ADOPTION OF INNOVATIONS

HOW, WHY AND WHEN ARE INNOVATIONS ADOPTED

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- S. Gonçalves, M. F. Laguna and J. R. Iglesias, Eur. Phys. J. B, 85, (June 2012), 192
- Mirta Gordon, M. F. Laguna, J. R. Iglesias and S. Gonçalves (in preparation)

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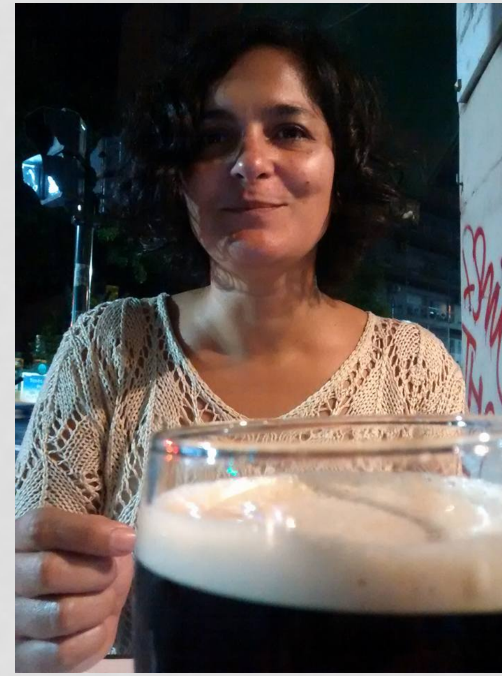

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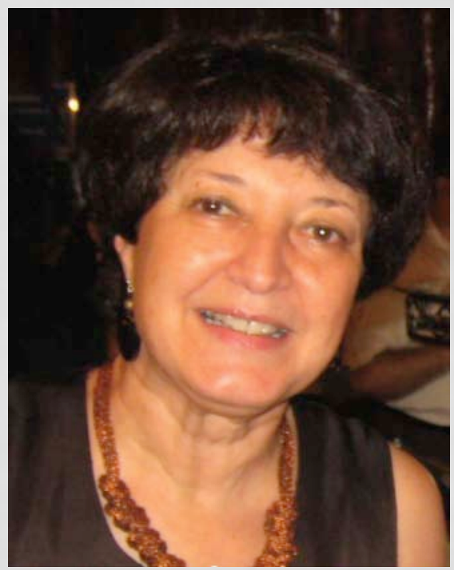

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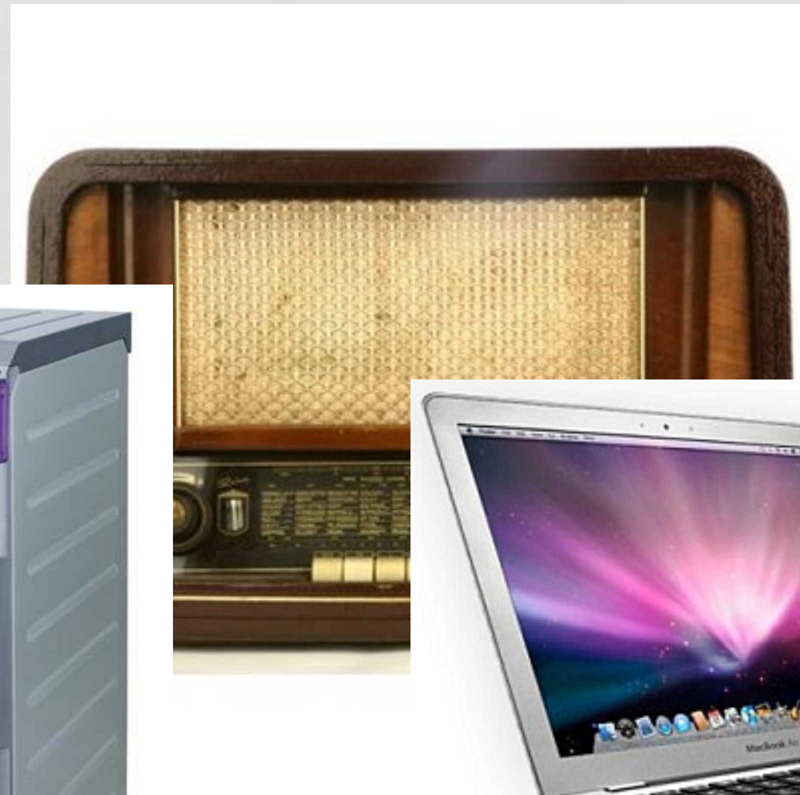
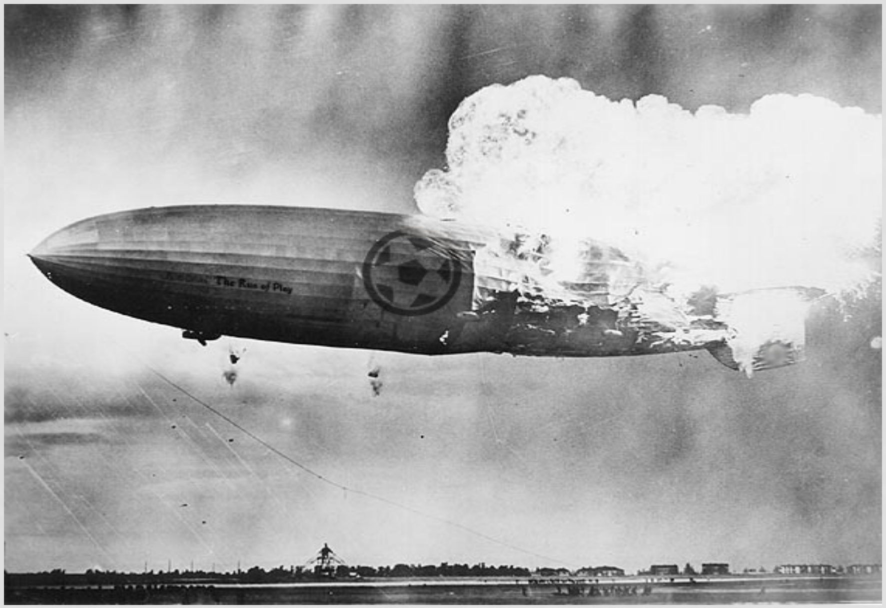
INNOVATIONS

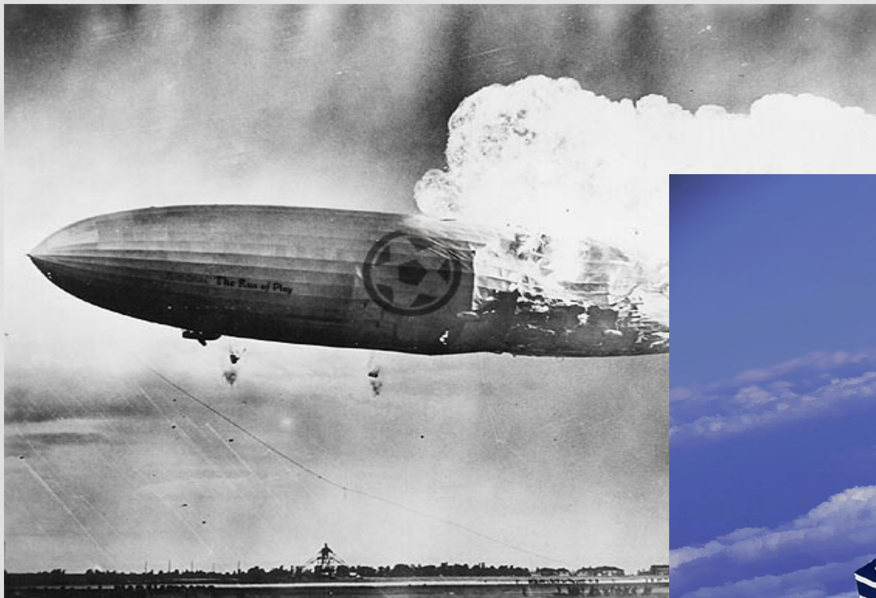
(SUCCESSFUL) INNOVATIONS



OR NOT SO….

