Price War with Migrating Customers

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Econ@tel WG 4 meeting, Rome, Sept 2009

Context

- End of the monopolistic era in telecommunications services
- Customers can freely *migrate* from a provider to another
- For mobile services, observed migration (churn) rates as high as 25% annually Wieland'06

Why do people churn?

Several determinants Ahn, Han, Lee'06

- Price differences Eshghi, Haughton, Topi'07
- Attractive offers for new customers (free device)
- Unsatisfying service

This work: we focus on the **price** factor.

In this work

We consider providers with both positions of losing and recipient provider, for

- the same customer at different times;
- different customers at the same time.

We propose a game-theoretic model between two providers

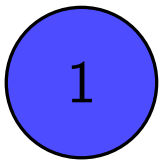
- decision variables: the price charged (in previous work we focused on retention strategies)
- provider objective: mean revenue
- underlying process: customers switching from one provider to the other

We analyze the equilibria of that noncooperative game.

Model of user behavior

Model of user behavior

User with provider 1



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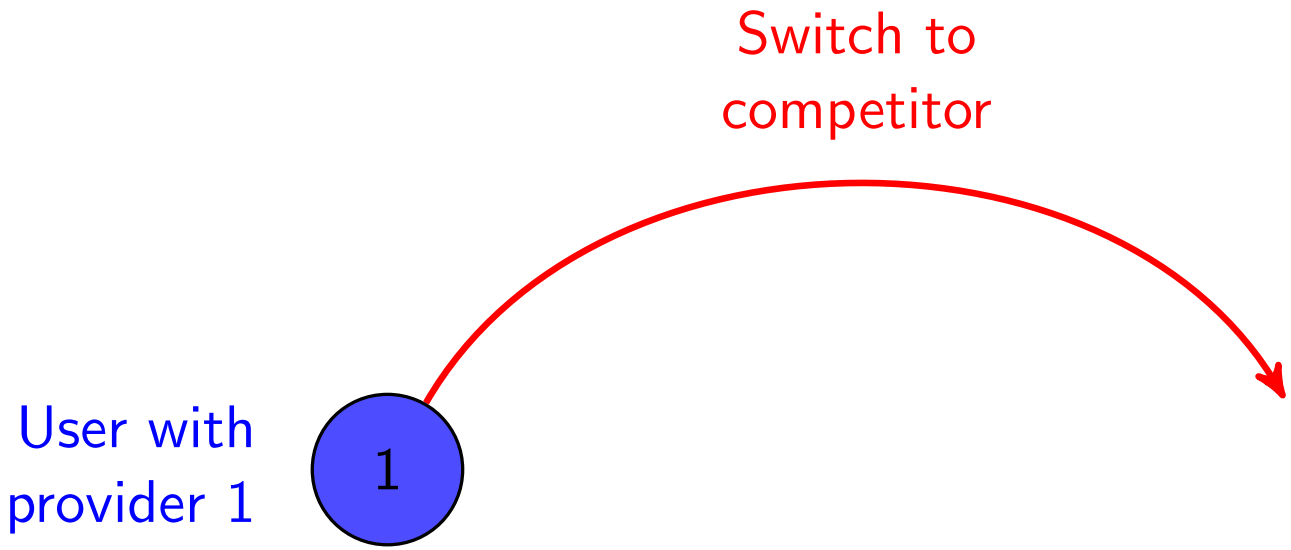

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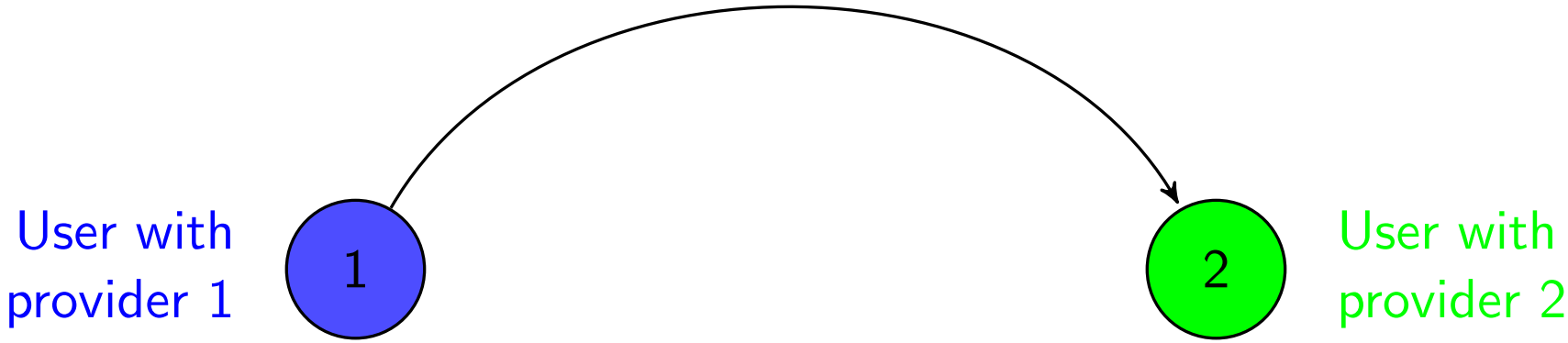

