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Modelling Dynamic ICT Services Markets

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Motivation and contribution

- ICT products have some unique properties influencing market adoption
 - Network effects
- These properties are crucial to understand in order to increase revenue for companies when offering ICT services
- **We provide a theoretical framework and a first step to quantitatively model ICT services markets**

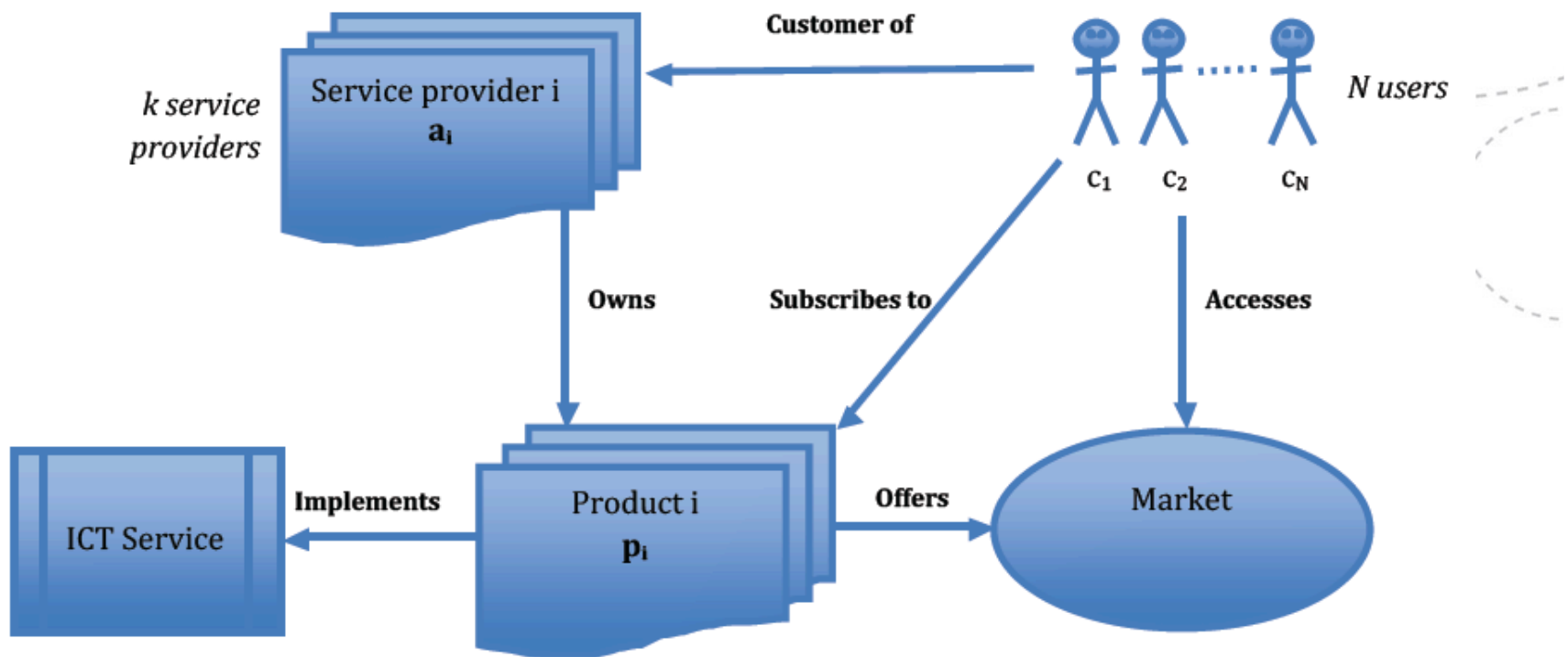


Outline

- ICT services markets
 - Network effects
 - Positive feedback
 - Churning
- Quantifying market parameters
- Discrete event simulation model
- Market evolution