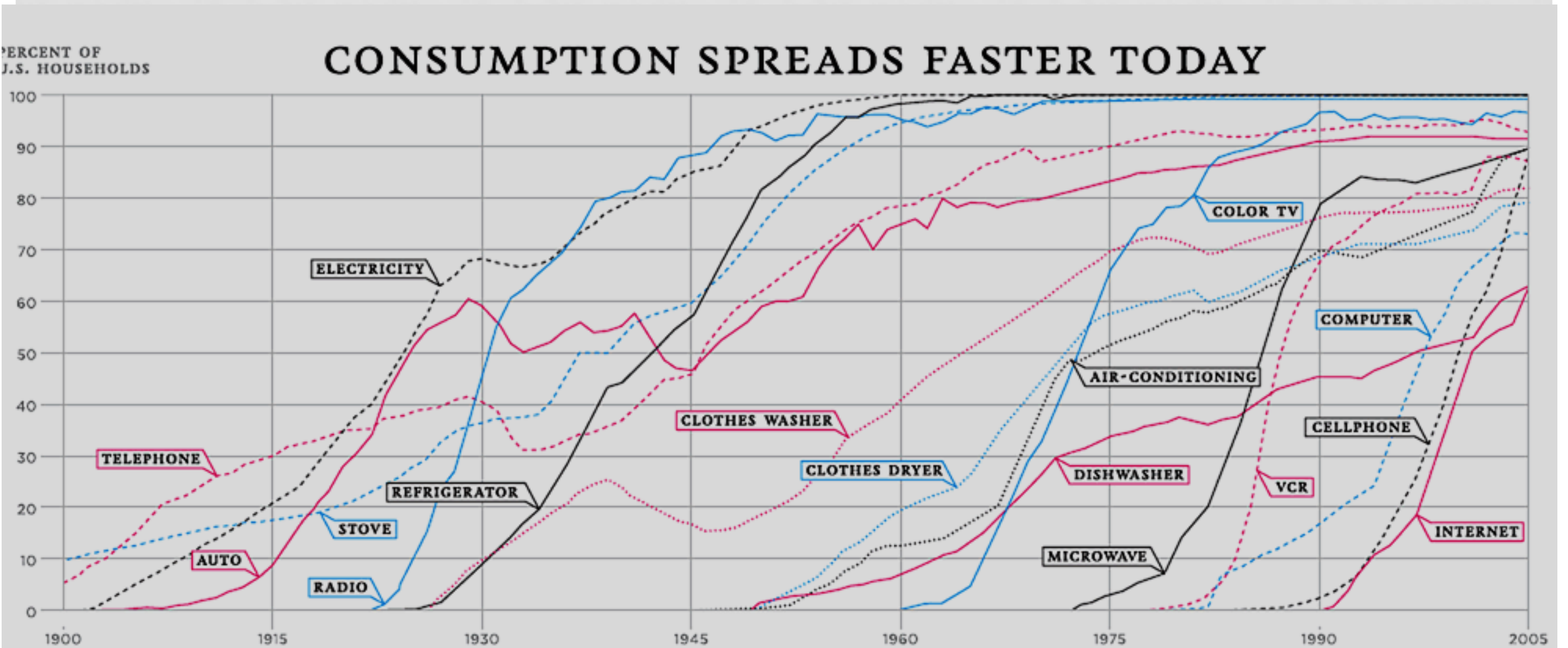


OR NOT SO….



ADOPTION OF INNOVATIONS ALONG THE 20TH CENTURY

M. Cox, R. Alm, You are what you spend (New York Times, 2008)

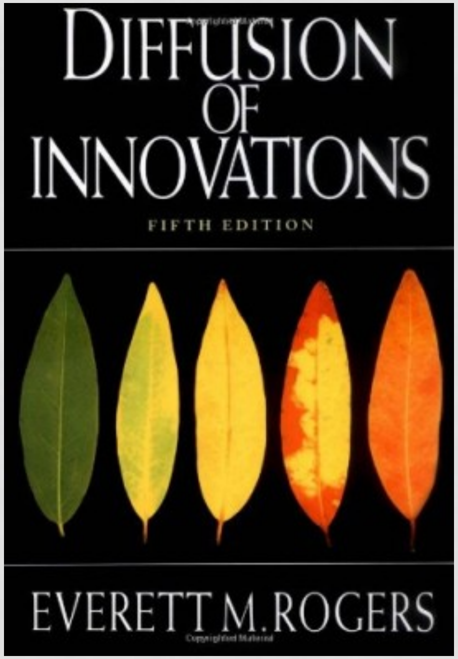


THE APPEAL OF NOVELTIES

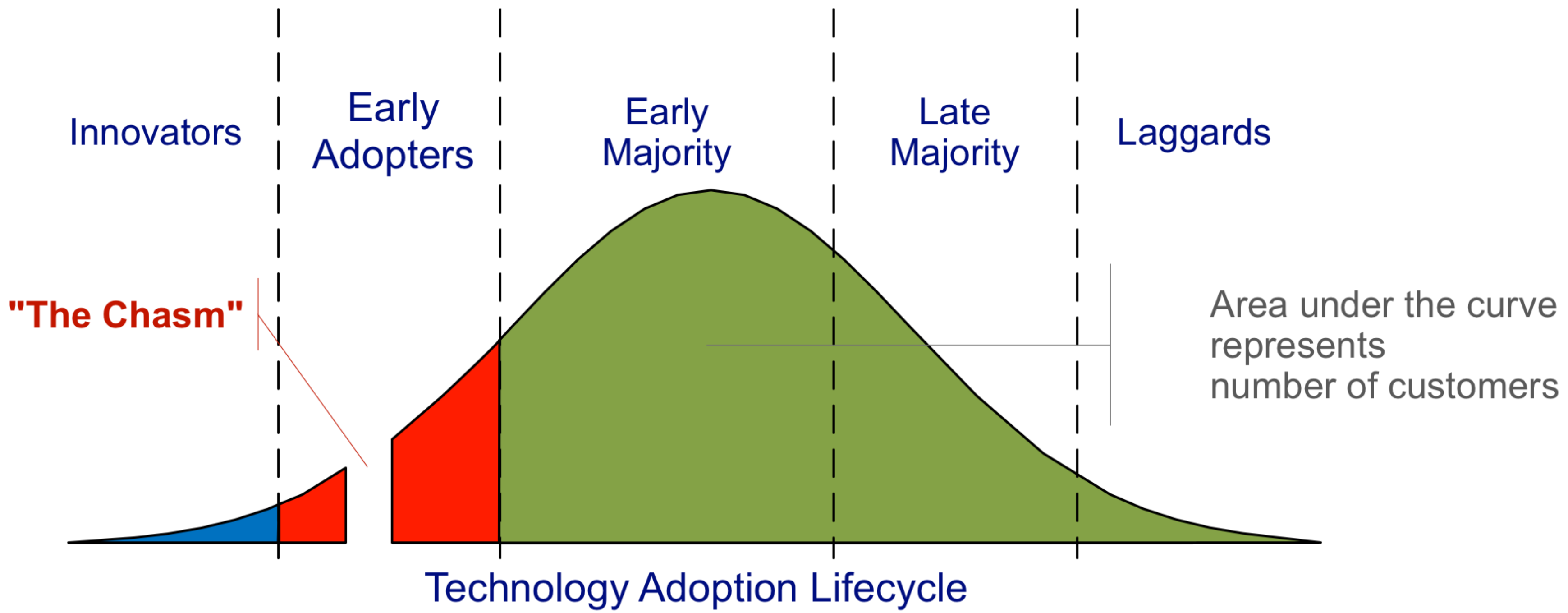
THE APPEAL OF NOVELTIES

Everett Rogers

(1931-2004)

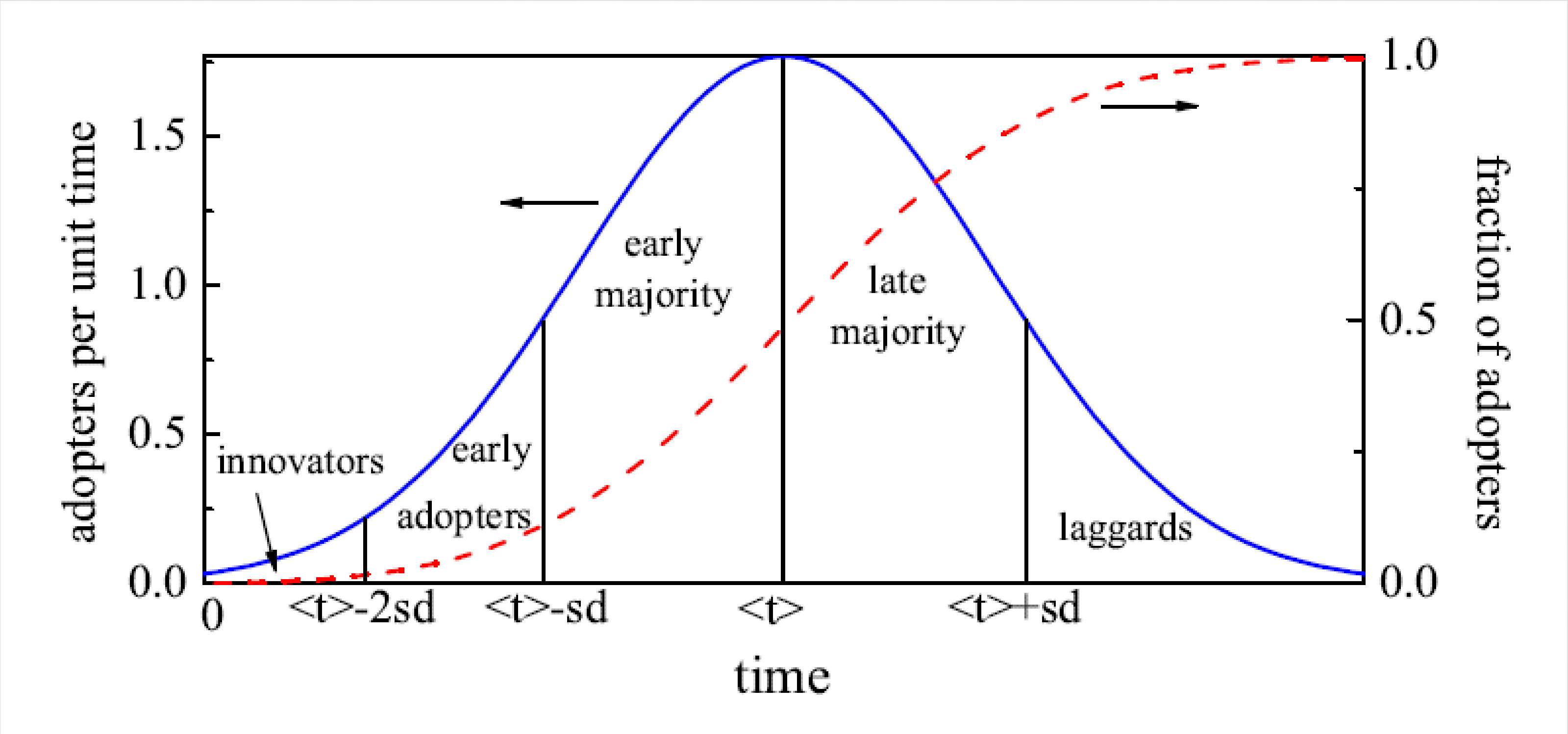


ROGER'S HYPOTHESIS



E.M. Rogers, *Diffusion of Innovations*, 5th edition (Free Press, 2003)