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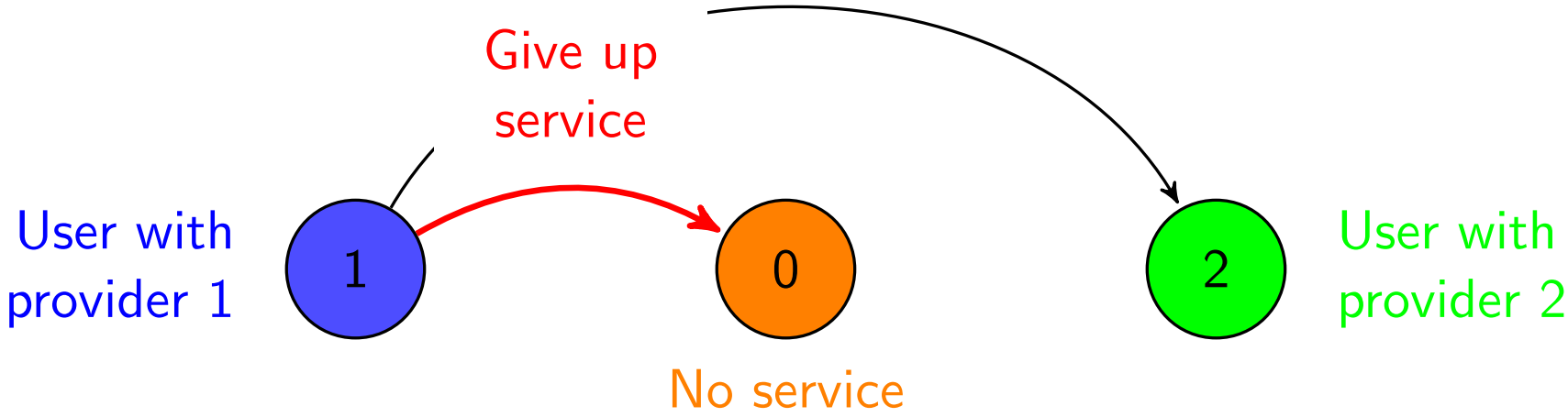

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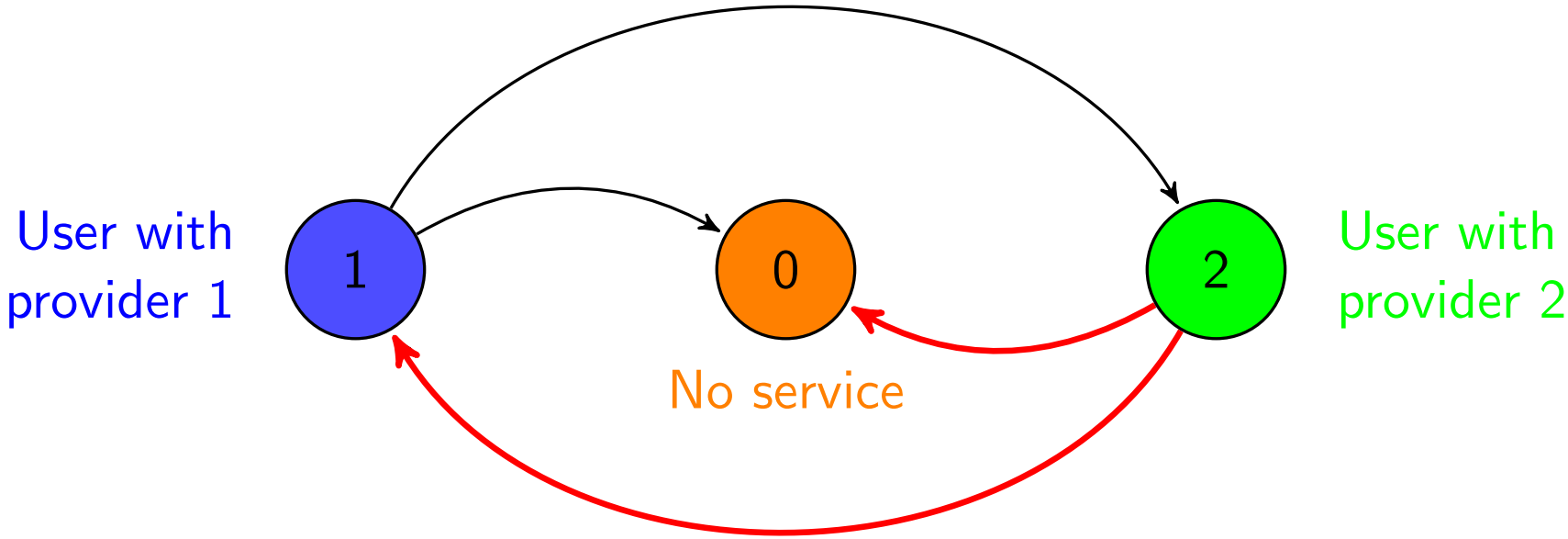

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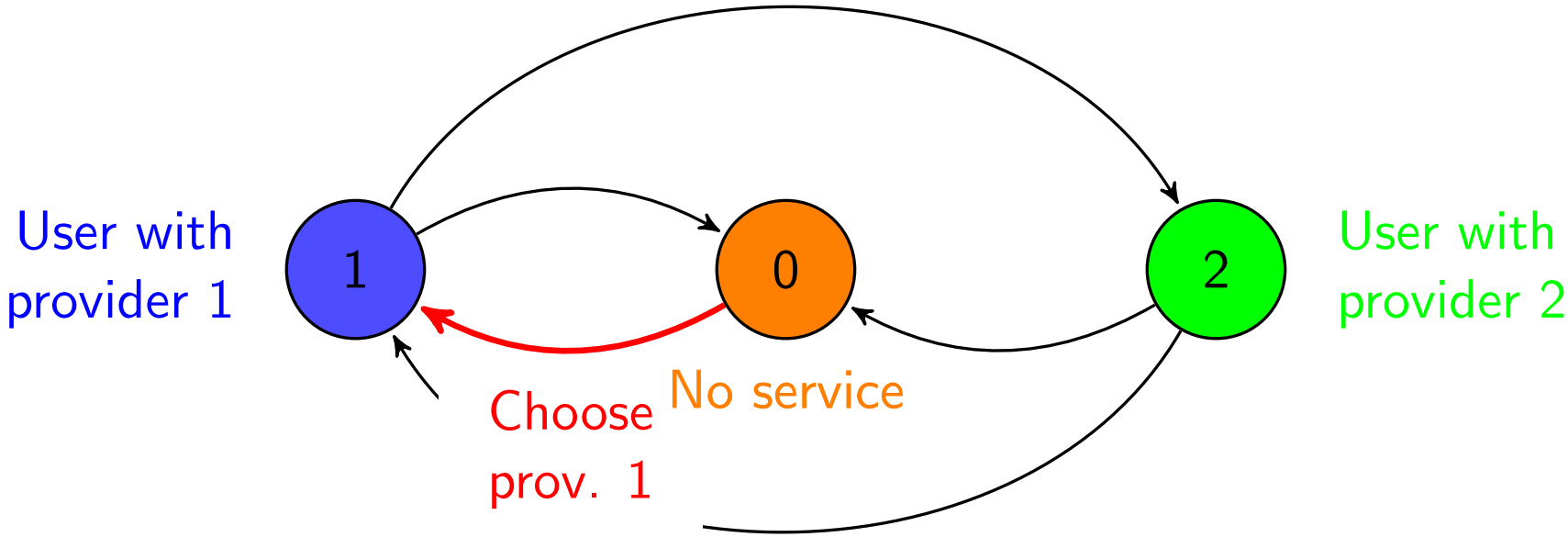