ICT service markets

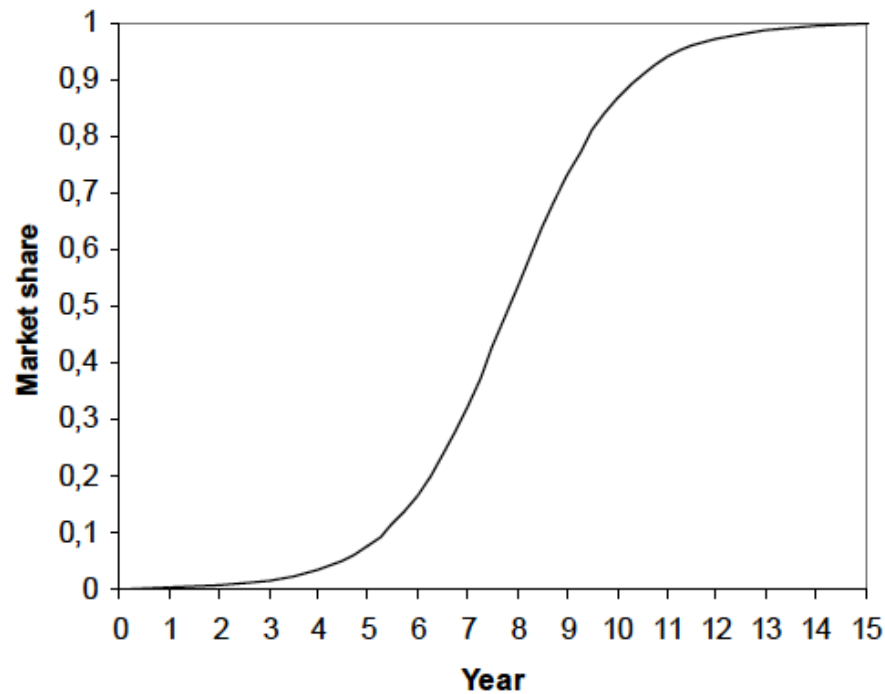


Assumptions

- **Homogenous service**
 - All implementations of the considered service implement the service in the same way
- **Exclusive market**
 - User can subscribe to maximum one service
- **Equal value**
 - User put the same value on each product, i.e. we assume equal price and popularity among products



Product diffusion – S curve



$$R_t = \left(1 + e^{\left(\ln(R_0^{-1} - 1) - \left(\frac{2 \ln 9}{\Delta T} \right) t \right)} \right)^{-1}$$



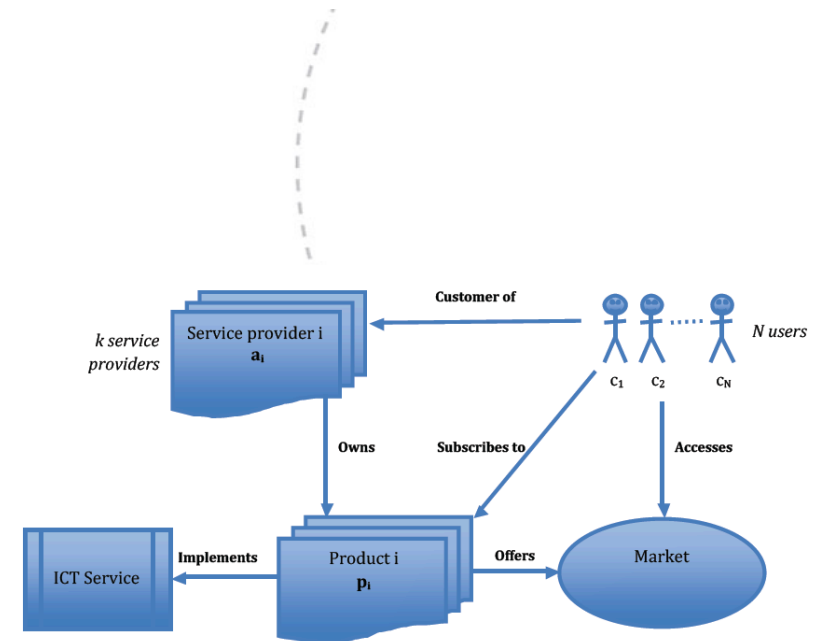
Suitable services

- Instant Messaging services
 - Video, text, voice conversation
- Mobile telephony
 - Voice service
- Mobile Operating Systems
 - iOS, Android, Windows Phone
- Web browsers
 - IE vs Netscape vs Firefox



