Competition for migrating customers: a game-theoretic analysis in a regulated regime

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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

Retention policies

The losing provider has an economic interest in delaying the migration process Buehler, Dewenter, Haucap'07

$\Rightarrow$ unfair practices, to be sanctionned (economically) by the regulator

What sanction level to define?

- Trade-off for providers: revenue benefit *versus* sanction risk
- From a model focused on the losing provider point of view: identification of a maximum tolerable sanction value above which delaying customer liberation is not profitable Naldi'08

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.

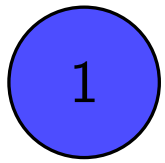
We propose a game-theoretic model between two providers

- decision variables: the retention strategies
- provider objective: mean revenue
- underlying process: customers switching from one provider to the other

We analyze the equilibria of that noncooperative game when the sanction changes

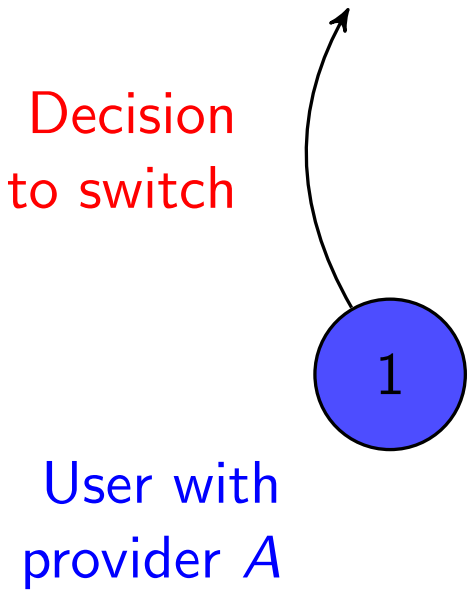
Model of user behavior

Model of user behavior



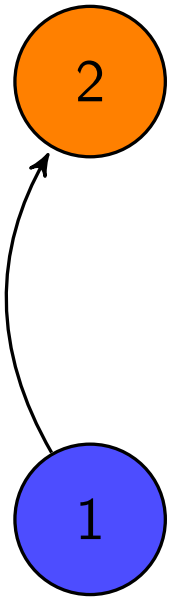
User with
provider A

Model of user behavior



Model of user behavior

User delayed in switching to prov. B



Decision to switch

User with provider A

Model of user behavior

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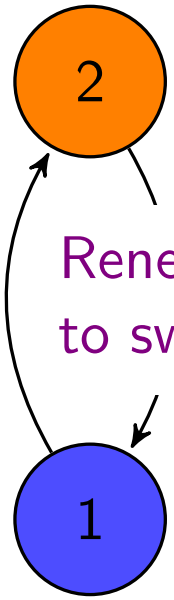
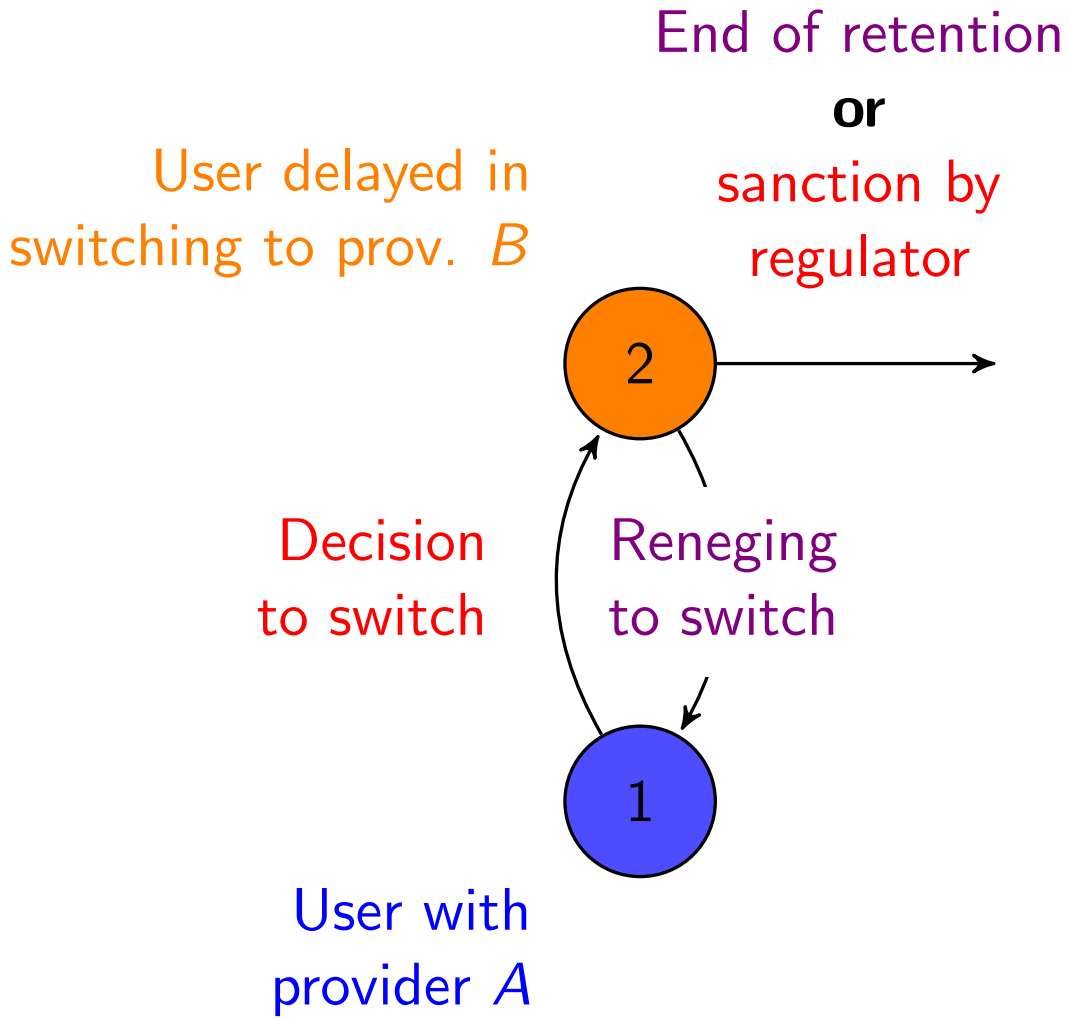