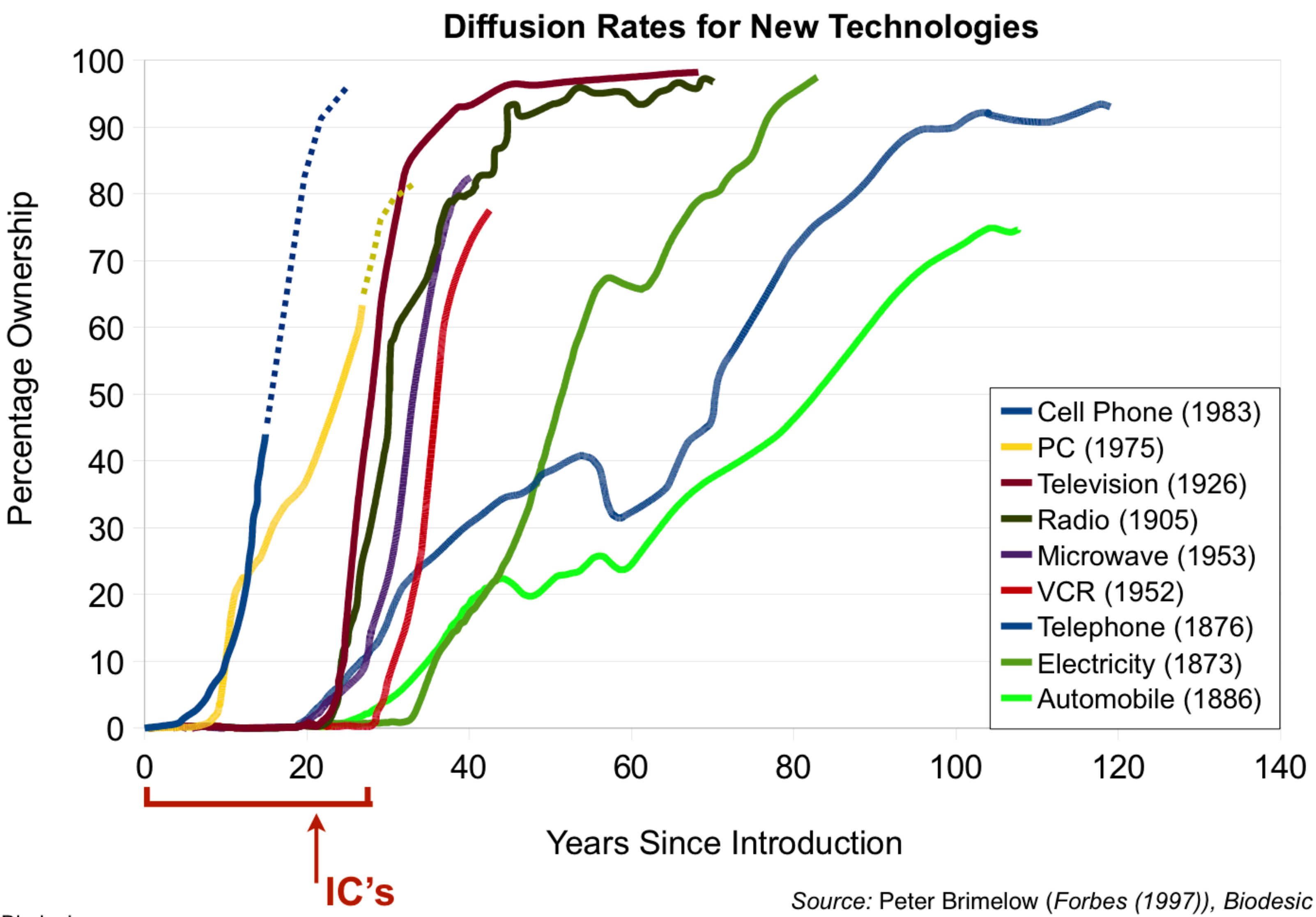
Rogers's hypothesis



Caveats II: "The Silent Boom"

More Recent = More Rapid Adoption?

More Recent = Steeper Slope?



Source: Peter Brimelow (*Forbes (1997)*), *Biodesic*

Bass Model (1969)

A New Product Growth for Model Consumer Durables

Frank M. Bass

Management Science, Vol. 15, No. 5, Theory Series (Jan., 1969), 215-227.

The Theory of Adoption and Diffusion

The theory of the adoption and diffusion of new ideas or new products by a social system has been discussed at length by Rogers [13]. This discussion is largely literary. It is, therefore, not always easy to separate the premises of the theory from the conclusions. In the discussion which follows an attempt will be made to outline the major ideas of the theory as they apply to the *timing* of adoption.

Bass Model (1969)

b) The likelihood of purchase at time T given that no purchase has yet been made is

$$[f(T)]/[1 - F(T)] = P(T) = p + q/m\,Y(T) = p + q\,F(T),$$

where $f(T)$ is the likelihood of purchase at T and

$$F(T) = \int_0^T f(t)\,dt, \qquad F(0) = 0.$$

Since $f(T)$ is the likelihood of purchase at T and m is the total number purchasing during the period for which the density function was constructed,

$\Downarrow$

p ← coeficiente de inovação
q ← coeficiente de imitação

Bass Model (1969)

The behavioral rationale for these assumptions are summarized:

a) Initial purchases of the product are made by *both* "innovators" and "imitators," the important distinction between an innovator and an imitator being the buying influence. Innovators are not influenced in the timing of their initial purchase by the number of people who have already bought the product, while imitators are influenced by the number of previous buyers. Imitators "learn," in some sense, from those who have already bought.

b) The importance of innovators will be greater at first but will diminish monotonically with time.

c) We shall refer to p as the coefficient of innovation and q as the coefficient of imitation.

Bass Model vs. Data

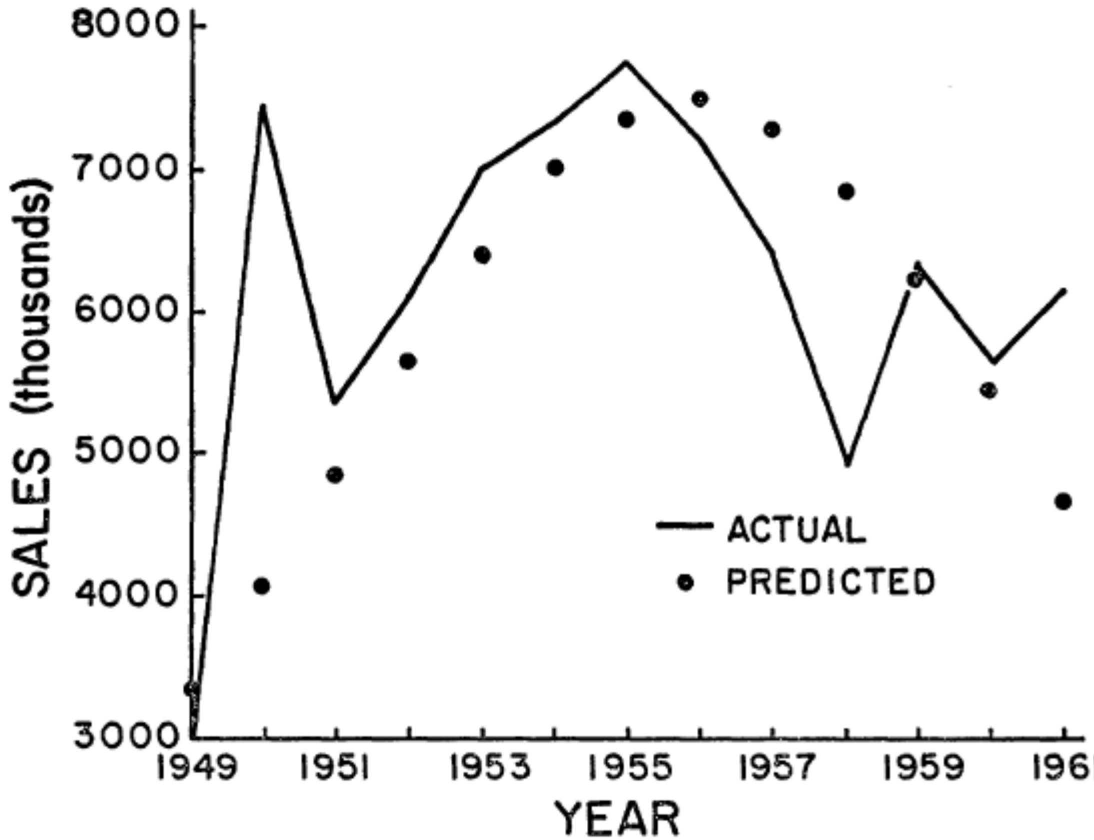


FIG. 9. Actual sales and sales predicted by model (black & white television)