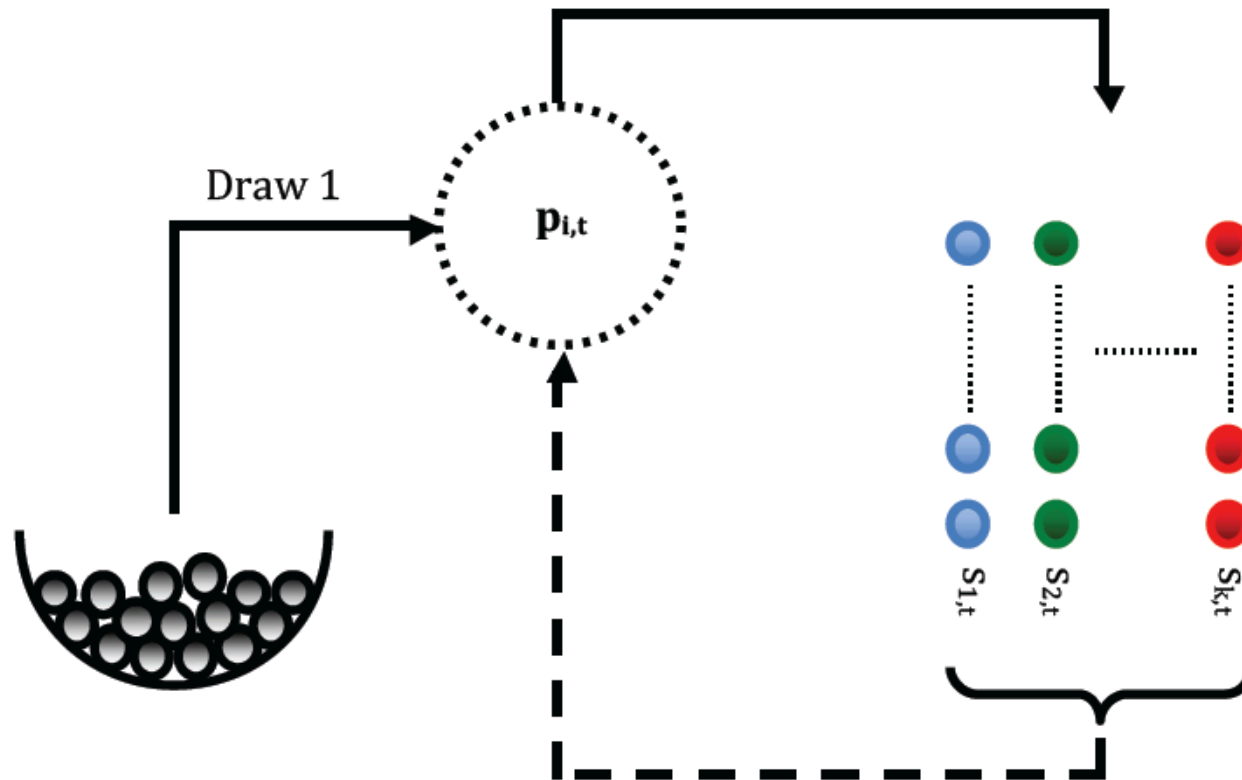
Positive feedback

- Positive feedback rises due to
 - Positive network effects
 - Demand and supply side
 - Direct and indirect effects
- Model positive feedback using Polya's urn problem
- Scale parameter γ
 - Express network externalities



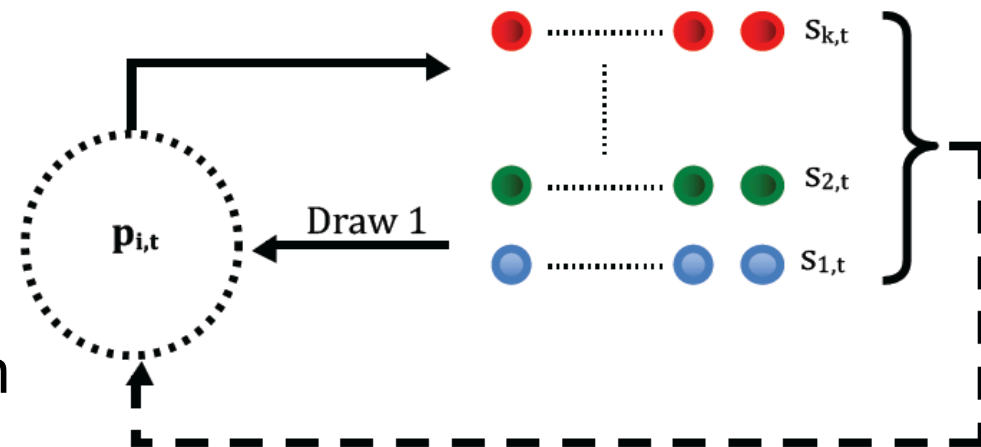
$$p_{i,t} = \frac{s_{i,t}^\gamma}{\sum_{j=1}^k s_{j,t}^\gamma} .$$