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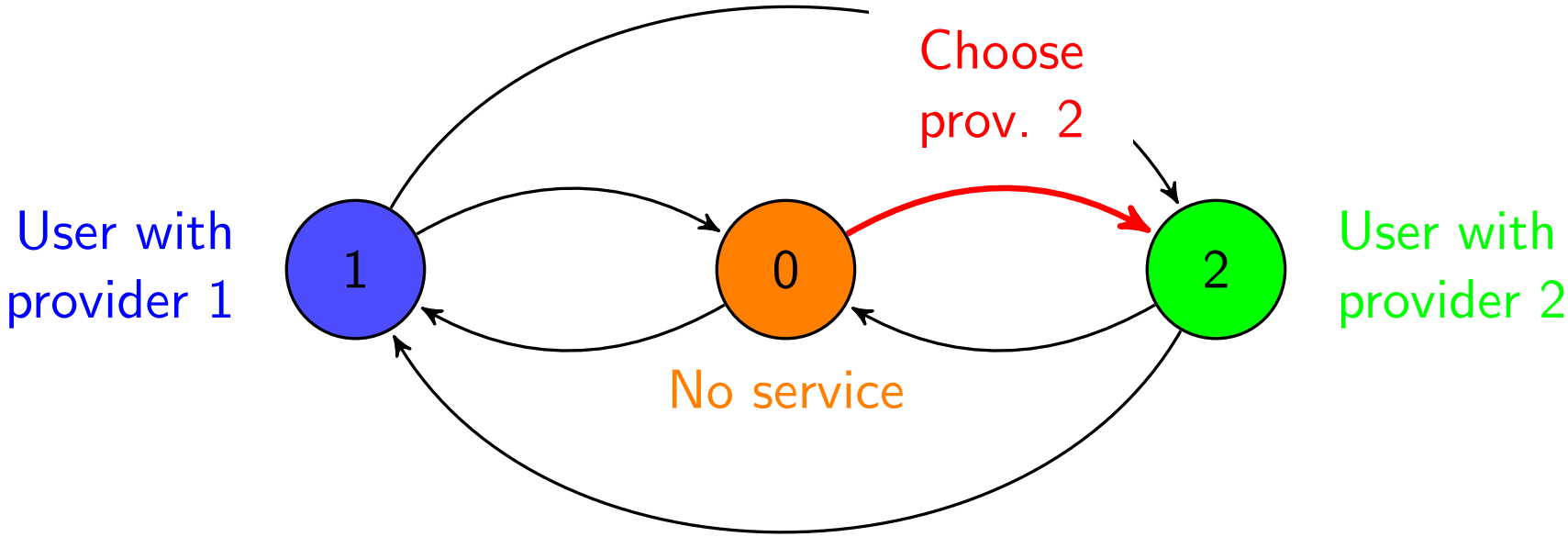

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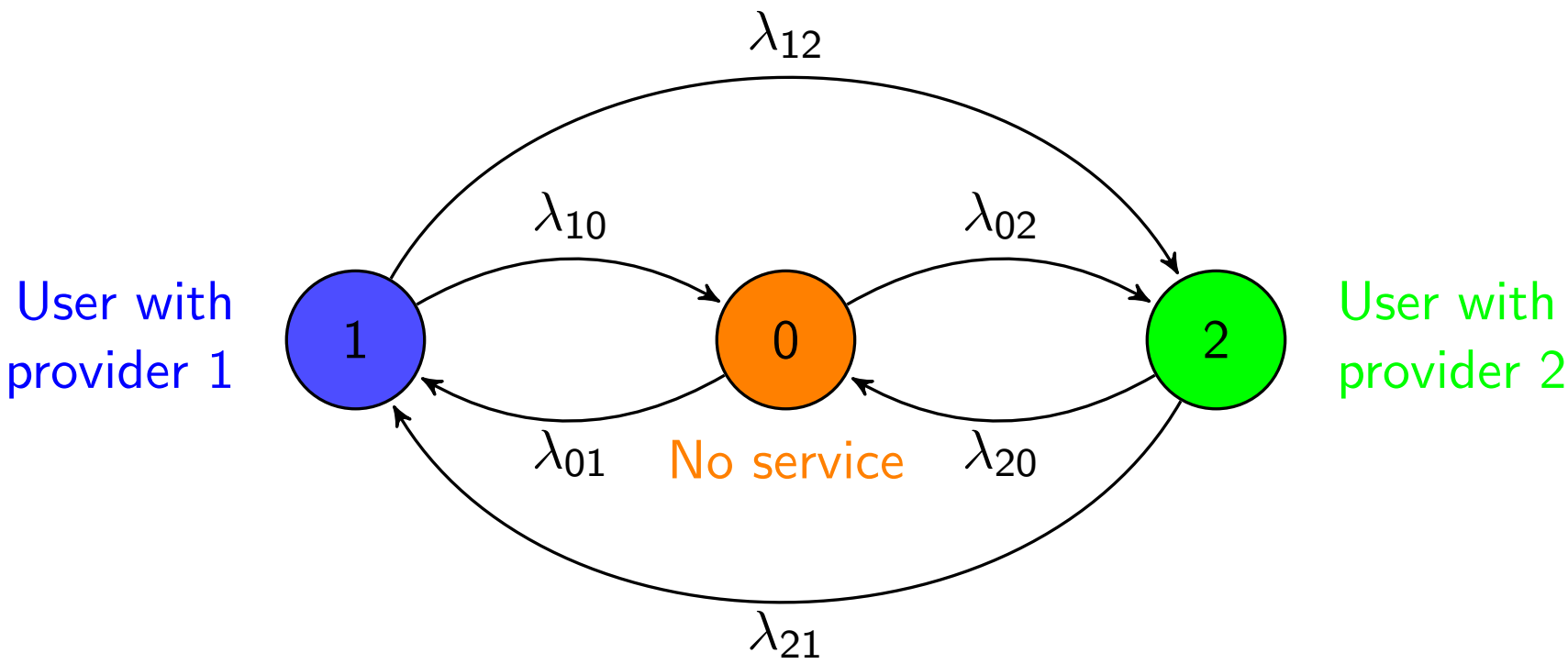

Transition rates are assumed to depend on prices.