Nosso modelo

- **Publicidade**: pressão externa (campo) para adoção da nova tecnologia: $\boldsymbol{A}$ $\boldsymbol{0 < A < 1}$

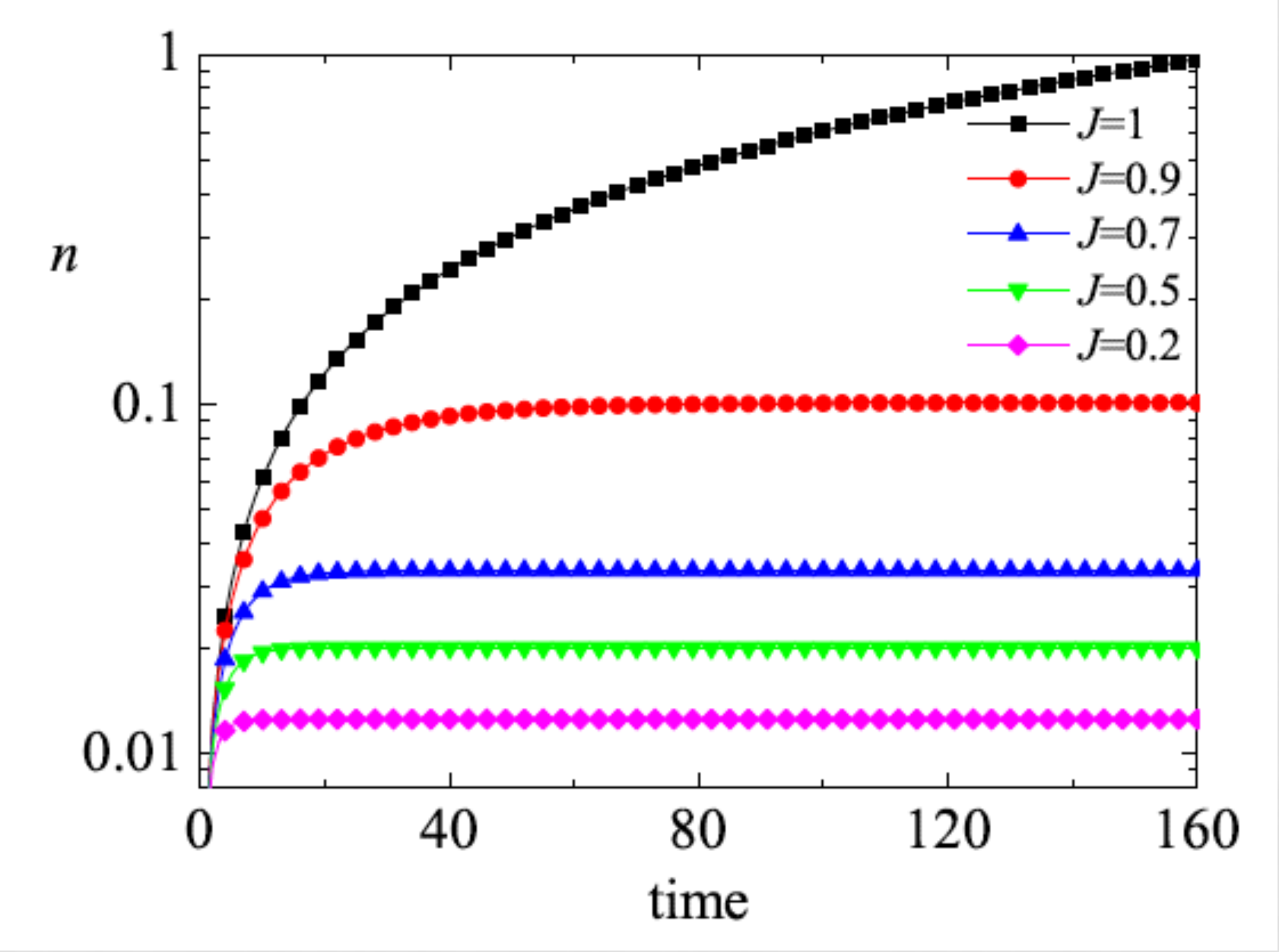
- **Resistencia Idiosincratica** à mudança $\boldsymbol{u_i}$ (valor aleatório : $0 < \boldsymbol{u_i} < 1$)

- **Influencia social** proporcional ao número de "adopters": $\boldsymbol{J \times n}$ $(n = N_{adopters}/N)$

=> $\boldsymbol{Payoff} = \boldsymbol{A - u_i + J \times n}$

Agente i (selecionado aleatoriamente) adotará a novidade **se *Payoff* > 0**

Simulations as a function of J



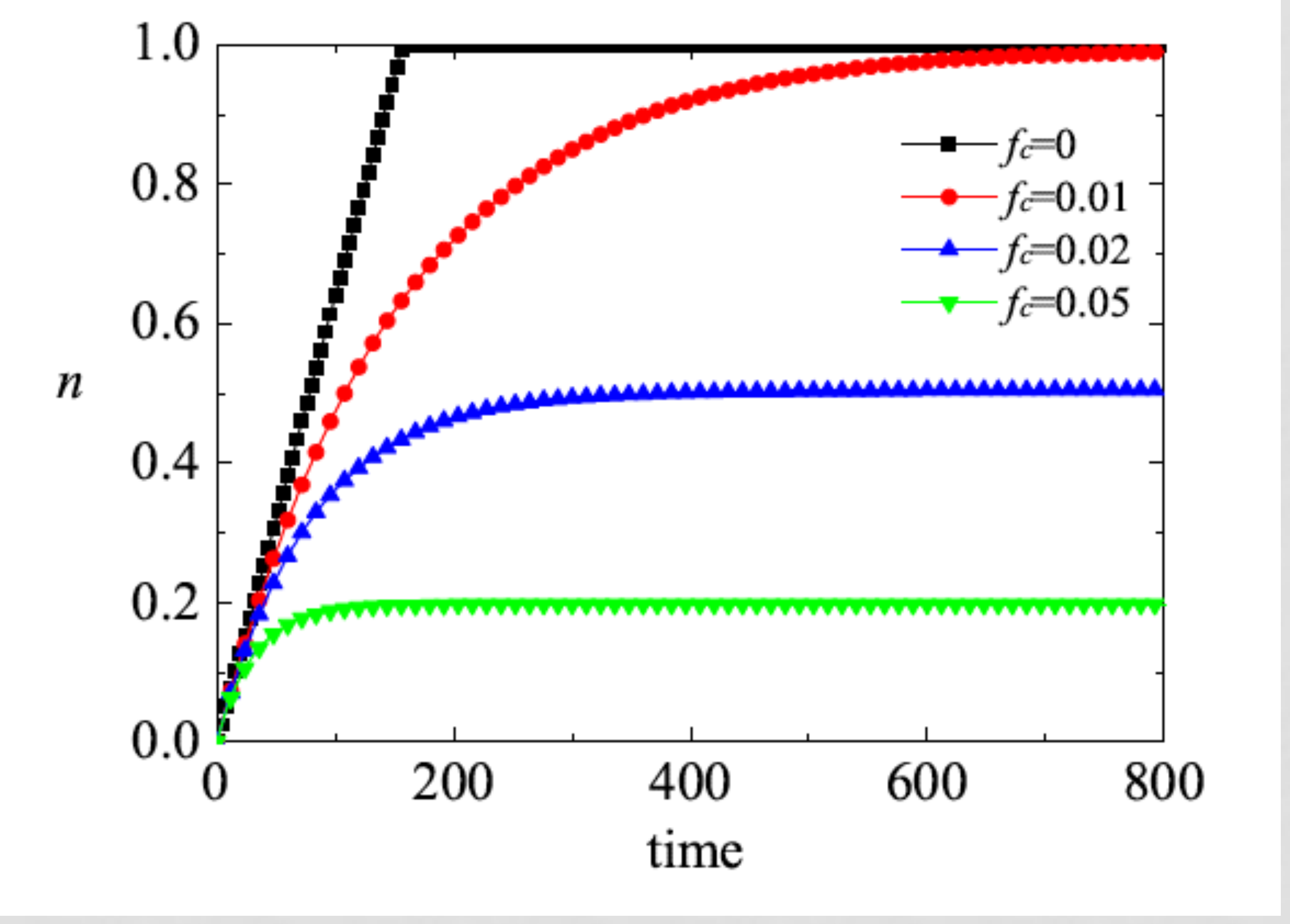
A=0.01

"Contrarians"