Polya's urn problem



Churning

- Loss/gain of users to other service providers in the market
- Influenced by switching costs
- Assume a certain number of users churn each time period



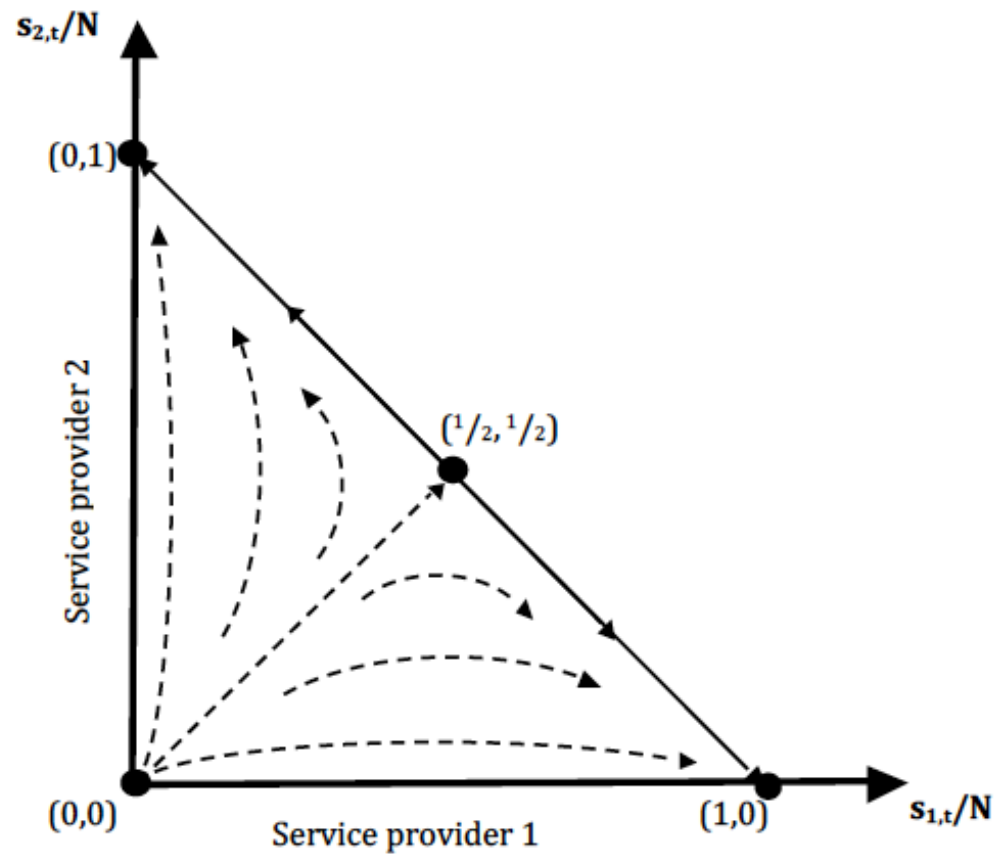
Mathematical model

- Market with positive feedback, churning and two service providers
- Described by differential equations
- Cannot be solved analytically

$$\frac{ds_{i,t}}{dt} = \beta \frac{s_{i,t}}{N} \left(1 - \frac{s_{1,t}}{N} - \frac{s_{2,t}}{N} \right) + f(t, t + \Delta) p_{i,t}$$



Mathematical model – plane portrait



Simulations

- Mathematical model has no closed form solutions
- Results obtained through simulations
- **SIMULA/DEMOS**
 - Monte carlo type of simulations
 - New customers are discrete events
 - Churning customers are discrete events