Decision to switch

Reneging to switch

User with provider A

Model of user behavior



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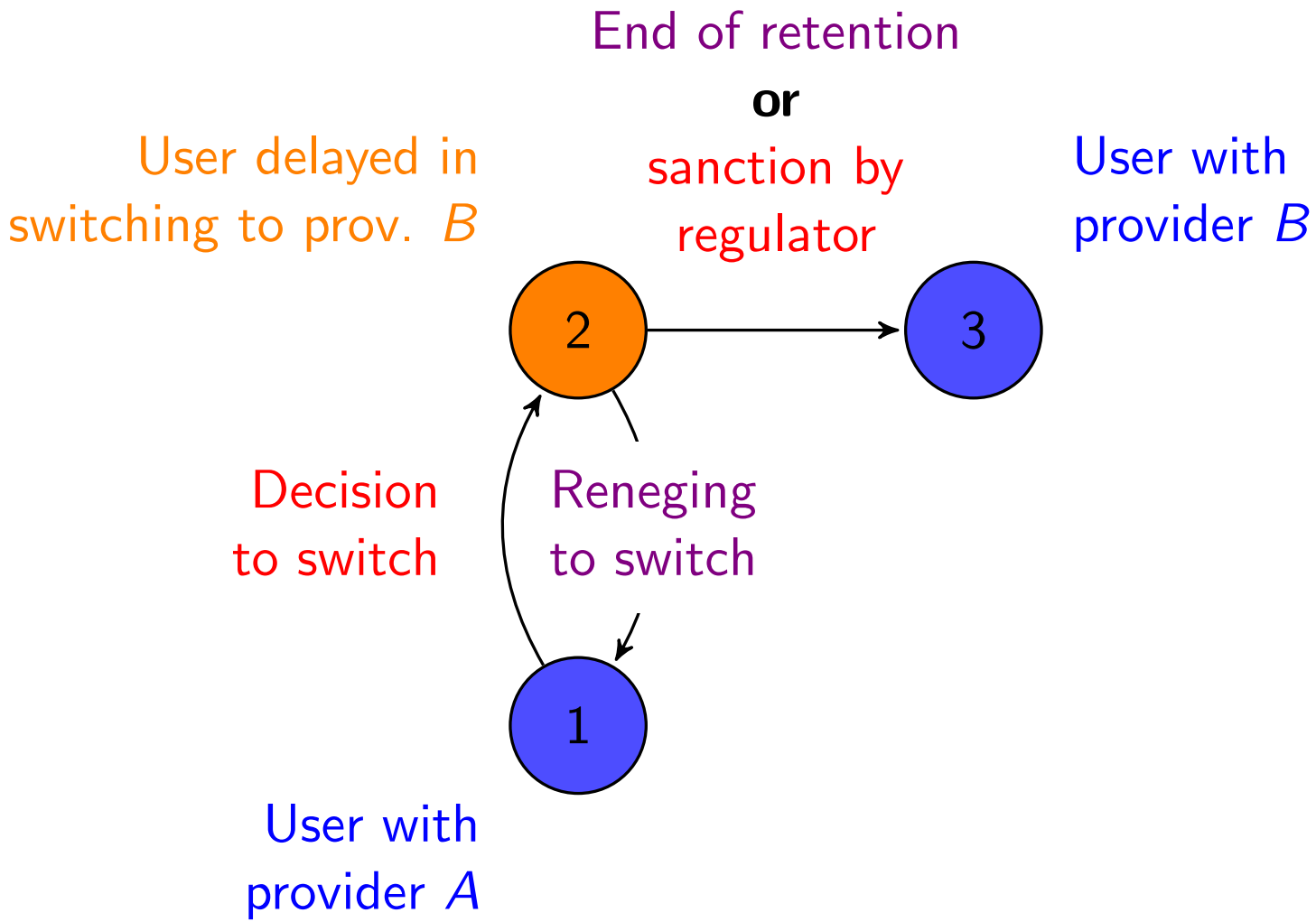