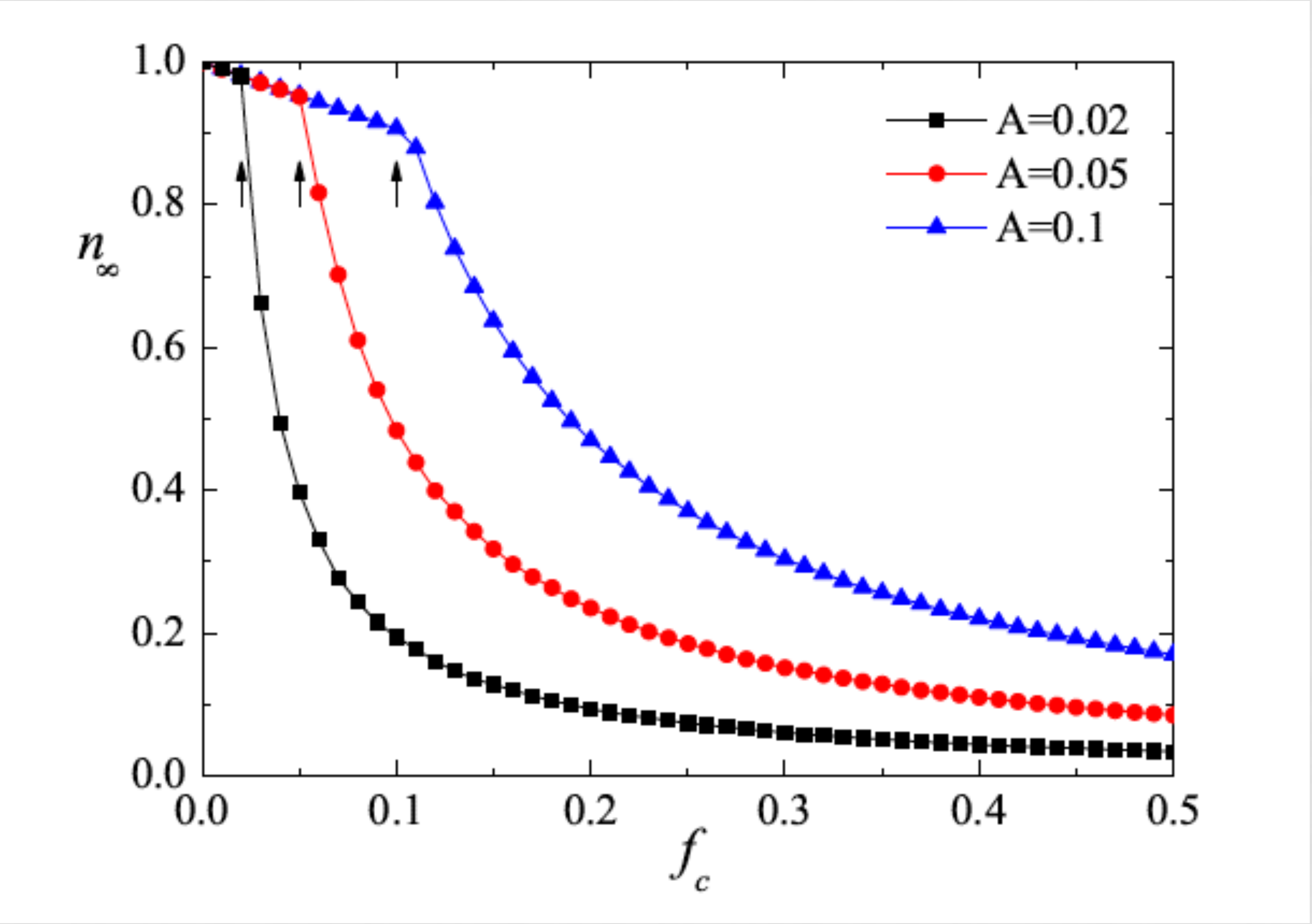
- Agents against the herd ($J_i < 0$) (Serge Galam)
- For a "contrarian" social influence changes sign $Payoff = A - u_i - J \times n$

Efeect of "contrarians"

A=0.01



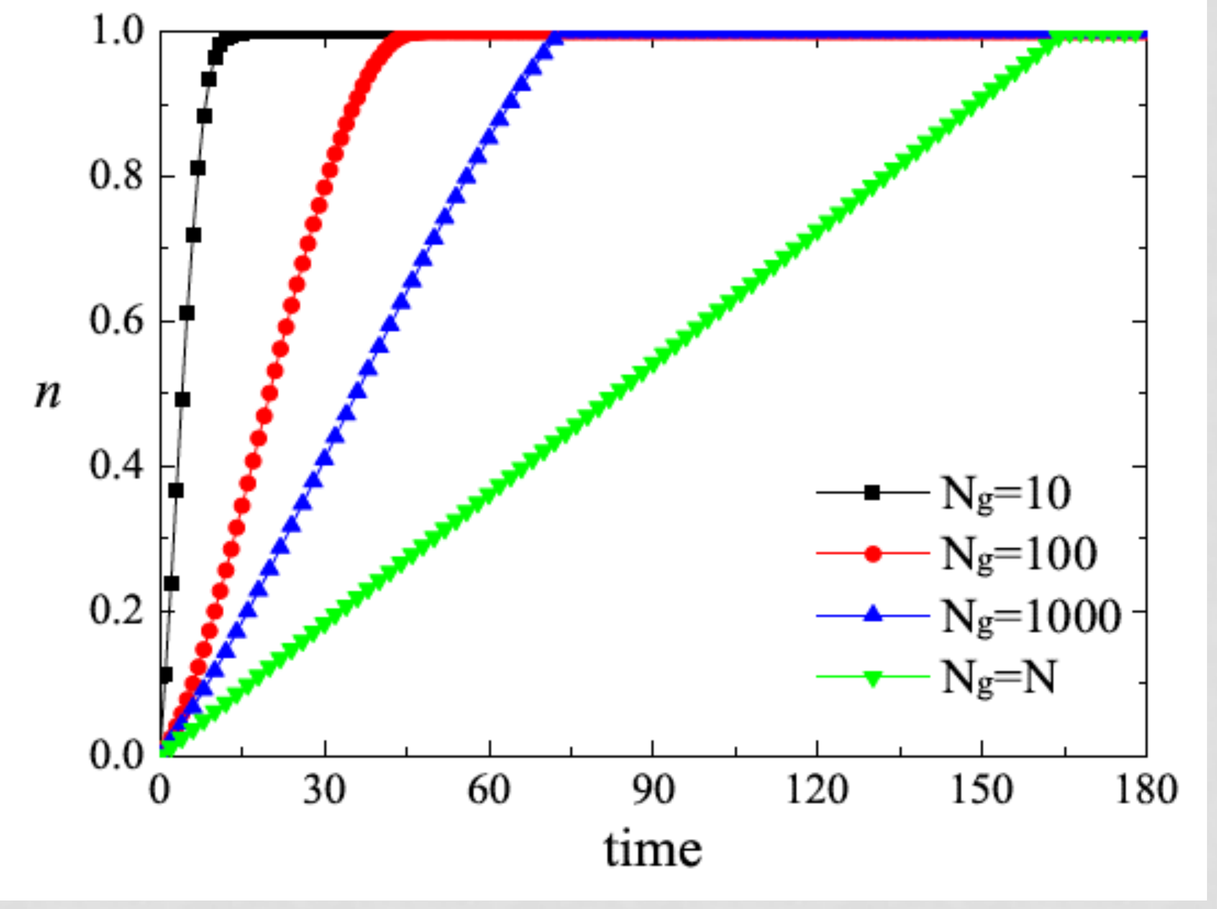
Effect of contrarians



Groups of influence

- Agents cannot have instantaneously and full information of the decisions of the rest of he society.
- It is more realistic to assume interactions with a smaller group, the group of influence.
- At each time step the agent selects at random a group of size Ng) and n is now the number relative to the size of the group. n=N/Ng