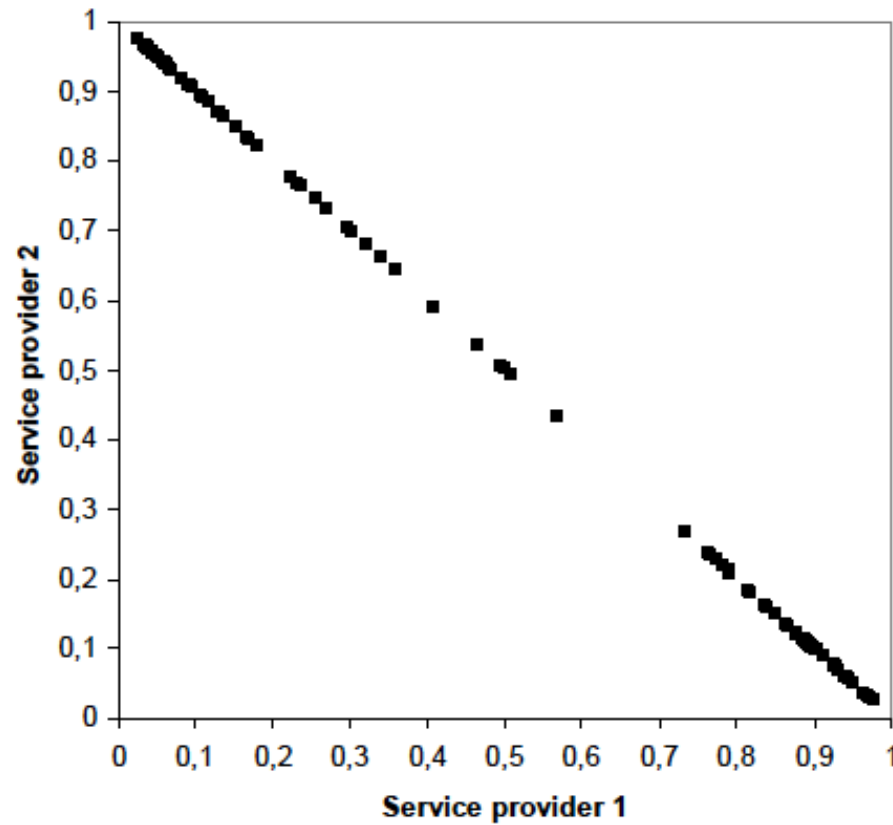


Numerical evaluation

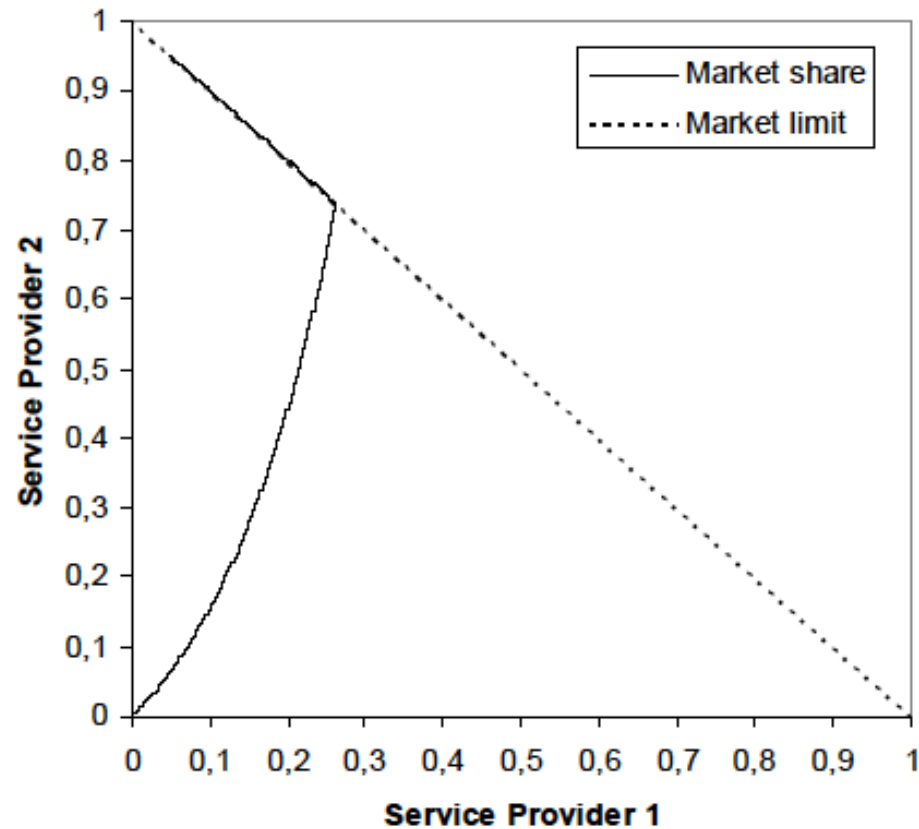
Parameter	Description	Value
N	Total number of users in the market	100,000,000
k	The number of service providers	2 or 4
γ	Scale parameter	1.4-2.0
θ	Churn parameter (yearly churning)	30%
R_0	Relative share of users already using the considered service at time $t=0$	0.001
ΔT	Number of years for the service to reach 90 % user penetration from 10 % penetration	5
Q_0	Start conditions for time $t=0$	{2500,2500, 2500,2500}, {5000,5000}