Markov model

We assume that

- the time before the customer wills to switch providers,
- the time before the customer gives up the service,
- the time before the customer chooses a new provider,

are independent exponentially distributed random variables.

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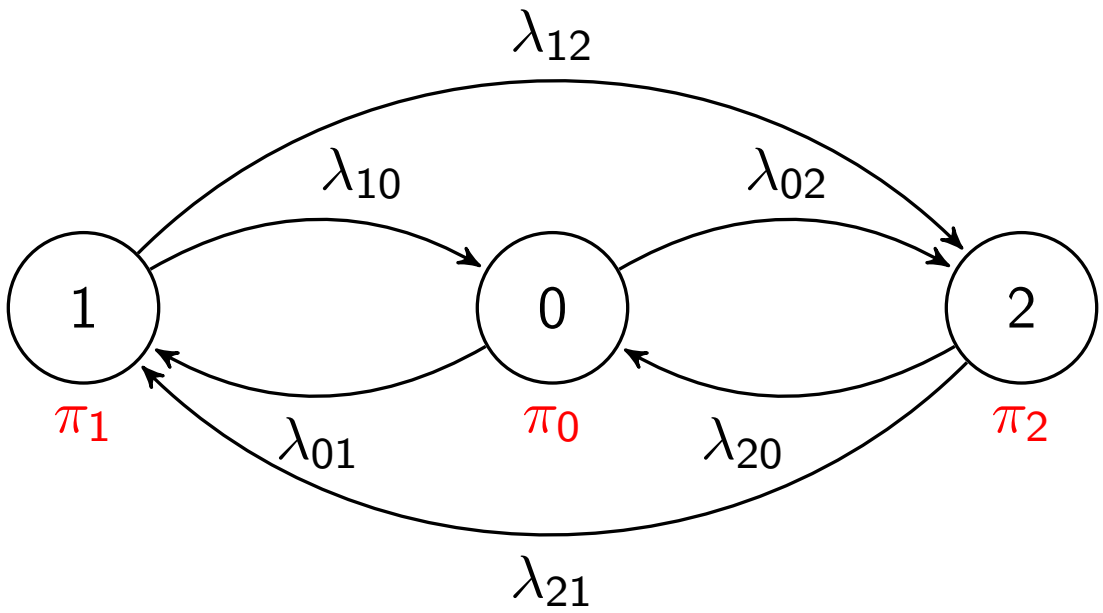
$\Rightarrow$ The user behavior is then a **continuous-time Markov chain**.

Mean revenue (utility) of providers

The process has some Steady-state probabilities.



$R_1 = p_1\pi_1$; $R_2 = p_2\pi_2$

with p_i= price per unit time charged by provider i.

Game formulation

We associate a "price" p_0 to state 0, corresponding to the cost of not having access to the service.
Transition rates are assumed to depend on prices
$\Rightarrow$ to a price vector (p_1, p_2, p_0) corresponds a steady-state probability vector (π_1, π_2, π_0), and provider revenues (R_1, R_2).

$\Rightarrow$ the utility of a provider depends not only on his price choice, but also on his competitor's choice.

Each provider will choose his strategy so as to maximize his own utility (revenue);

$$\begin{aligned} R_1 &= p_1 \pi_1 \\ R_2 &= p_2 \pi_2 \end{aligned}$$

Numerical analysis

Following the literature, Kim & Yoon (2004), Kim *et al.* (2004), Qi *et al.* (2006) we take transition rates of the form

