The Value of Ignoring Risk: Competition between Better Informed Insurers

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Motivation

- The improvement in data collection and analytics over the last decades has significantly affected the insurance industry
- Insurance companies are better able to reliably forecast risk than in the past
- Because of their expertise and access to relevant statistics, insurers are likely to be better equipped than policyholders in accurately assessing all relevant risk factors
- The traditional information asymmetry affecting the insurance sector may 'flip-over' to the other side of the market

Stylized Facts

- The empirical literature on insurance markets highlights at least three stylized facts:
  1. persistent profitability (e.g. Sommer, 2017)
  2. prevalence of unused observables (evidence of pooling, e.g. Finkelstein and Poterba, 2014)
  3. high market concentration (Robinson, 2004)
- However, there is no evidence of significant entry barriers or of collusive behavior, and profitability is not explained by market concentration

  $\rightarrow$ Dafny et al. (2009), Hyman and Kovacic (2004), among others

Related Literature

- The seminal theoretical contributions in the field do not account for such stylized facts
  - → Rothschild and Stiglitz (1976) predicts actuarially fair, separating outcomes
- More recent contributions have attempted to fill the gap, allowing for the possibility of pooling equilibria and profitable contracts:
  - → non-exclusive contracts (Attar et.al., 2011)
  - → exclusive contracts with more informed insurers (Villeneuve, 2005)
- However, the actuarially fair outcome is never ruled out, and the existence of equilibria may rely on a large number of latent contracts

Our Paper

We study a competitive insurance market with exclusive contracts in which:

1. insurers have superior information over risk factors that are relevant for the insurance contract

2. insurers are heterogeneous, in the sense that each insurer's assessment of risk is private and imperfect

   → The heterogeneity of insurers' evaluations can be due to the use of different data warehouses, or predictive algorithms

   → We depart from the pertinent literature (e.g., Villeneuve, 2005) that typically assumes homogeneous insurers

Main Findings

We show that competition between better, but imperfectly, informed insurers is consistent with the empirical evidence on insurance markets:

1. Non-informative equilibria can exist
   → This result is robust when we let our model converge to that by Rothschild and Stiglitz (1976) by adding a second source of asymmetric information

2. The competitive mechanism is not only consistent with, but actually requires, strictly positive profits

3. Equilibria exist only if the number of competing firms is limited
   → Furthermore, a larger industry dispersion may entail larger equilibrium profits, consistently with the observed unstable relationship between market concentration and profitability.

The Baseline Model

- 2 risk neutral profit maximizer insurers competing on contracts
- 2 possible environments: **d**angerous or **s**afe, $\theta \in \{d, s\}$
- Insurer $i = (1, 2)$ privately receives a noisy informative signal $\hat{\theta}_i \in \{\hat{d}; \hat{s}\}$ about θ
- One risk averse policyholder with von Neumann Morgenstern preferences
- She is subject to a potential lump sum loss with probability p_θ, with $p_d > p_s$
- The outside option of the policyholder is no-insurance

Timing

1. Nature moves first, choosing the environment θ and drawing – independently and from a common distribution – each insurer's signals on the environment, $\hat{\theta}_i$;

2. Insurer i, $i = 1, 2$, privately observes $\hat{\theta}_i$ and he updates his prior on θ conditional on $\hat{\theta}_i$;

3. Insurers simultaneously make offers consisting of a menu of contracts

4. The policyholder observes all offers, updates her beliefs $\tilde{p}$, and selects one contract within a specific menu, or no-insurance

5. The accepted contract is implemented and payoffs are received

Equilibrium and Beliefs

- We focus on symmetric Perfect Bayesian Equilibria
- Beliefs $\tilde{p}$ off the equilibrium path are arbitrarily defined
- We define the policyholder's *degree of optimism* off the equilibrium path as the probability that the policyholder assigns to the fact that a deviating insurer received a safe signal about the environment
  - $\rightarrow$ Differently from most of the pertinent literature, we allow for beliefs that are not necessarily fully optimistic or fully pessimistic

Non-informative Equilibria - Existence

- In *non-informative* equilibria, insurers' offers don't reveal their private signals
  - → Equilibria pool the insurers' types (in order not to reveal information)
  - → The policyholder has only prior information on risk
- Why is pooling possible? graphically
  - → Out-of-equilibrium beliefs play a crucial role
  - → In particular, if the policyholder believes that the deviating insurer assesses the risk of the environment as being low, she revises her own assessment of risk downwards
  - → Hence, she is only willing to accept deviation contracts offering a large discount, which might however be unprofitable for the insurer