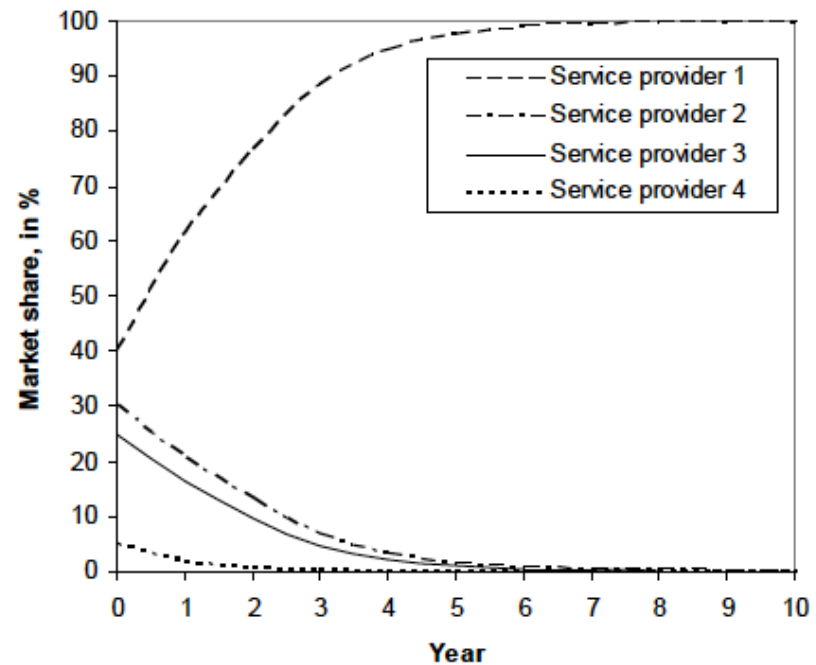
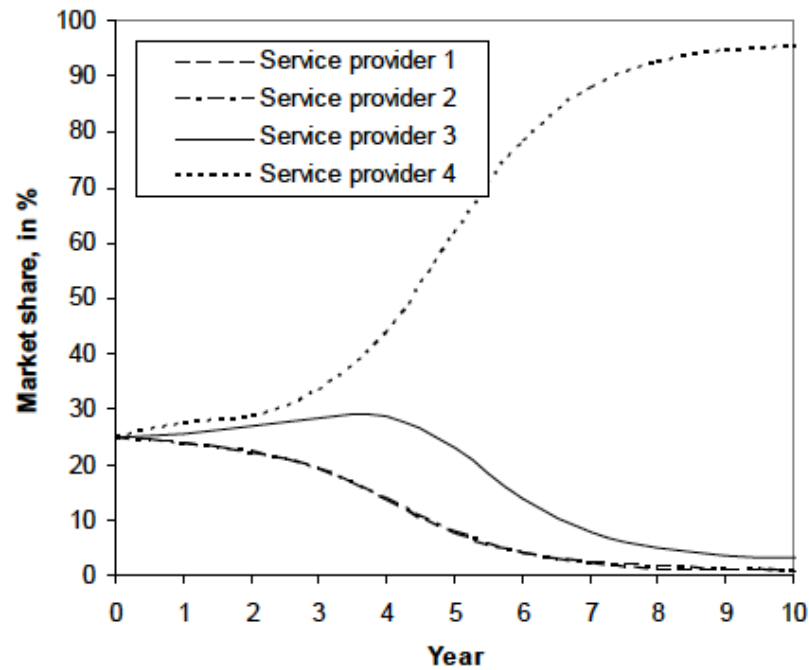
Market without churning