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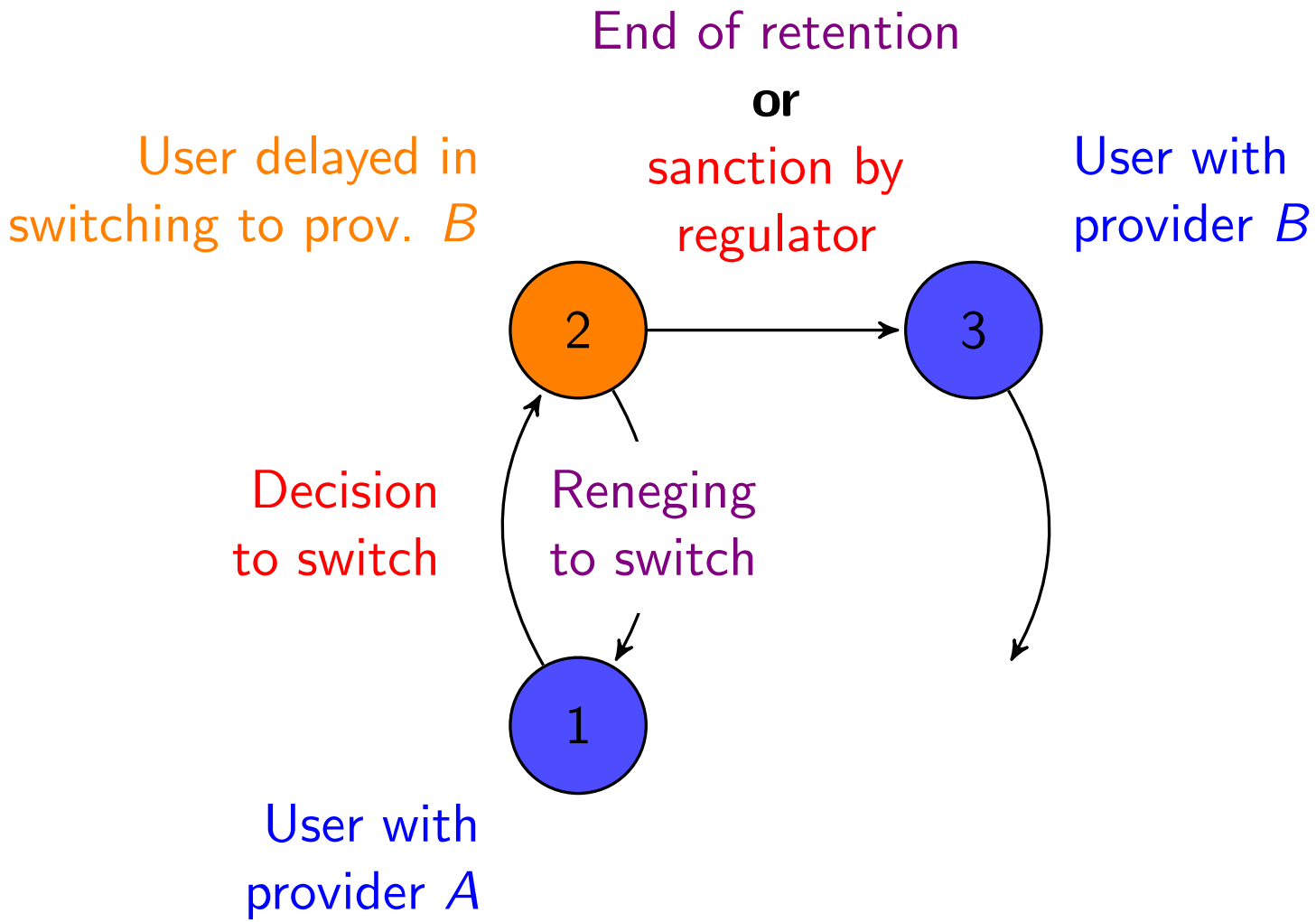