Non-informative Equilibria - Implications

- The impossibility of 'undercutting' deviations induces a failure of the usual (Bertrand) competitive mechanism
- This failure has several implications
  1. The equilibrium must be profitable for $\hat{s}$, and may be profitable for $\hat{d}$
  2. Non-informative equilibria can entail full insurance
  3. There are multiple non-informative equilibria

Profitability: The Underlying Driving Forces

- An equilibrium contract must meet the *individual rationality* constraints of all insurers regardless of their assessments of the riskiness of the environment
- The participation constraint must be met also for those insurers believing that the environment is very risky
- Hence, to be an equilibrium, a pooling contract must entail positive expected profits for the insurers assessing a safer environment

Two Sided Asymmetric Information

- One may conjecture that the existence of non-informative equilibria depends on opposite informational assumptions than those in Rothschild & Stiglitz (1976)
- We extend our model by adding a second source of asymmetric information
  - $\rightarrow$ insurers are more informed about the risk of the environment, the policyholder about her own idiosyncratic risk
- Even in the limit case in which the two-sided model converges to that by Rothschild and Stiglitz, non-informative pooling equilibria survive provided that the types of policyholder are not *too different*

simulation

Informative Equilibria - Information Revelation

- In *informative* equilibria, insurers' offers reveal their private signals
  - → The policyholder observes the offers and infers market information, i.e. the vector of signals received by all insurers
  - → Based on market information, the policyholder chooses the contract explicitly designed for the market state she assesses
  - → Equilibria are *fully separating*, i.e. they separate both the insurers' types (in order to reveal information) and the policyholder's types (in order to screen them)

Informative Equilibria - Characterization

- Informative equilibria are fully separating; i.e. insurers offer an incentive compatible menu with a different contract for each vector of signals graphically
- The policyholder self-selects on the basis of market information collected from the insurers' offers
- The characterization of informative equilibria follows a logic similar to that of Rothschild & Stiglitz (1976), except that here there are different types of insurers
- Insurers need the incentive to reveal their private information
- Hence, the equilibrium allocation must be strictly profitable for insurers with a low risk assessment

More on Profitability: The Underlying Driving Forces

- Positive profits are required to ensure truthful revelation of insurers' private information
- Insurers with a lower assessment of risk may have an incentive to lie, pretending to expect a riskier environment, in order to charge higher premia to customers
- Hence, a truthful disclosure of the riskiness of the environment requires a higher informational rent the safer is the insurer's estimation of risk

Non-informative and Informative Equilibria: a Comparison

- Non-informative equilibria exist for a larger set of out of equilibrium beliefs than informative equilibria
  - $\rightarrow$ Informative equilibria require fully optimistic equilibrium beliefs: if not, following a deviation by the $\hat{s}$ insurer, the policyholder would assess a riskier environment than the one consistent with the market information, entailing a profitable deviation for the $\hat{s}$ insurer
- When they coexist, non-informative equilibria are socially more efficient
  - $\rightarrow$ Non-informative equilibria can entail full insurance, whereas informative equilibria may entail very little insurance, especially when the number of firms increases
  - $\rightarrow$ Numerical simulations suggest that non-informative equilibria are associated to higher ex-ante expected profits than informative equilibria

The n-Firm Case

- We extend our baseline model to the case of n competing insurers, hence allowing for a richer market information and for a better understanding of the role of competition
- We find that there exists an upper bound to the number of firms that is consistent with both non-informative and informative equilibria
  - $\rightarrow$ For non-informative equilibria, when the number of competitors increases and all firms offer the same contract, the probability of winning a customer decreases, hence deviations become more tempting
  - $\rightarrow$ For informative equilibria, when many insurers have a low assessment of risk, then it is more likely that the environment is indeed safe. Hence, cross-subsidies deviations become profitable

Market Concentration and Profits

- With a larger number of insurers, only contracts with *higher* premia can be sustained as non-informative equilibria
  - → Because of the lower probability of winning the customer, only contracts with higher premia can be sustained as equilibria
  - → This establishes a non-standard, negative relationship between insurance premia and market concentration
- With a larger number of insurers, only contracts with *lower* premia can be sustained as informative equilibria
  - → High premia would entail profitable cross-subsidies deviations