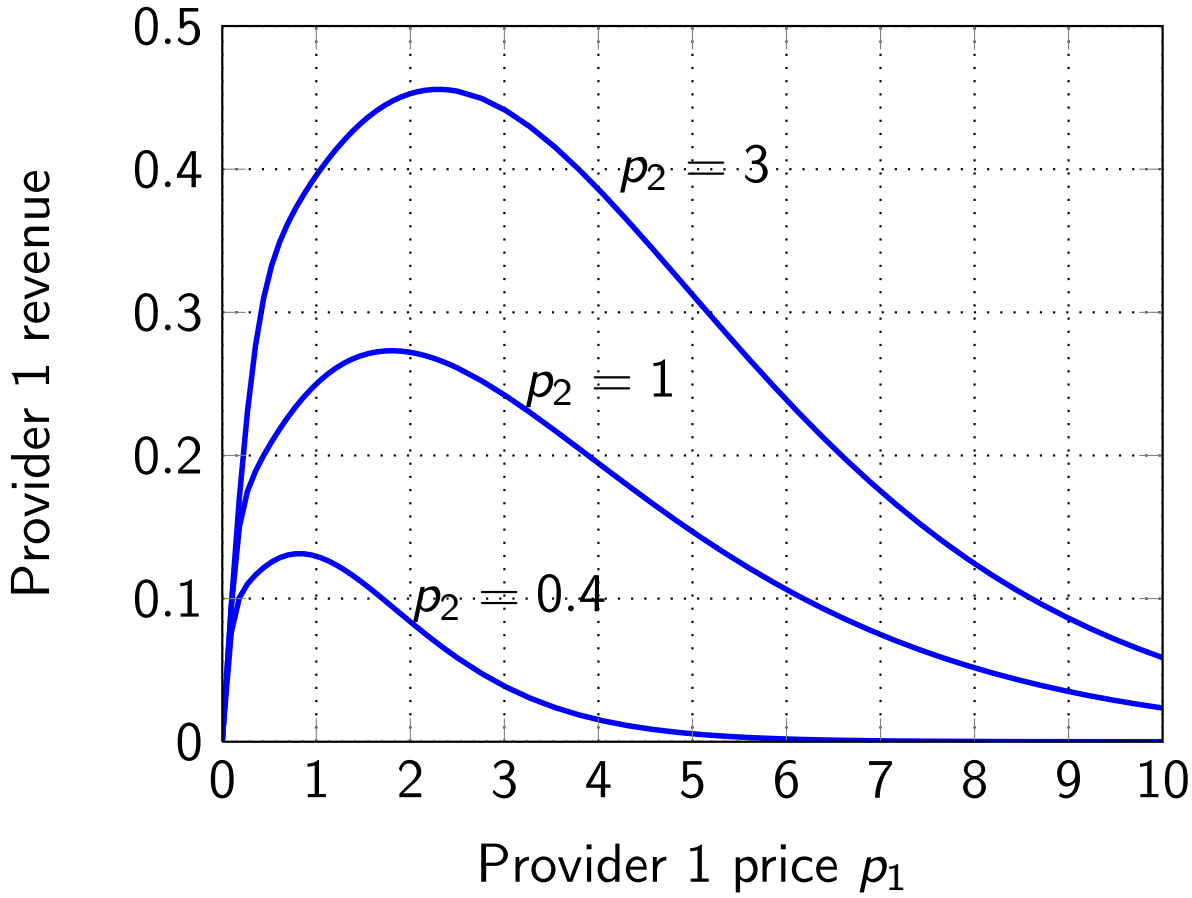
$$\lambda_{ij}(p_i, p_j) = \frac{1}{\gamma_i} e^{\beta p_i / p_j}, \tag{1}$$

where

- the parameter γ_i introduces asymmetry among providers: it encompasses the reasons other than price (e.g., Quality of Service, reputation, ...), why a user should stay in state i.
- β represents the user price sensitivity

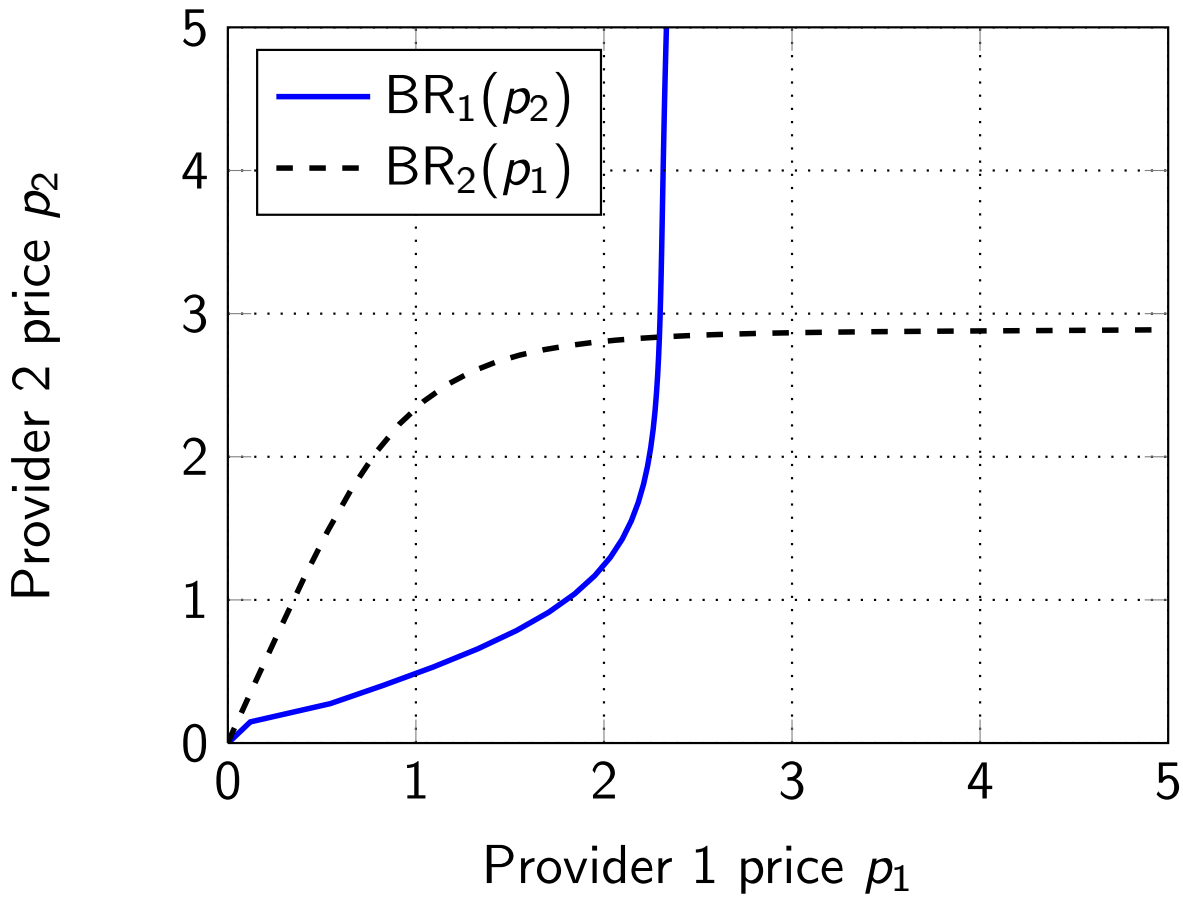
Default parameter values considered here:
$p_0 = 1, \beta = 0.5, \gamma_1 = \gamma_0 = 1, \gamma_2 = 2$.