Grupos de influencia



$N = 10^7$, $A = 0.01$, $J = 1$,

REGRETS, I'VE HAD A FEW

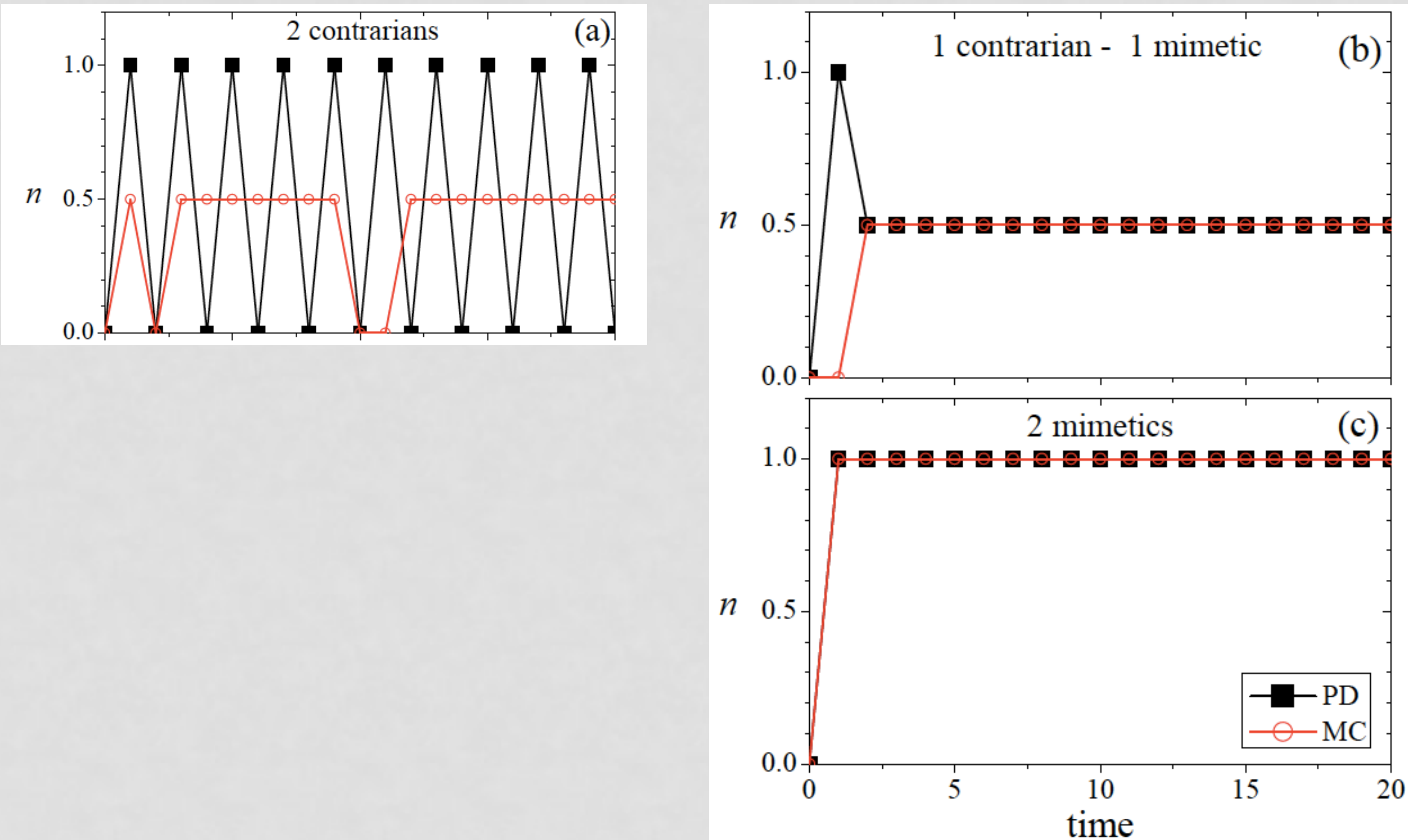
What happen if some agents regret their decissions and abandon the new technology?
Let's assume they abandon when the payoff is negative, even if they previously decided to adopt.
Payoffs are the same, but they can change their mind.

$$\pi_i^M = d - u_i + n_{-i} \quad \text{if } i \text{ is mimetic,}$$
$$\pi_i^C = d - u_i - n_{-i} \quad \text{if } i \text{ is contrarian,}$$

$$d \equiv \frac{A-R}{J}, \; u_i \equiv \frac{r_i}{J}, \; \sigma \equiv \frac{s}{J}$$

$$n_{-i} = \frac{1}{N-1} \sum_{k \neq i} \omega_k,$$

EXAMPLE WITH JUST TWO AGENTS



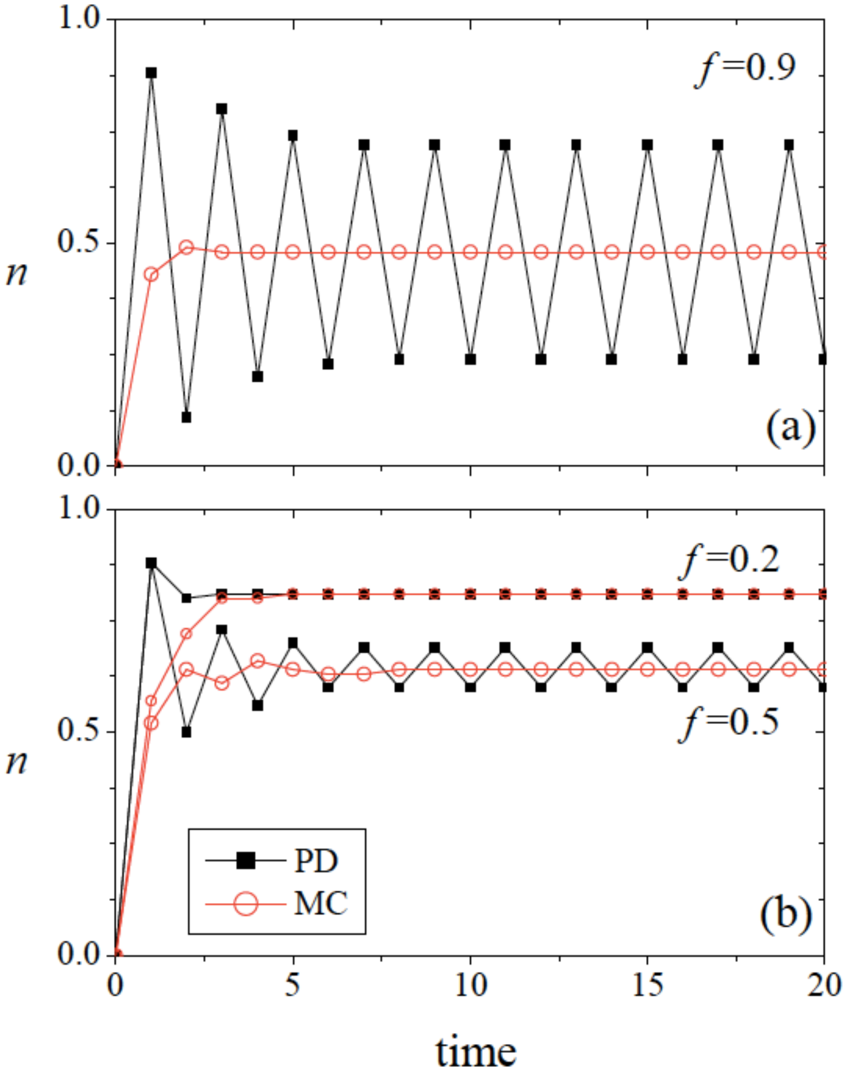


Figure 2. Number of adopters as a function of time for $N = 100$ agents and different values of the fraction of contrarians f. (a) $f = 0.9$, large sustained oscillations. (b) $f = 0.5$, lower oscillations and $f = 0.2$, no oscillations. The other parameters in all cases are $d = 0.4$ and $u_o = 0.5$.

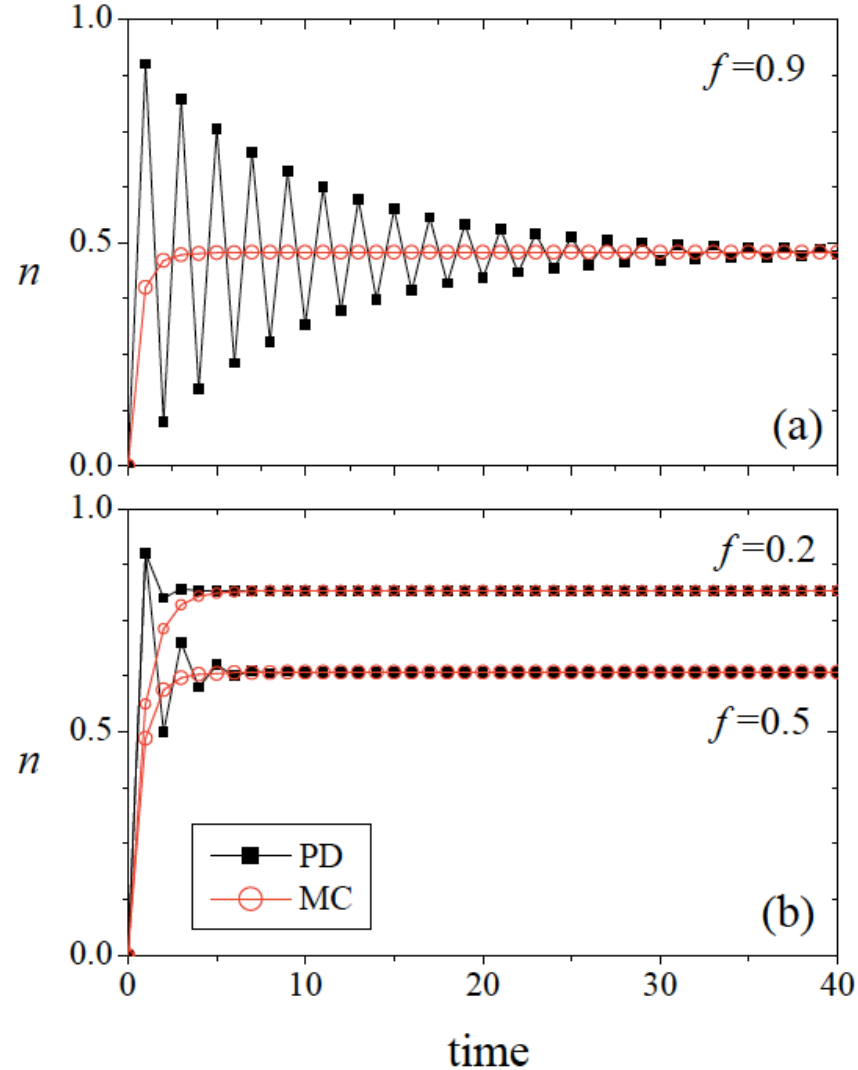
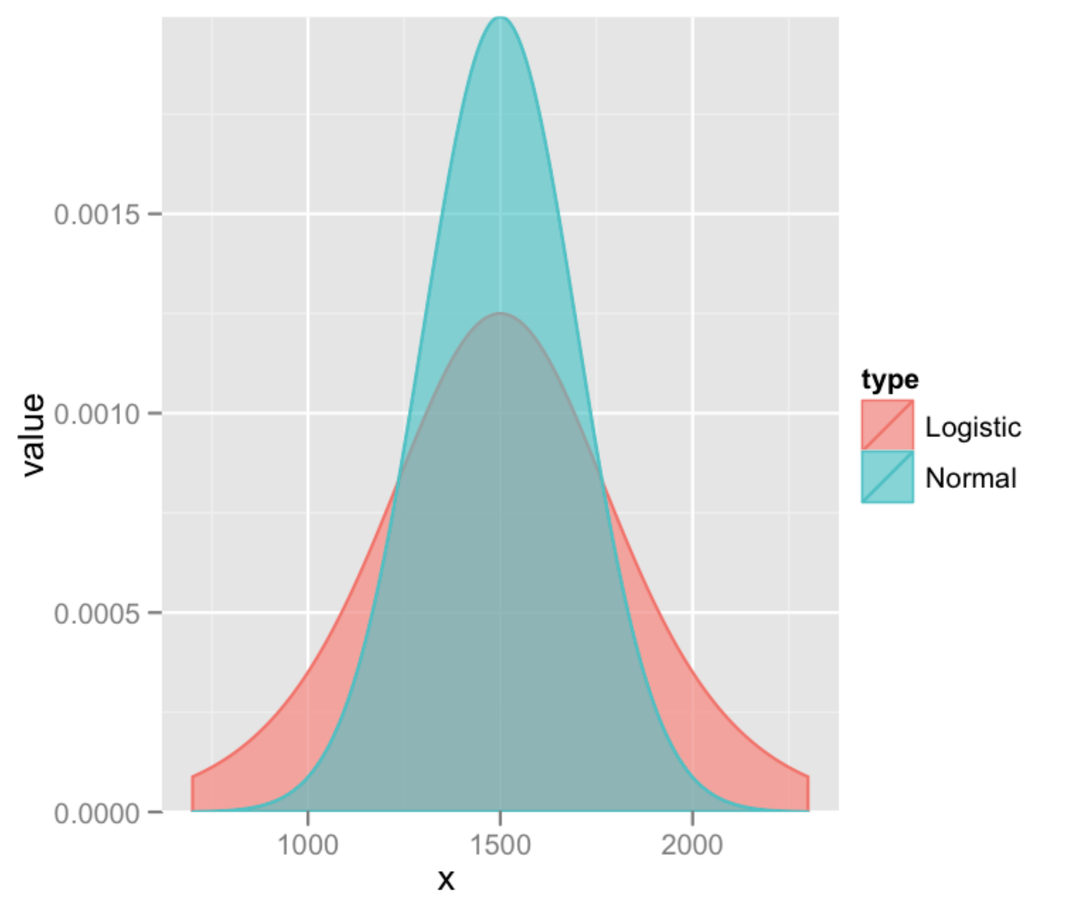