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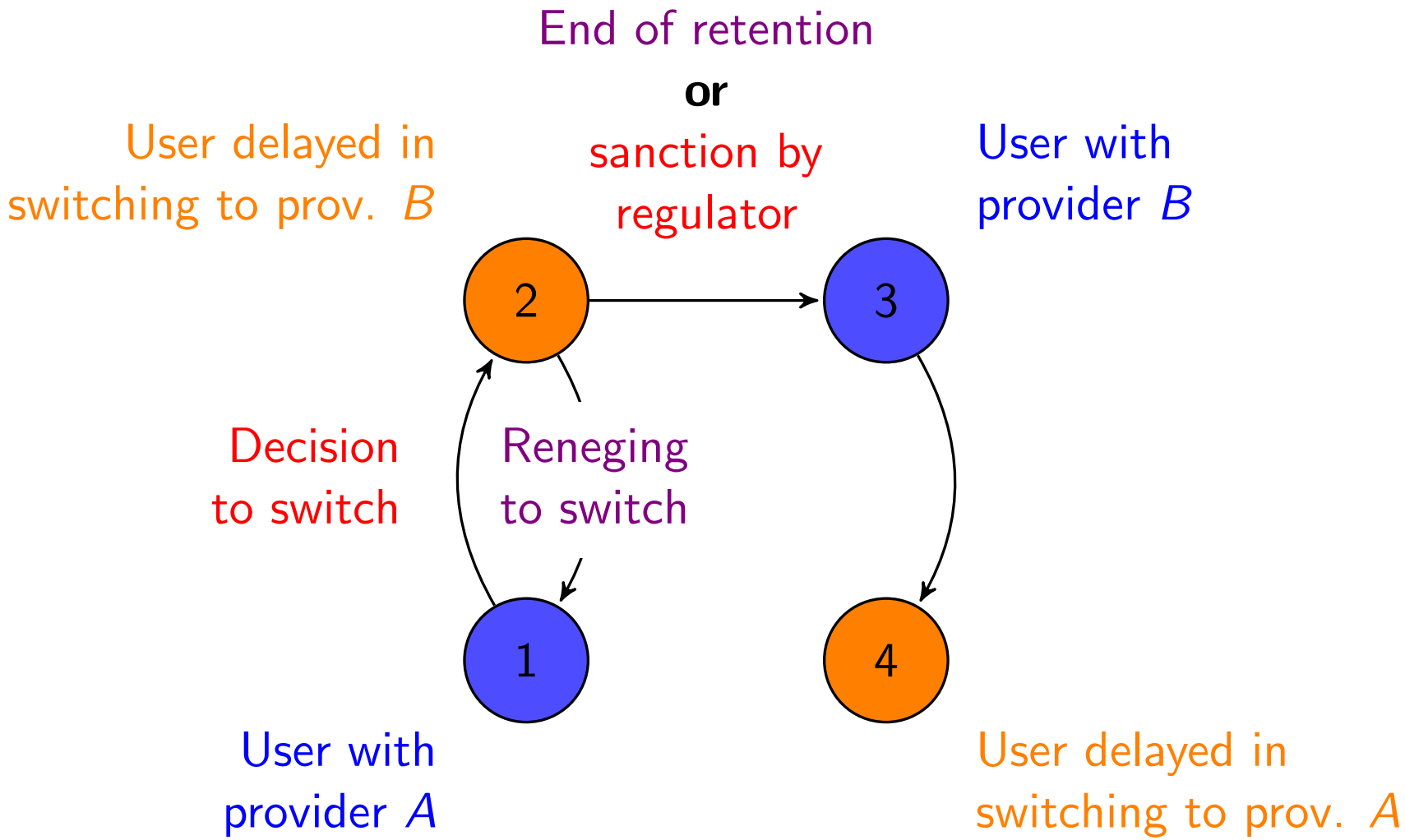

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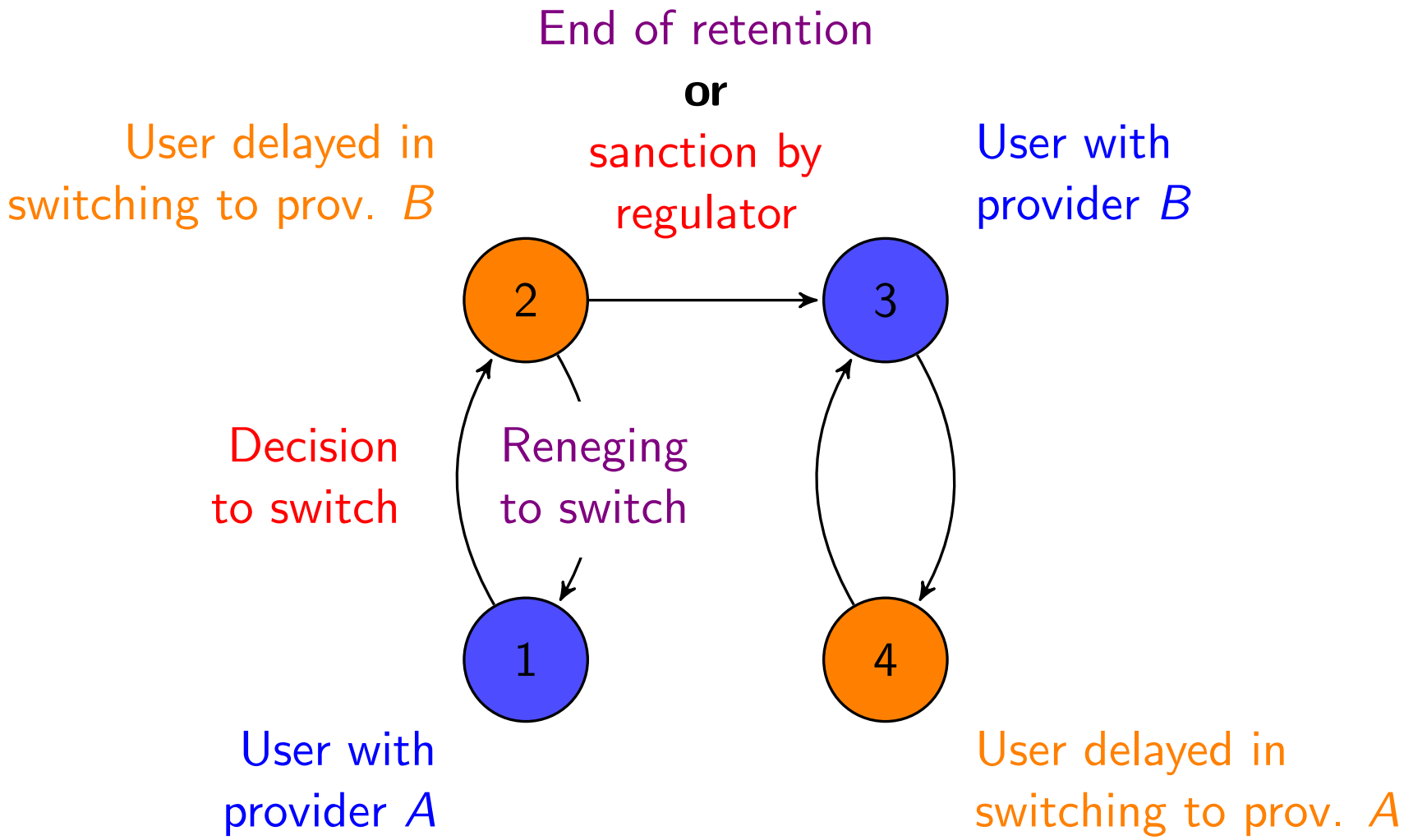