Provider best replies



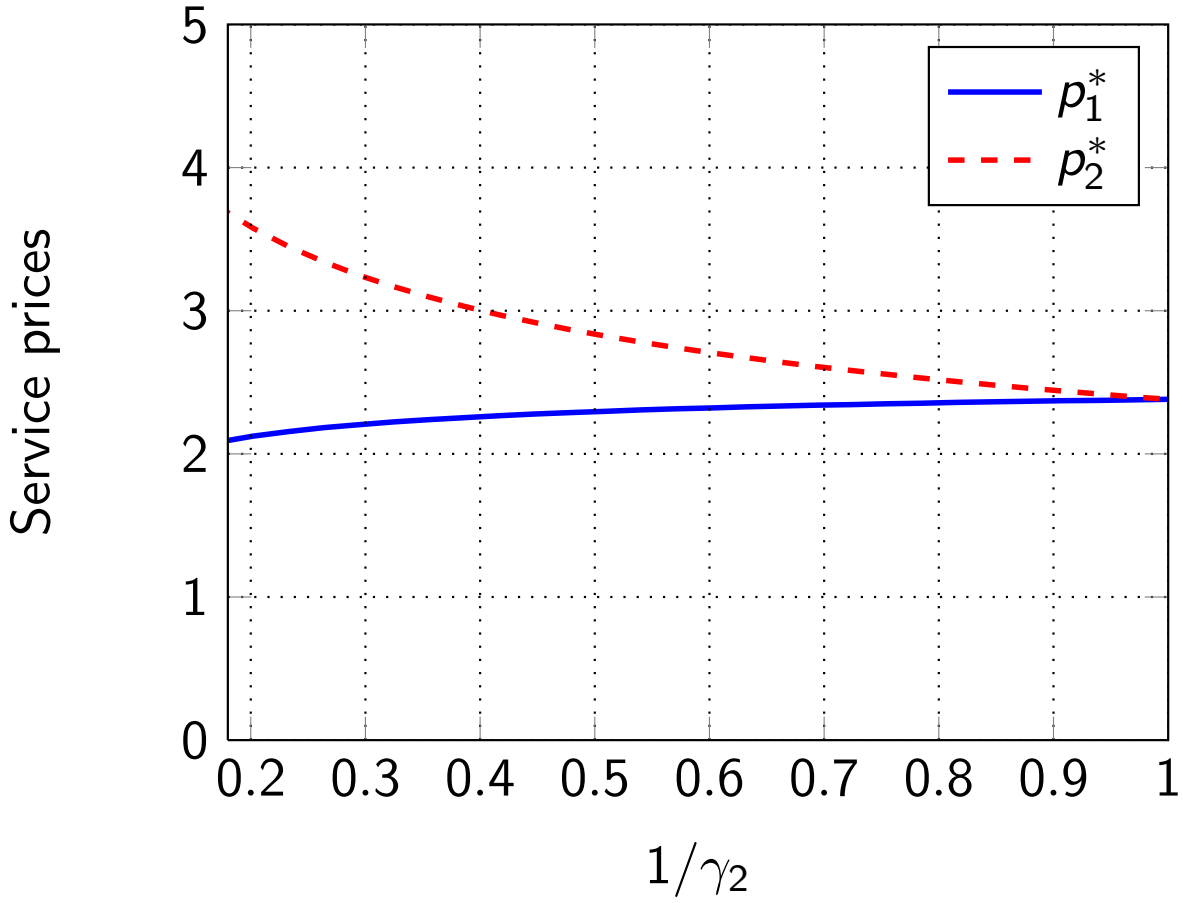
For each price p_2, provider 1 has a revenue-maximizing price $\mathrm{BR}_1(p_2)$

Provider best replies



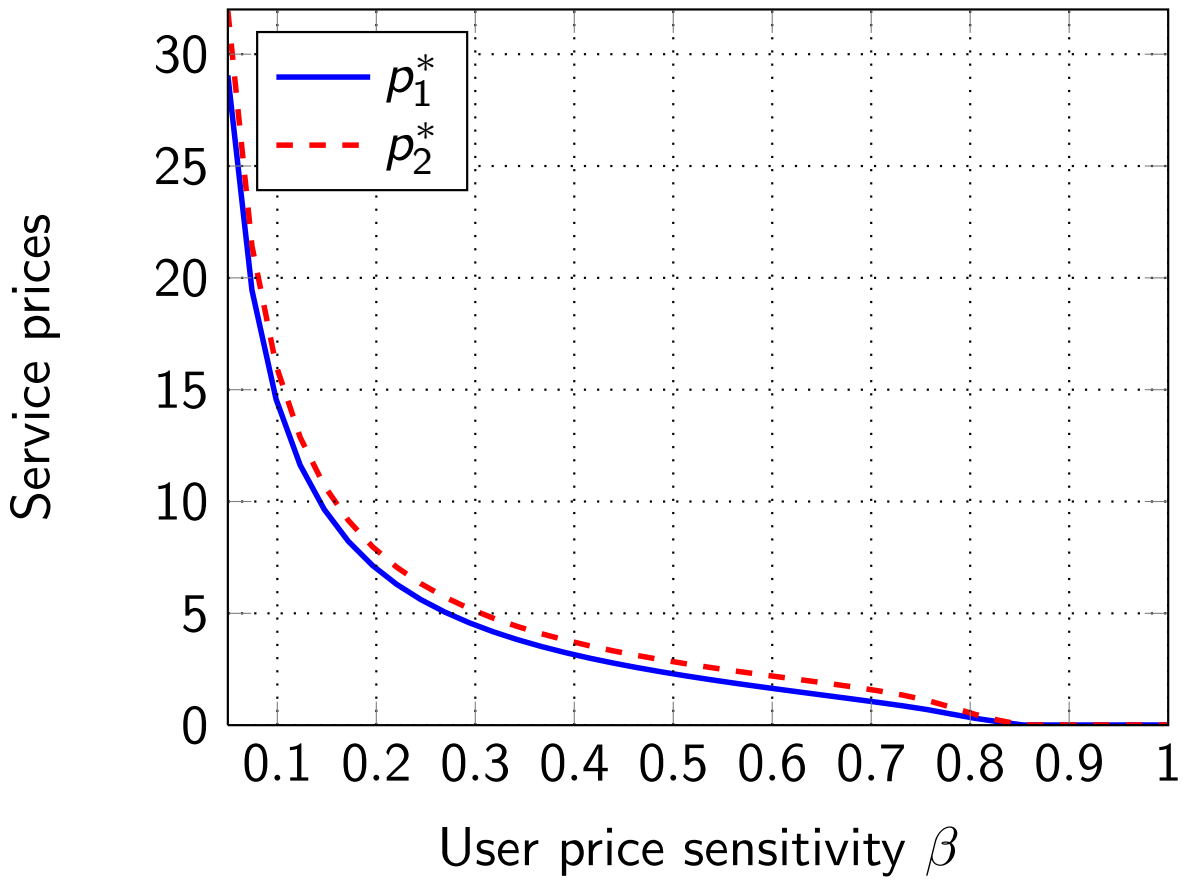
Nash equilibrium: each provider plays his best reply to the price of the other.