Figure 3. Number of adopters as a function of time for $N = 10^7$ agents and different values of the fraction of contrarians f. (a) $f = 0.9$, transient oscillations, (b) $f = 0.5$, very short lived oscillations and $f = 0.2$, no oscillations. The other parameters in all cases are $d = 0.4$ and $u_o = 0.5$.

LOGISTIC DISTRIBUTION

$$\mathcal{P}(u) = \frac{\beta}{2\cosh^2(\beta\, u)}.$$



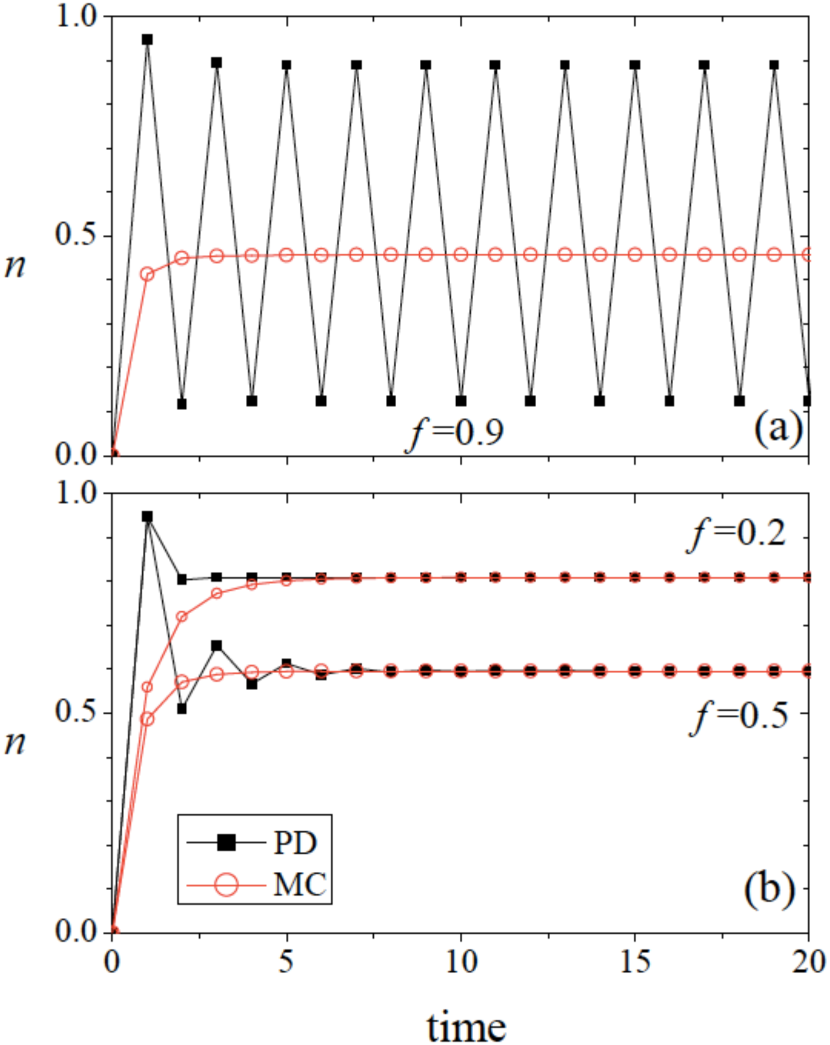


Figure 7. Temporal behavior of the fraction of adopters for the logistic distribution with $\sigma = 0.25$, $d = 0.4$ and $f = 0.9$ (top), 0.5 and 0.2 (bottom) for $N = 10^7$. Open red circles correspond to the MC simulations and black squares to PD simulations. In the PD case it is possible to see the oscillations in the number of adopters for a high concentration of contrarians. We have considered much longer times than those represented in the figure and the oscillations are stable.

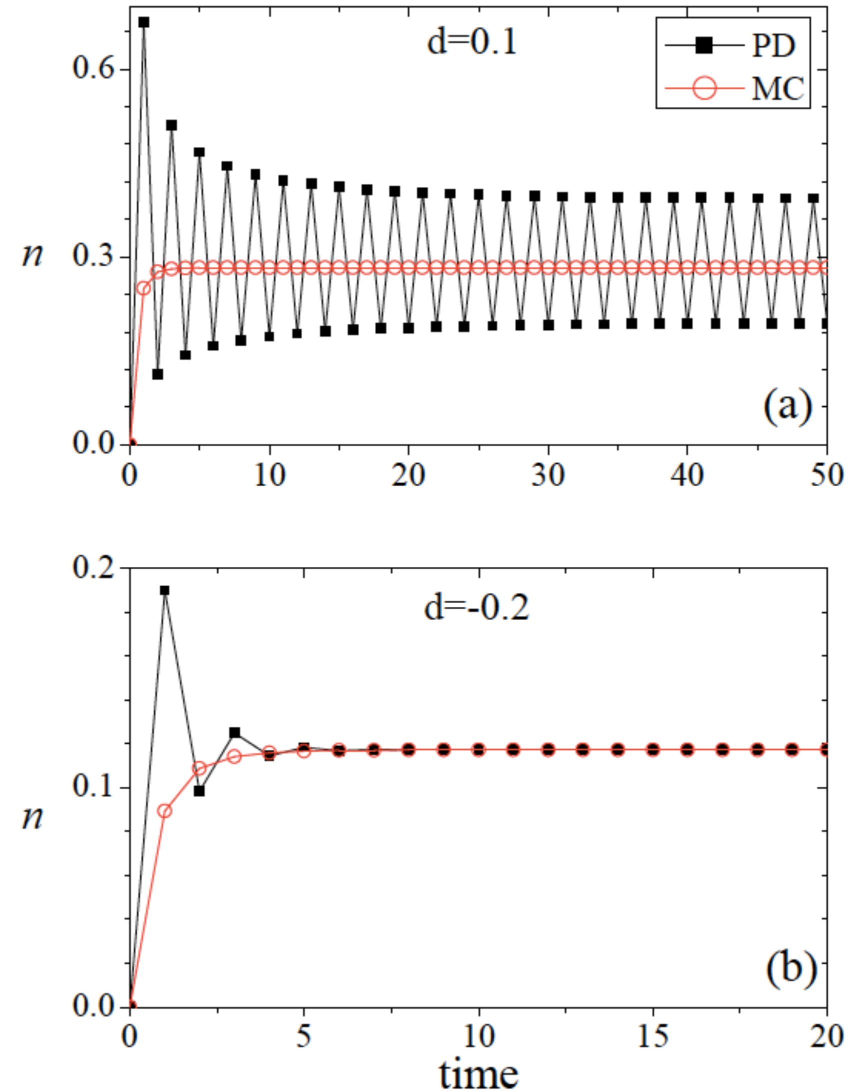


Figure 8. Temporal behavior for the logistic distribution with $\sigma = 0.25$, $f = 0.9$ and $d = 0.1$ (top figure) and $d = -0.2$ (bottom figure). One observes oscillations in the number of adopters only when $d > 0$.