Concluding Remarks

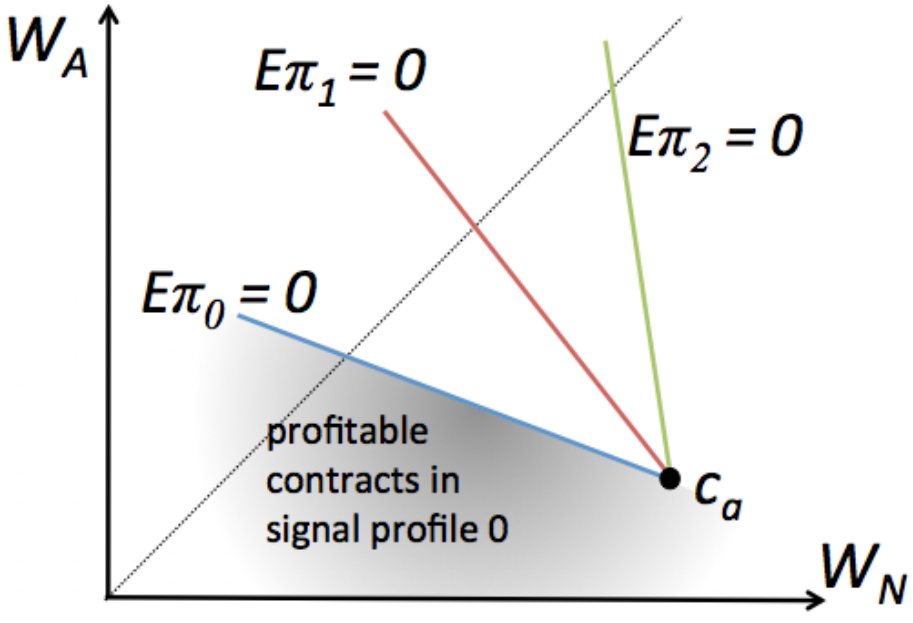
- We study a setup in which insurers have an imperfect informational advantage over policyholders
- We show that equilibria always entail positive profits for some insurers and do not necessarily imply disclosure of the insurers' information despite competition
  - $\rightarrow$ This holds also when adding the usual asymmetric information *à la* Rothschild-Stiglitz
- There is an upper bound on the number of firms consistent with the existence of equilibria. Furthermore, a larger industry dispersion may entail larger equilibrium profits
- In a policy perspective, our results may contribute to the debate on the impact of big data and data analytics technologies in the insurance industry

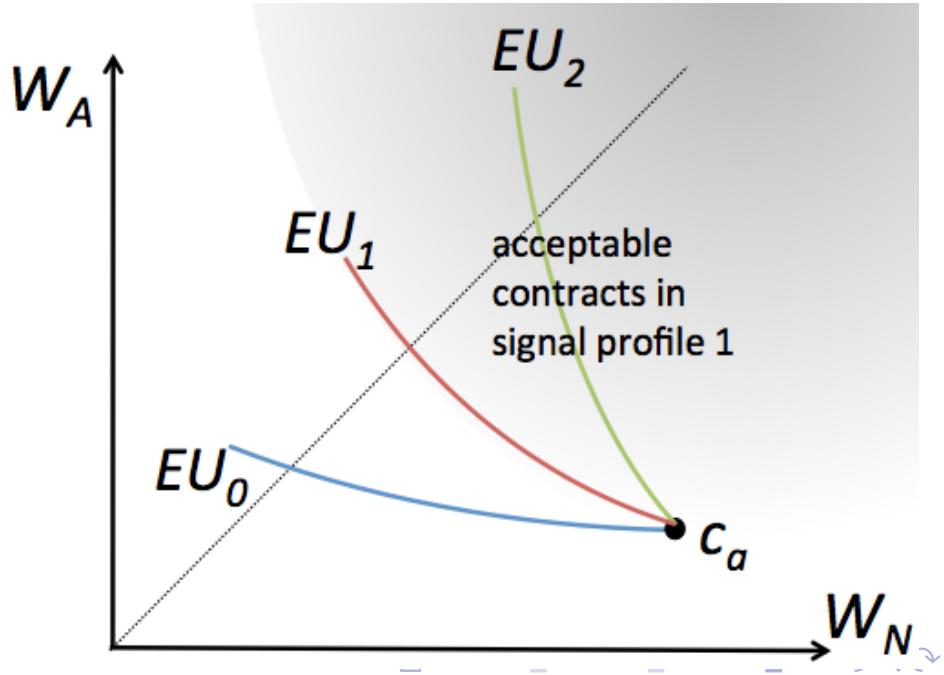
The 2-firms Case

- There are three possible market states $n_{\hat{s}}$:

$$n_{\hat{s}} = \begin{cases} 0 & (\rightarrow \hat{d}\hat{d}) \\ 1 & (\rightarrow \hat{d}\hat{s}) \\ 2 & (\rightarrow \hat{s}\hat{s}) \end{cases}$$