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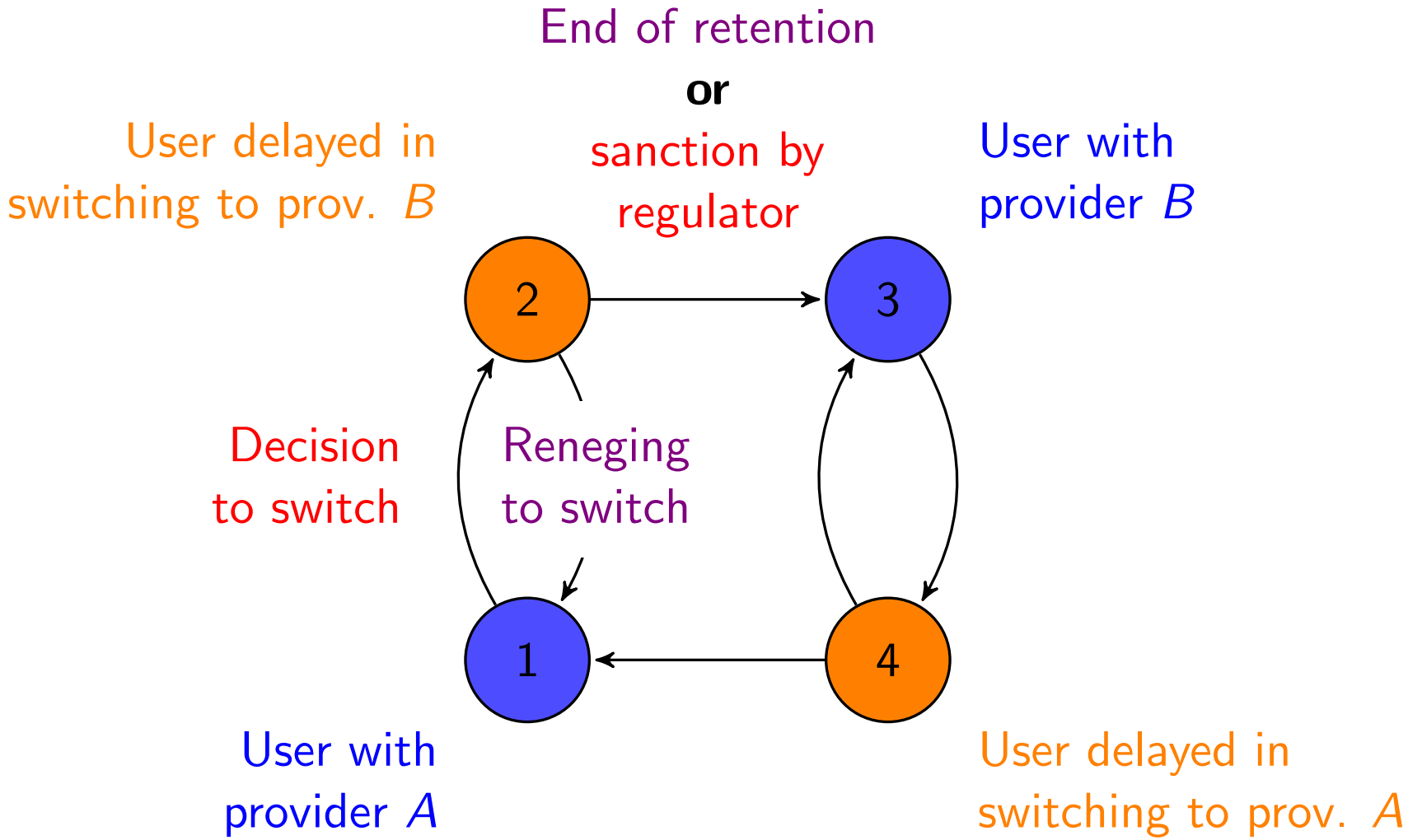

Markov model

We assume that

- the time before the customer wills to switch providers,
- the time before the customer reneges to switch and stays with his provider,
- the time before the customer loses patience and contacts the regulator,
- the delay introduced by providers before allowing the user to leave,

are independent exponentially distributed random variables.