Nash prices: effect of provider 2's "good reputation"



The high reputation provider has higher price, and the other one has to lower his price.

Effect of price sensitivity of users



Nash equilibrium prices

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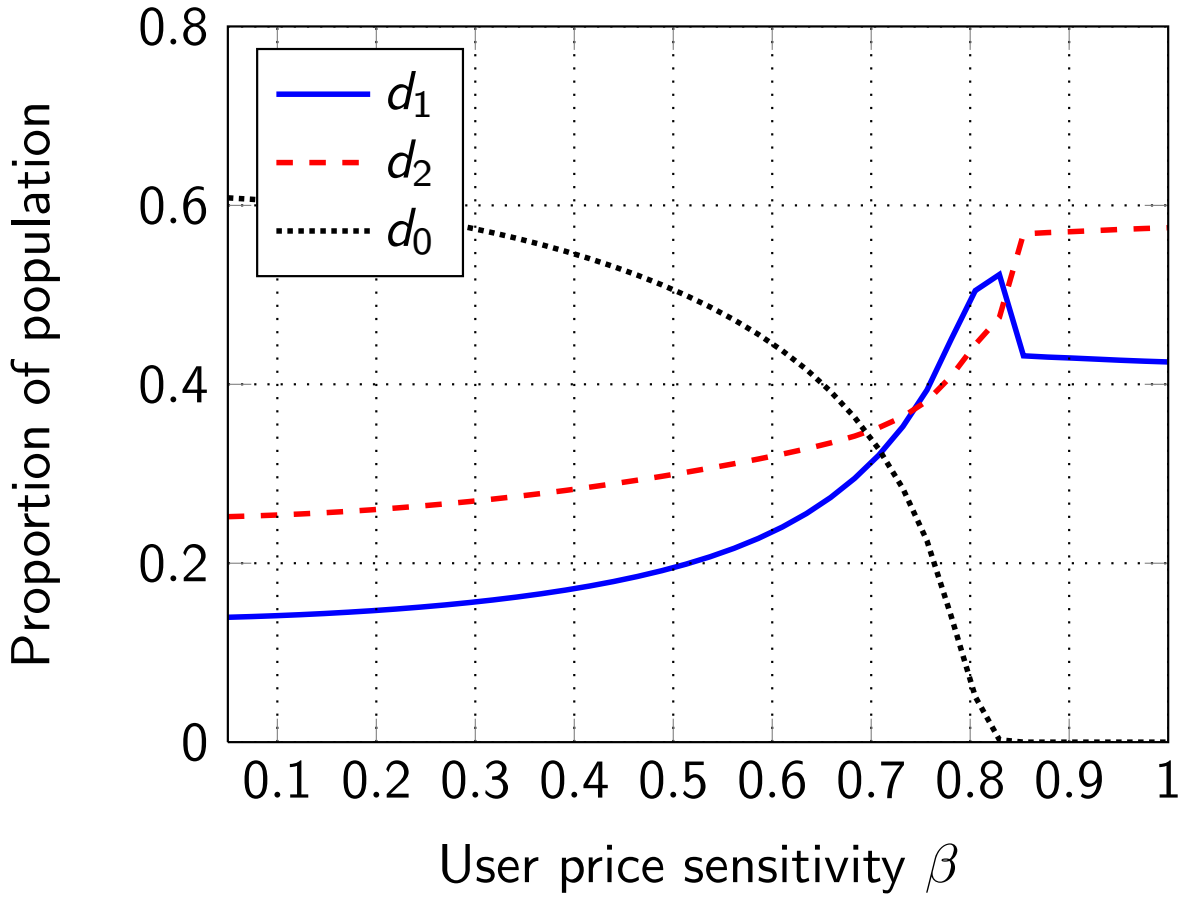
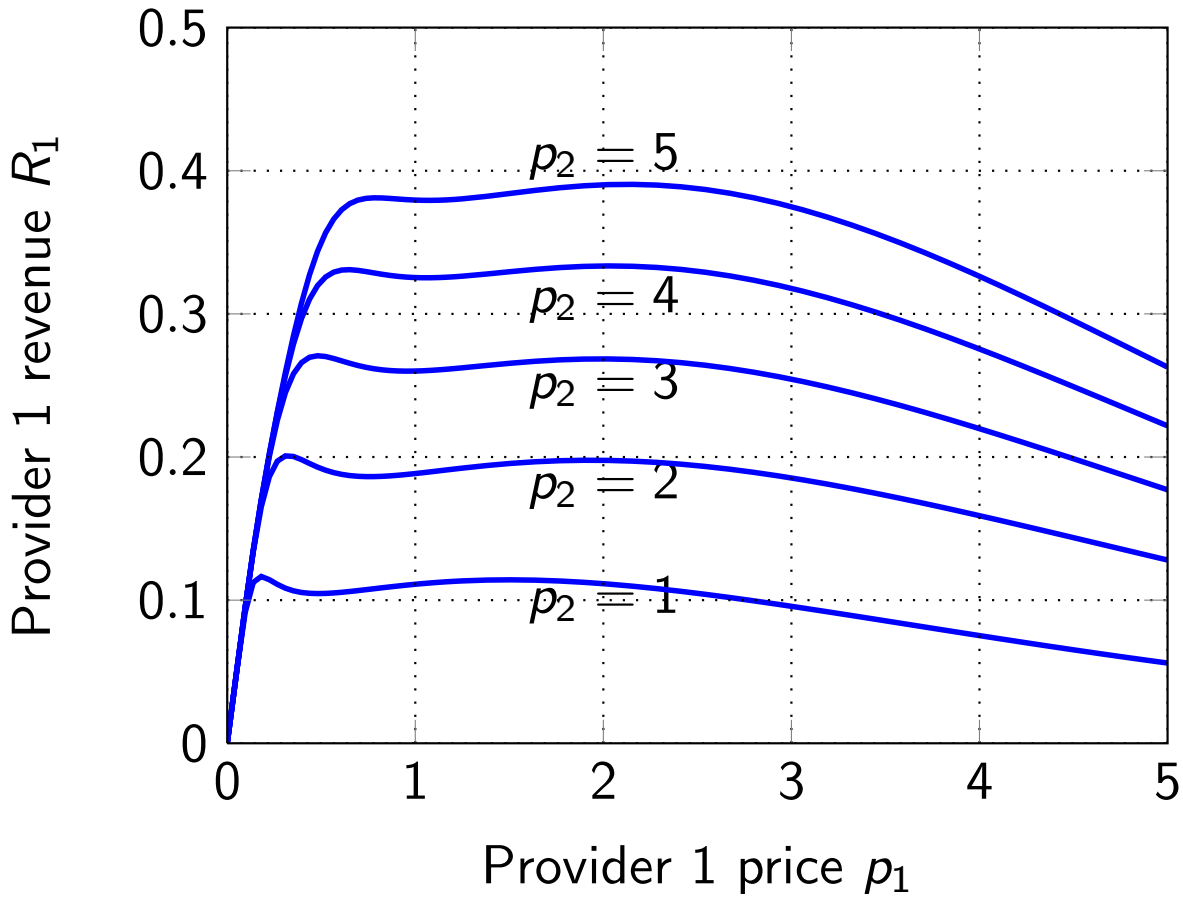


