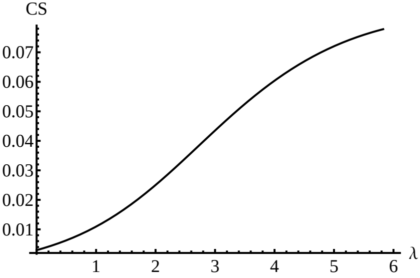
The amount of advertising is a non-monotone function in connectivity λ. More precisely, for sufficiently small λ it increases in λ, while for sufficiently high λ decreases. If the advertising cost is sufficiently low then the advertising level always decreases in λ.

Proposition

The optimal price decreases in connectivity λ.

CS and sales





Proposition

If network connectivity λ is sufficiently small then both consumer surplus and sales increase in λ. When network connectivity is sufficiently high and advertising cost is sufficiently low both consumer surplus and sales decrease in λ.