5 Discussion and Conclusions

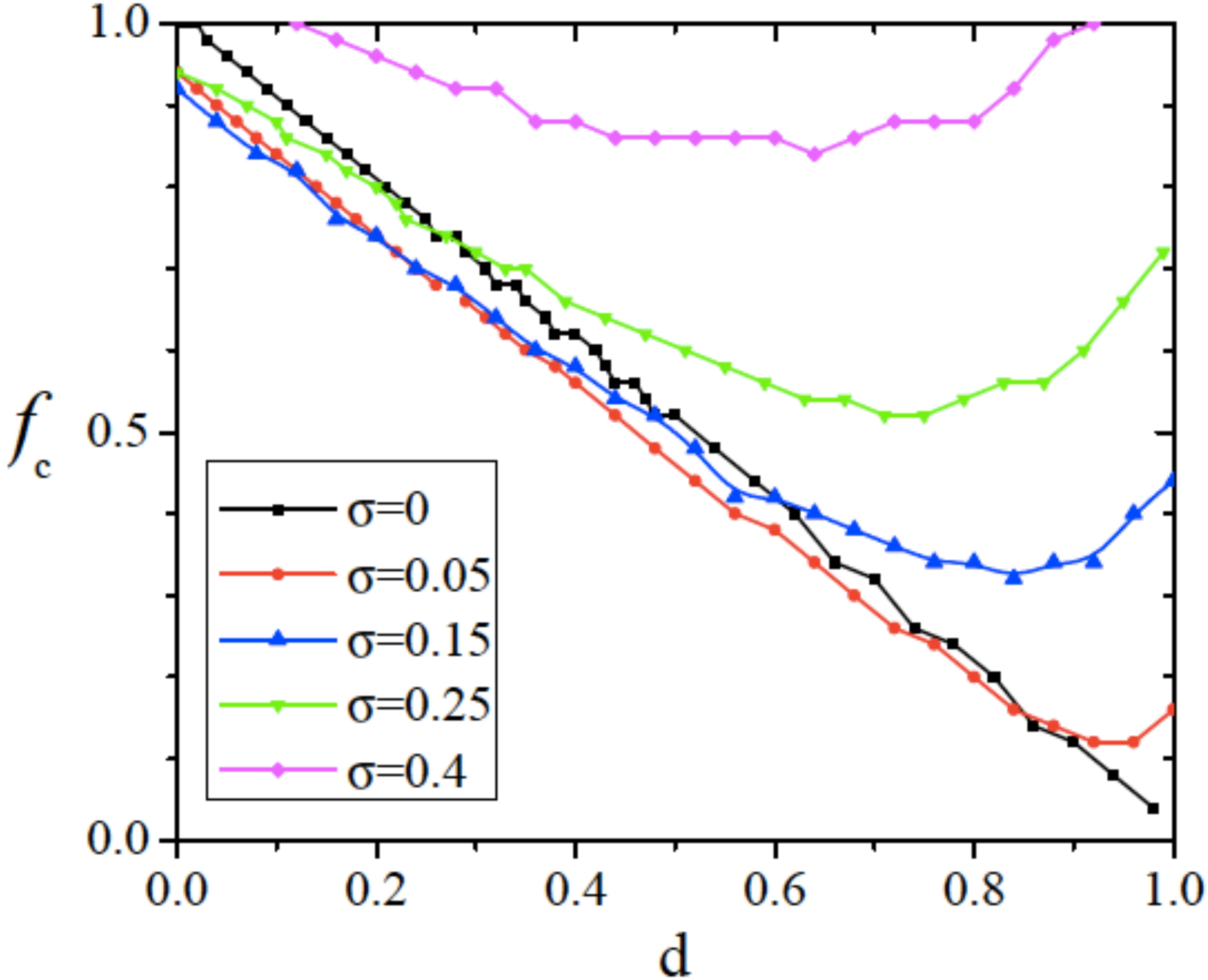


Figure 6. Thresholds value of the fraction of contrarians above which oscillations appear. The curves correspond to different values of the width of the logistic distribution, as indicated in the inset. We have represented just positive values of d as there are no oscillations for negative values. The curves go through a minimum that is lower the narrower the distribution.

COMPARISON BETWEEN WITHOUT AND WITH REPENTANTS

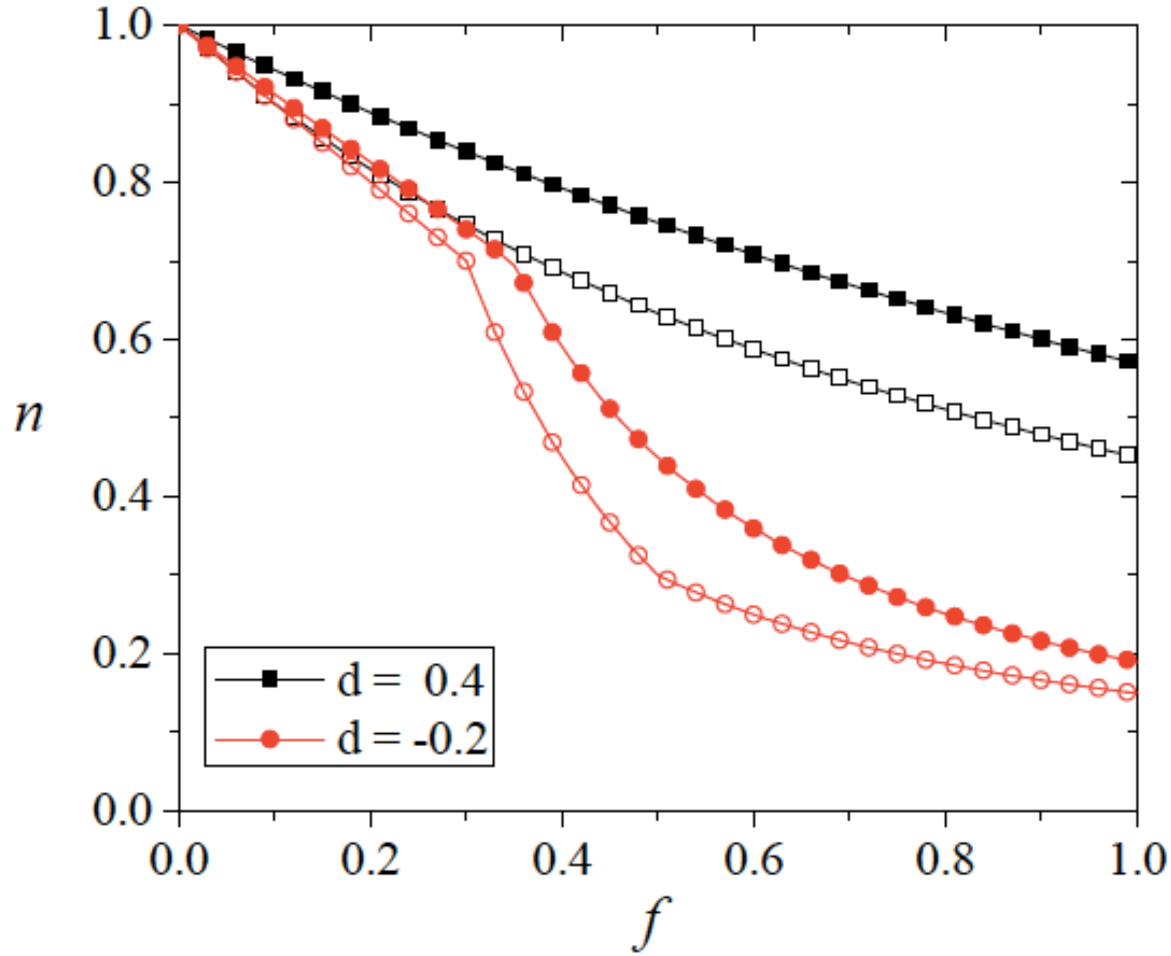


Figure 12. Comparison between the results of ref. [6] (without repentants) and the present ones with repentants. We represent the final number of adopters fro two values of d: $d = 0.4$ (filled squares correspond to the case without repentants and open ones to the present case with repentants) and $d = -0.2$ (filled circles without repentants and open ones without). It is possible that both curves are similar but the final adoption is lower in the case with repentants.

Conclusions

- THIS IS A SIMPLE MICROECONOMIC LEVEL WITHIN BASS'S IDEAS. THE MODEL INCLUDES A RESISTANCE TO ADOPT, AND THE WIEGHT OF SOCIAL INFLUENCE. WE ALSO CONSIDERED THE EFFECT OF CONTRARIANS AND REPENTANTS.
- CONTRARIANS REDUCE THE FINAL FRACTION OF ADOPTERS IN A VERY SIGNIFICATIVE WAY.
- GROUPS OF INFLUENCE SPEED THE ADOPTION.
- REPENTANS REDUCE FINAL ADOPTION, BUT ALSO CAN INDUCE OSCILLATIONS IN THE NUMBER OF ADOPTERS.


THANK YOU!