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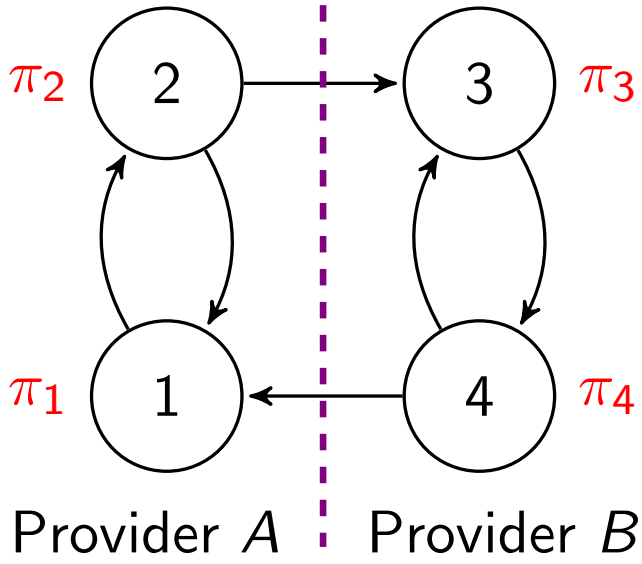
$\Rightarrow$ The user behavior is then a **continuous-time Markov chain**.

Mean revenue (utility) of providers

Steady-state probabilities



$$R_A = \underbrace{p_A(\pi_1 + \pi_2)}_{\text{income}} - \underbrace{s_0 \pi_2 \mu}_{\text{sanction freq}} \quad ; \quad R_B = \underbrace{p_B(\pi_3 + \pi_4)}_{\text{income}} - \underbrace{s_0 \pi_4 \mu}_{\text{sanction freq}}$$

with:
- p_i: price per unit time charged by provider i
- s_0: sanction for excessive retention
- μ: "loosing patience" rate (triggering sanctions)

Game formulation

In our model, the retention times can affect all transition rates directly (for liberation transitions), and because of reputation effects (for willing to switch and renege transitions).

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

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

$$\begin{aligned} R_A &= p_A(\pi_1 + \pi_2) - s_0\pi_2\mu \\ R_B &= p_B(\pi_3 + \pi_4) - s_0\pi_4\mu \end{aligned}$$

Nash equilibria of the game

We assume in this work that $p_A = p_B$ (same prices): providers play on retention times only.

A **Nash equilibrium** of the game is a strategy (here, retention times) profile (T_A, T_B) such that

$$\begin{aligned} T_A^* &\in \arg\max_T R_A(T, T_B^*), \text{ and} \\ T_B^* &\in \arg\max_T R_B(T_A^*, T). \end{aligned}$$

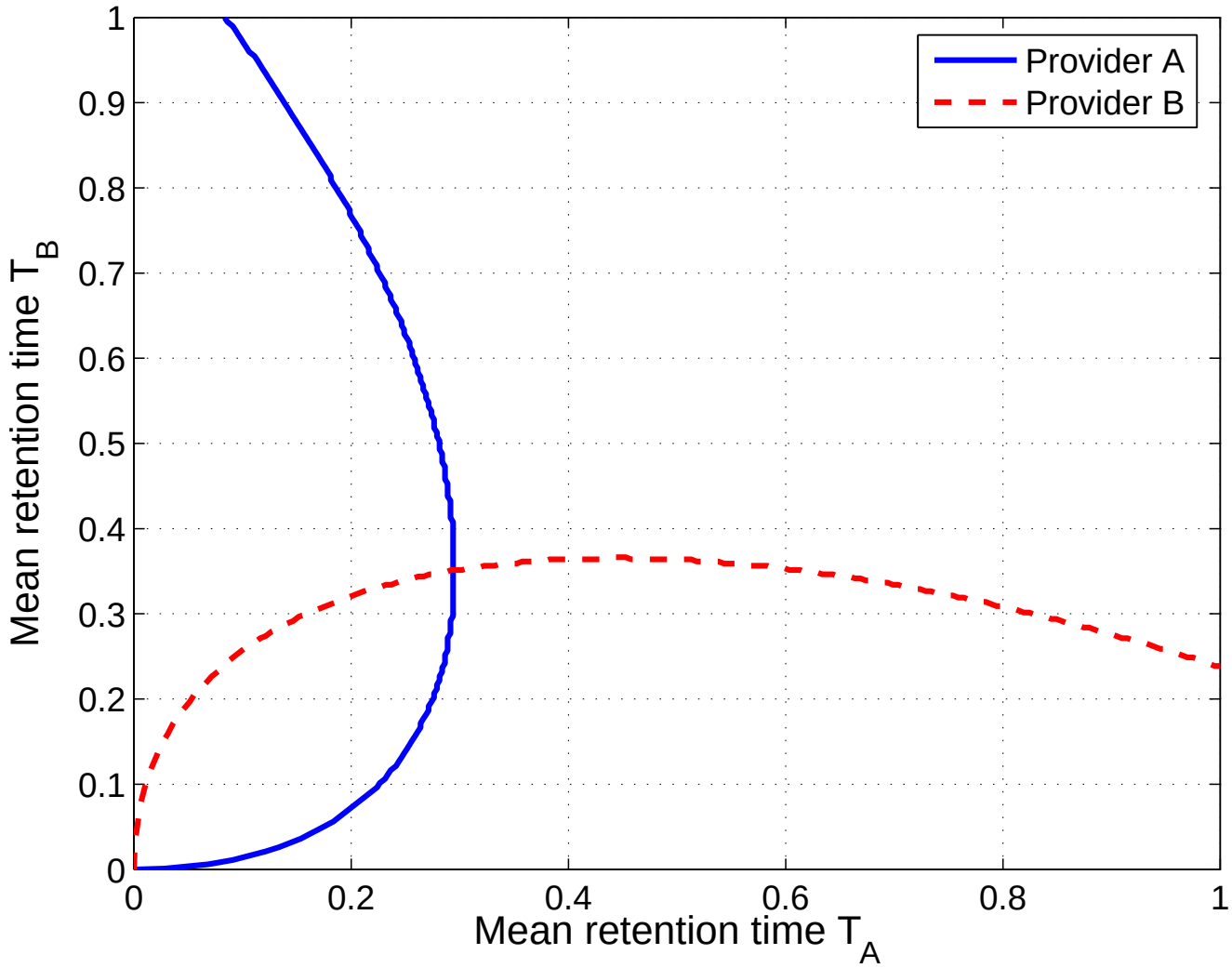
We determine numerically those equilibria.