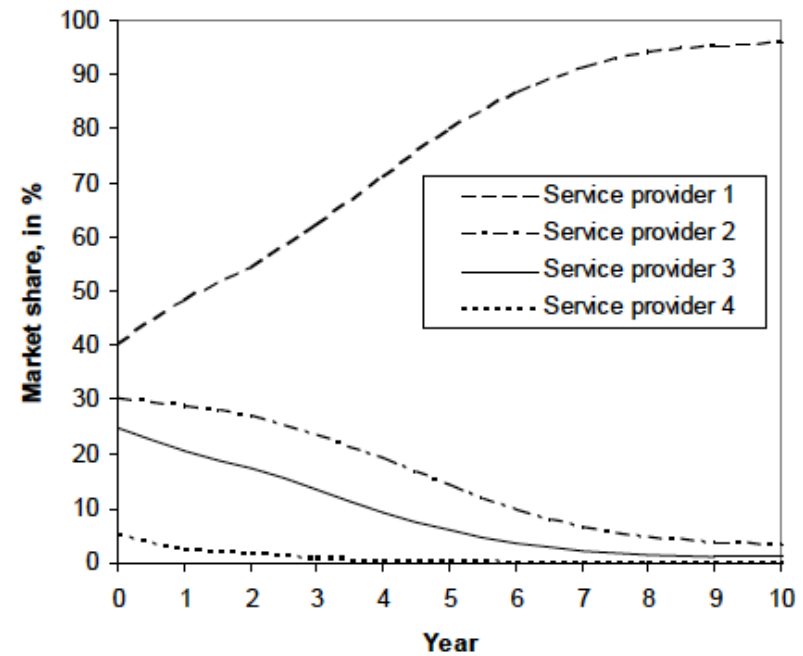
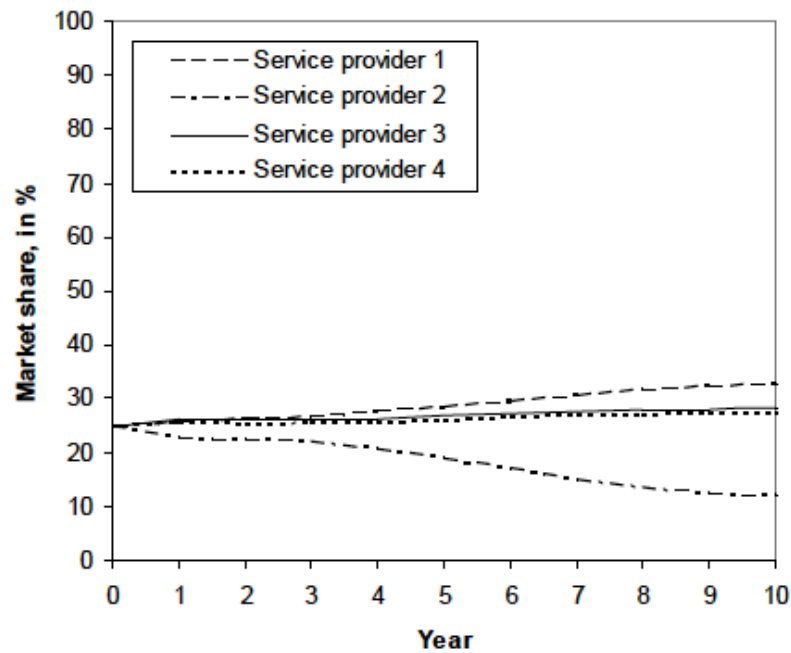
Market with churning