- Bayes' rule allows to assess the loss probability associated to each market state: $p_0; p_1; p_2$, with $p_0 < p_1 < p_2$





Non-informative Equilibria

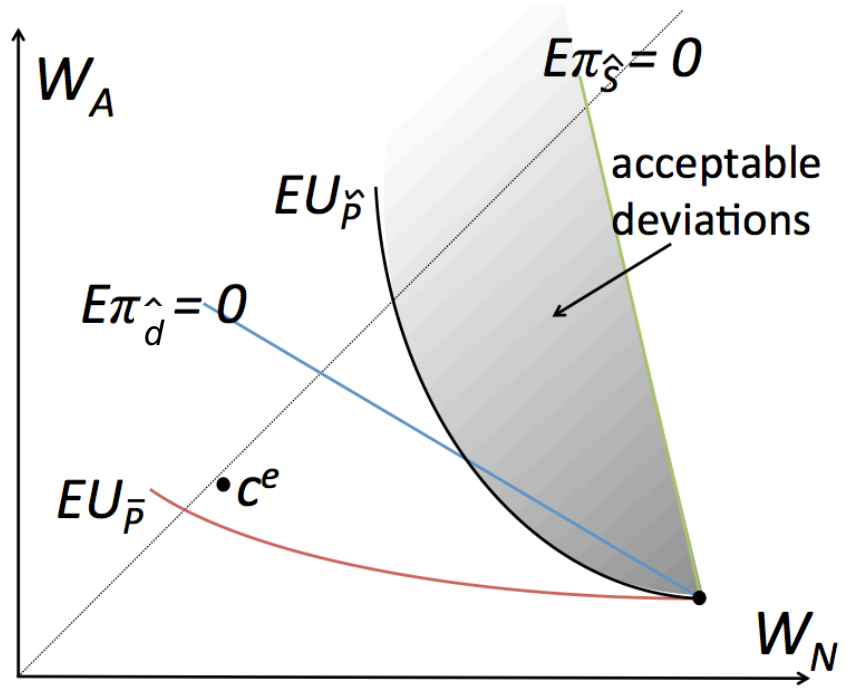
In equilibrium, both insurers' types offer the same contract c^e

- c^e satisfies the IR of $\hat{d}$, $\hat{s}$ and the policyholder (who has an ex-ante assessment $\bar{p}$ of the loss probability)

- An non-informative equilibrium exists iff the policyholder is sufficiently optimistic and

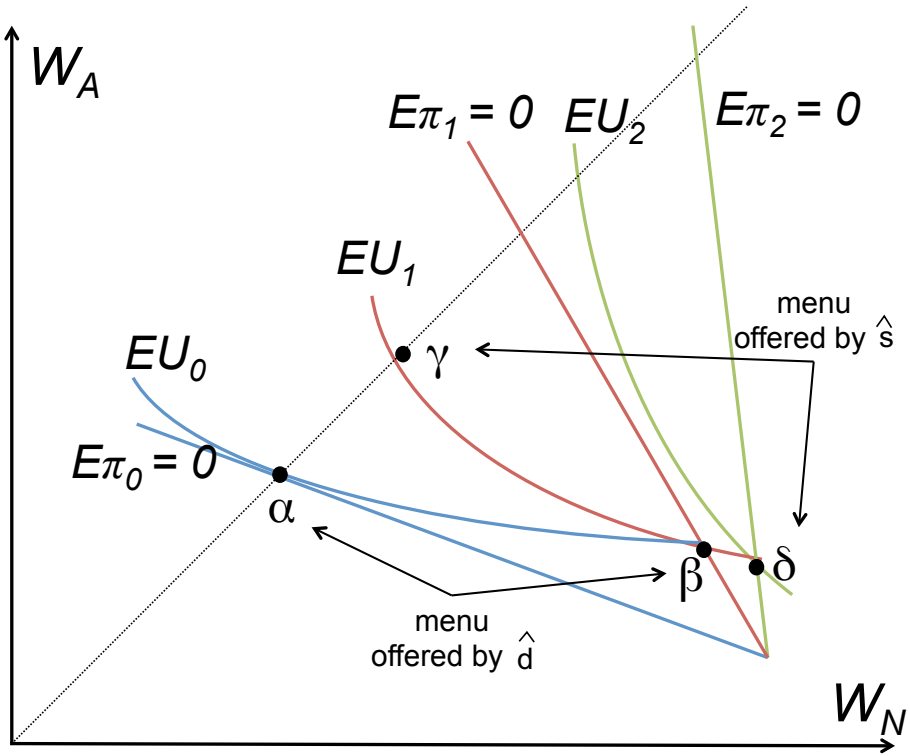
$$\frac{E\pi^e_{\hat{\theta}}}{n} \geq E\pi_{\hat{\theta}}\left(c^{dev}_{\hat{\theta}}\right),$$