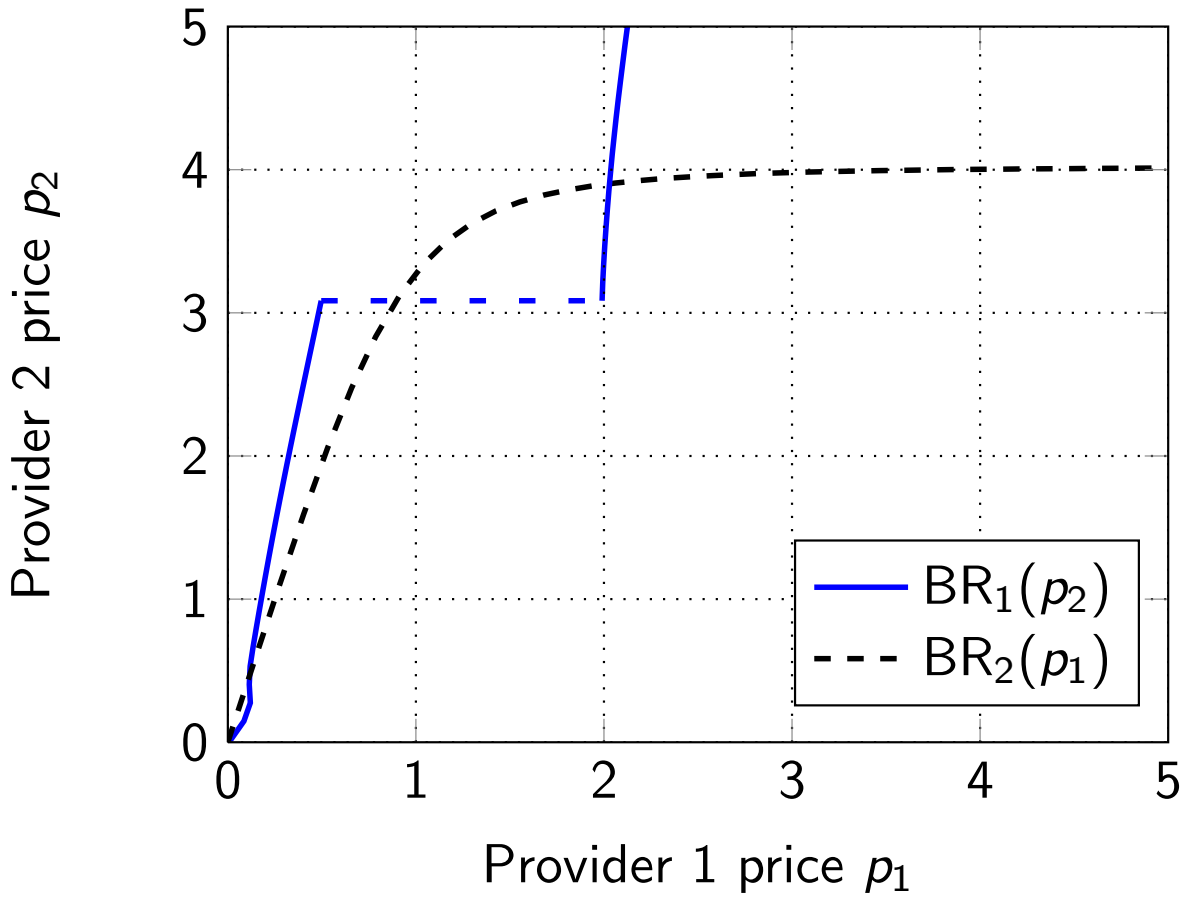
Population repartition at equilibrium

Provider best replies: a "less nice" case



Two local maxima for some parameter values...

Provider best replies: a "less nice" case



$\Rightarrow$ Discontinuities of the Nash equilibria.

Conclusions and perspectives

A game-theoretic model to analyze competition among providers, taking into account the churn behavior of customers, and the effect of prices.
The model could be much improved

- add the retention policies studied separately in a previous work,
- consider more realistic distributions of transition times,
- consider not only the steady-state but also the transient phase of the population reaction to prices.

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Thank you for your attention