A numerical example

$$
\begin{aligned}
\text{churning rate } A \to B &= \lambda \cdot \left(1 - \omega + \omega \frac{T_B - T_A}{T_A + T_B}\right) \\
\text{churning rate } B \to A &= \lambda \cdot \left(1 - \omega + \omega \frac{T_A - T_B}{T_A + T_B}\right) + \nu \\
\text{reneging rate for } A \text{ users} &= \alpha \cdot \left(1 - \omega + \omega \frac{T_A - T_B}{T_A + T_B}\right) \\
\text{reneging rate for } B \text{ users} &= \alpha \cdot \left(1 - \omega + \omega \frac{T_B - T_A}{T_A + T_B}\right)
\end{aligned}
$$

with $\lambda, \nu, \alpha, \omega$ positive constants.
ν represents an advantage of provider A over provider B (better reputation).

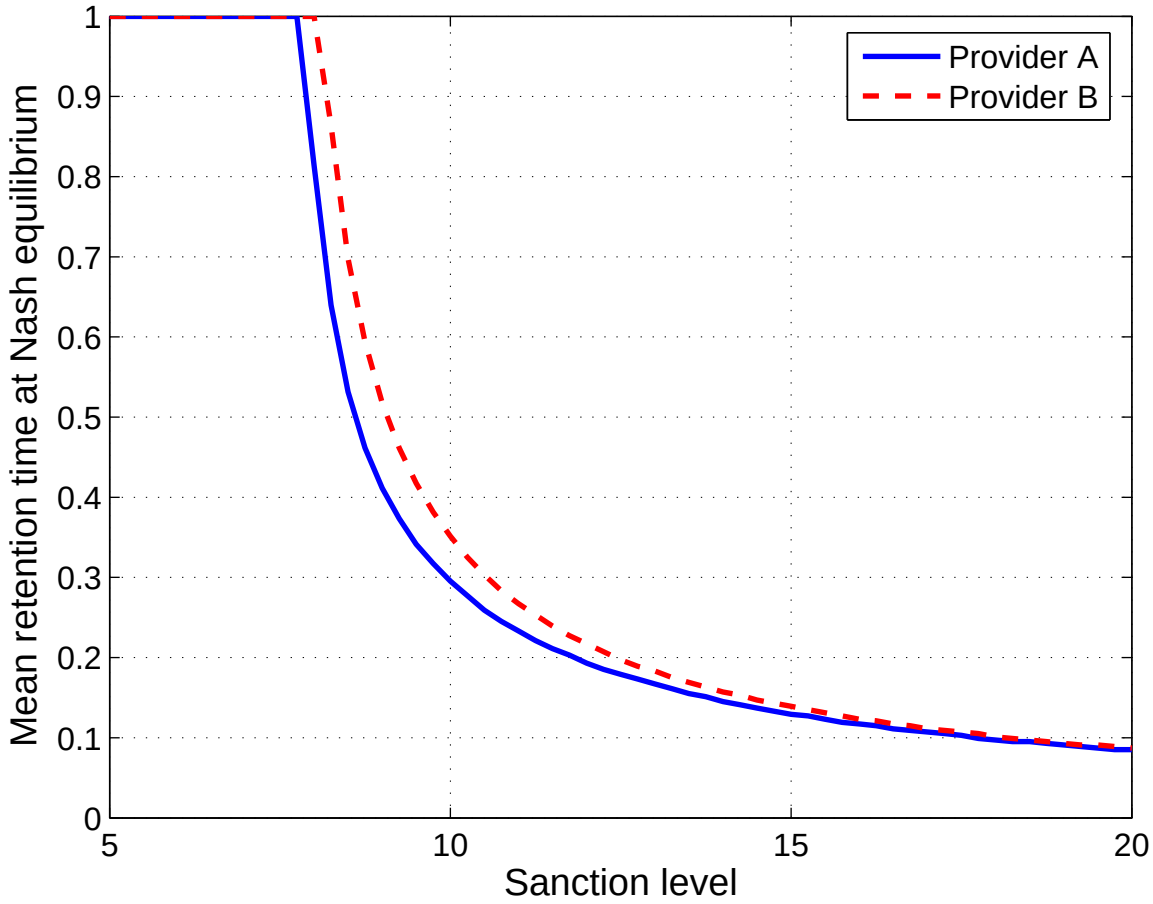
Best reply curves



$\Rightarrow$ two Nash equilibria, only one stable

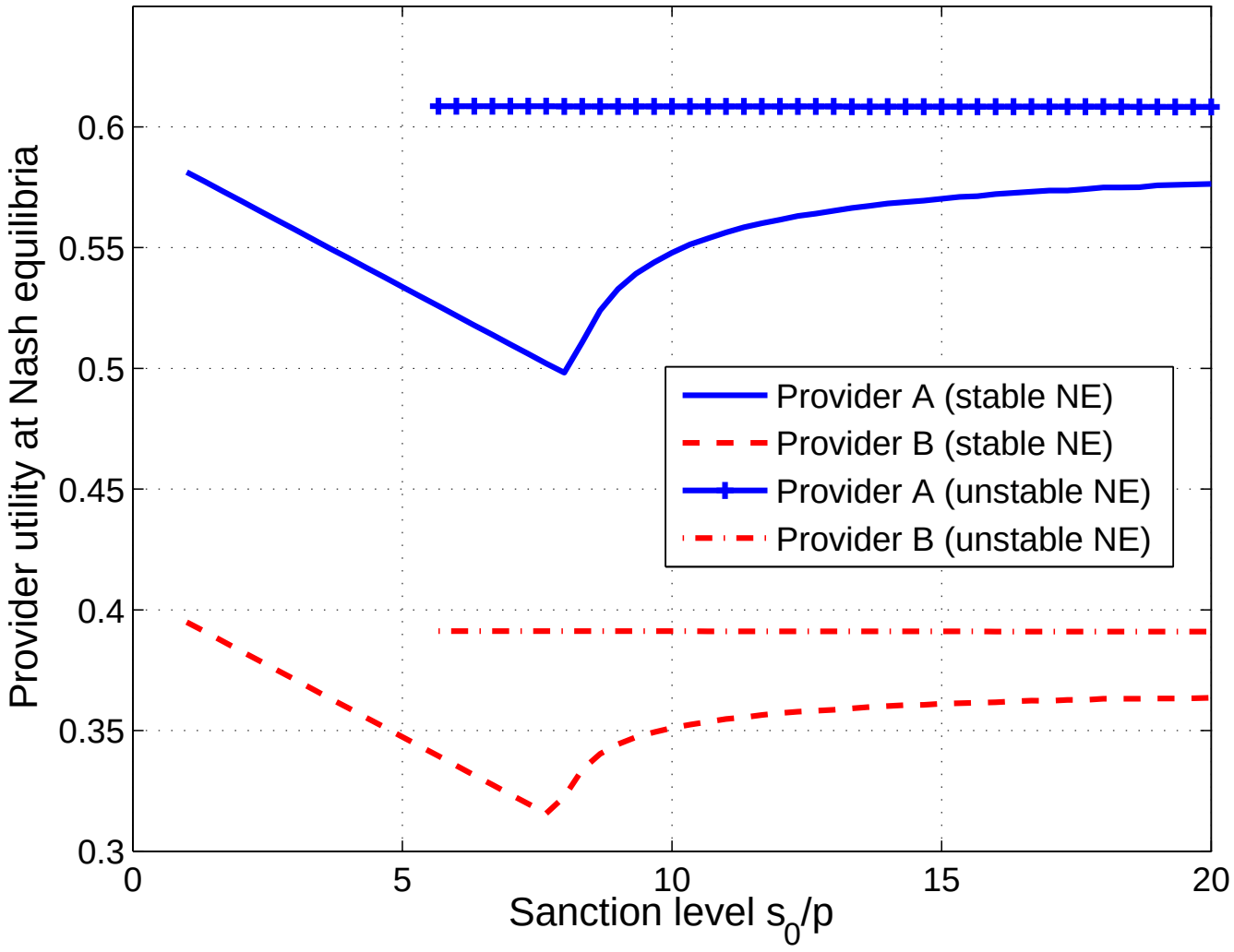
Influence of the sanction on retention times

We only plot the stable Nash equilibrium



As expected, increasing the sanction elicits provider to reduce their retention times

Corresponding provider revenues



Conclusions and perspectives

A game-theoretic model to analyze competition among providers, taking into account

- the delaying behaviour of providers,
- the sanctions levied by the regulatory authorities,
- the impatience of the customer willing to churn.

A simplified setting has been examined. The equilibrium delays appear to be strongly non linear functions of the sanction imposed by the regulator.

The model could be much improved

- add a state where the user does not subscribe to any service,
- add competition on prices,
- consider more realistic distributions of transition times.

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Thank you for your attention