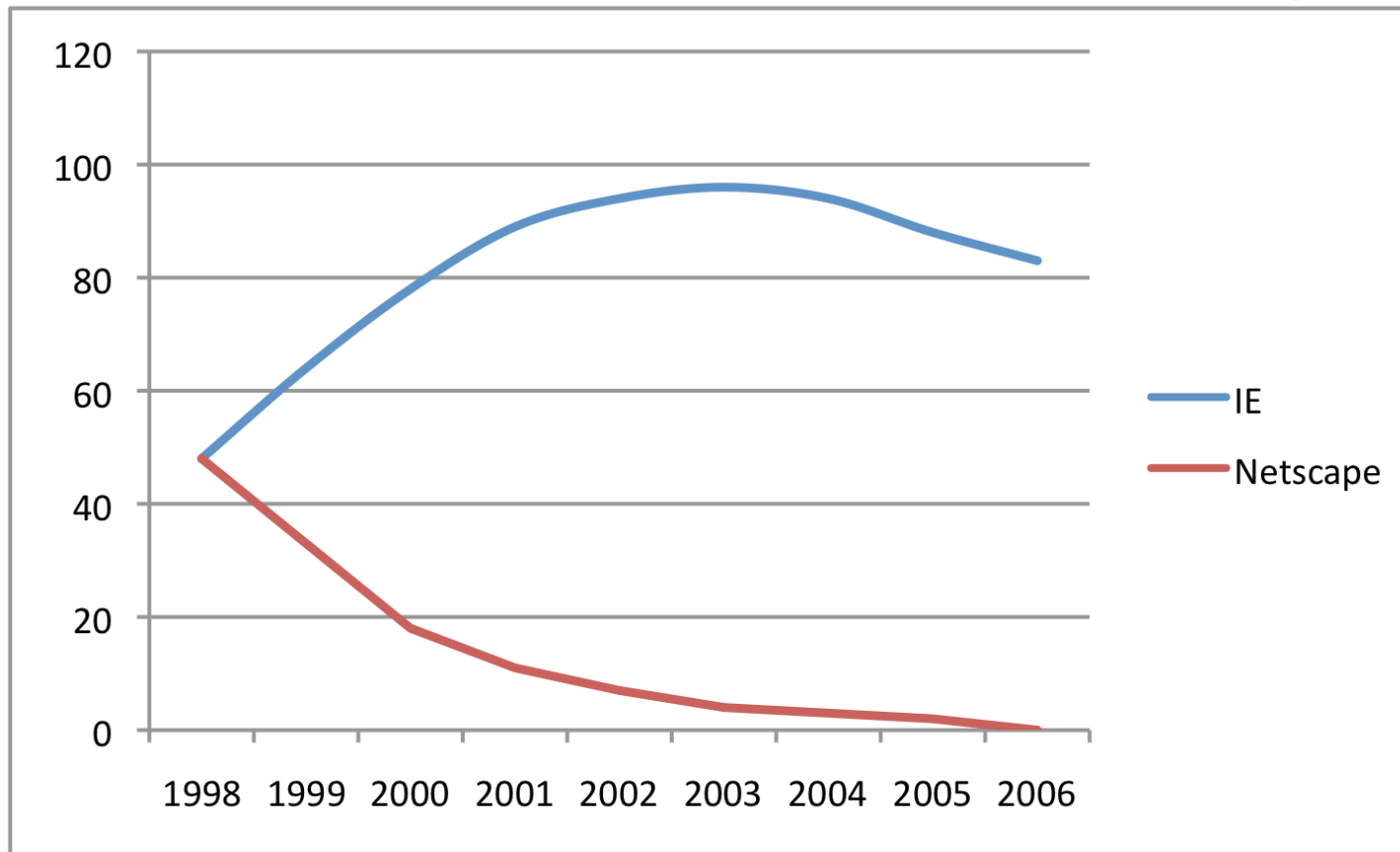
High positive feedback



Low positive feedback



Web browser market (real data)



Conclusions

- Developed a market simulator for dynamic ICT services markets
- Quantify parameters influencing the outcome of competition in ICT services markets
- Future work will extend the model
 - Pricing
 - Loyalty
 - Popularity