where $c^{dev}_{\hat{\theta}}$ is the most profitable deviation for $\hat{\theta}$ that is acceptable by the policyholder



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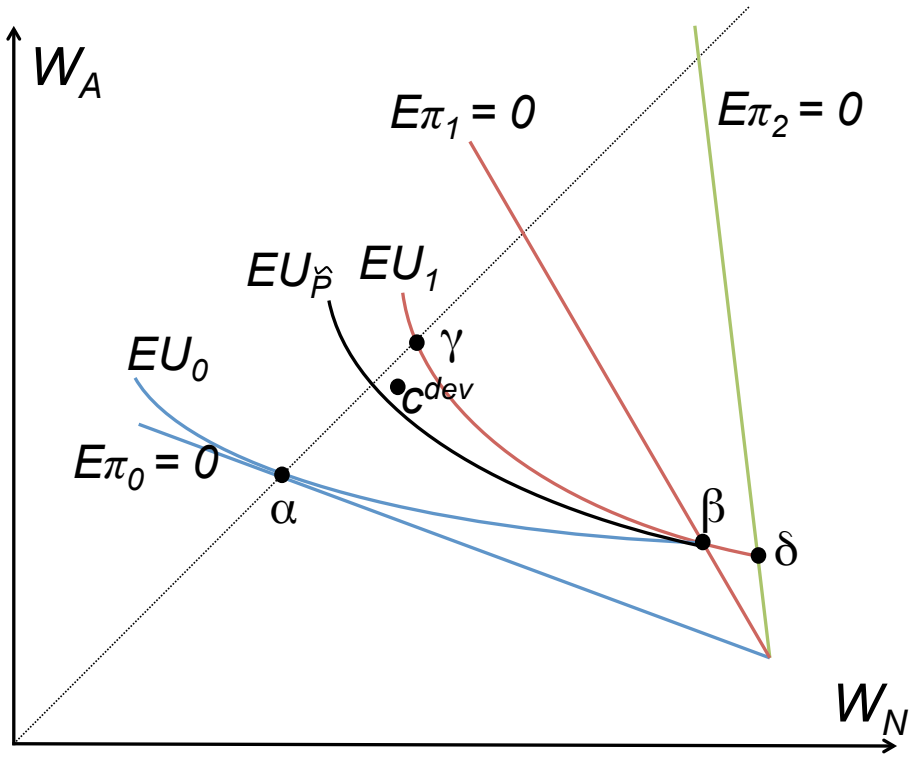
Informative Equilibria



- In equilibrium, $\hat{d}$ offers the IC menu $\{\alpha, \beta\}$ and $\hat{s}$ offers $\{\gamma, \delta\}$
- If e.g., both firms are $\hat{s}$, they both offer $\{\gamma, \delta\}$; the policyholder infers that the signal profile is $n_{\hat{s}} = 2$ and chooses δ
- By IC, the contract β entails underinsurance in menu $\{\alpha, \beta\}$
- γ is strictly preferred to β

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Informative Equilibria - Fully Optimistic Beliefs



- Suppose that the vector of signals is $(\hat{s}, \hat{d})$
- $\hat{d}$ offers $\{\alpha, \beta\}$, while $\hat{s}$ deviates and offers c^{dev}
- The policyholder observes the deviation c^{dev} and assesses risk by $\tilde{p} > p_1$
- Then the policyholder accepts the deviation c^{dev}

Comparison with Rothschild Stiglitz (1976)

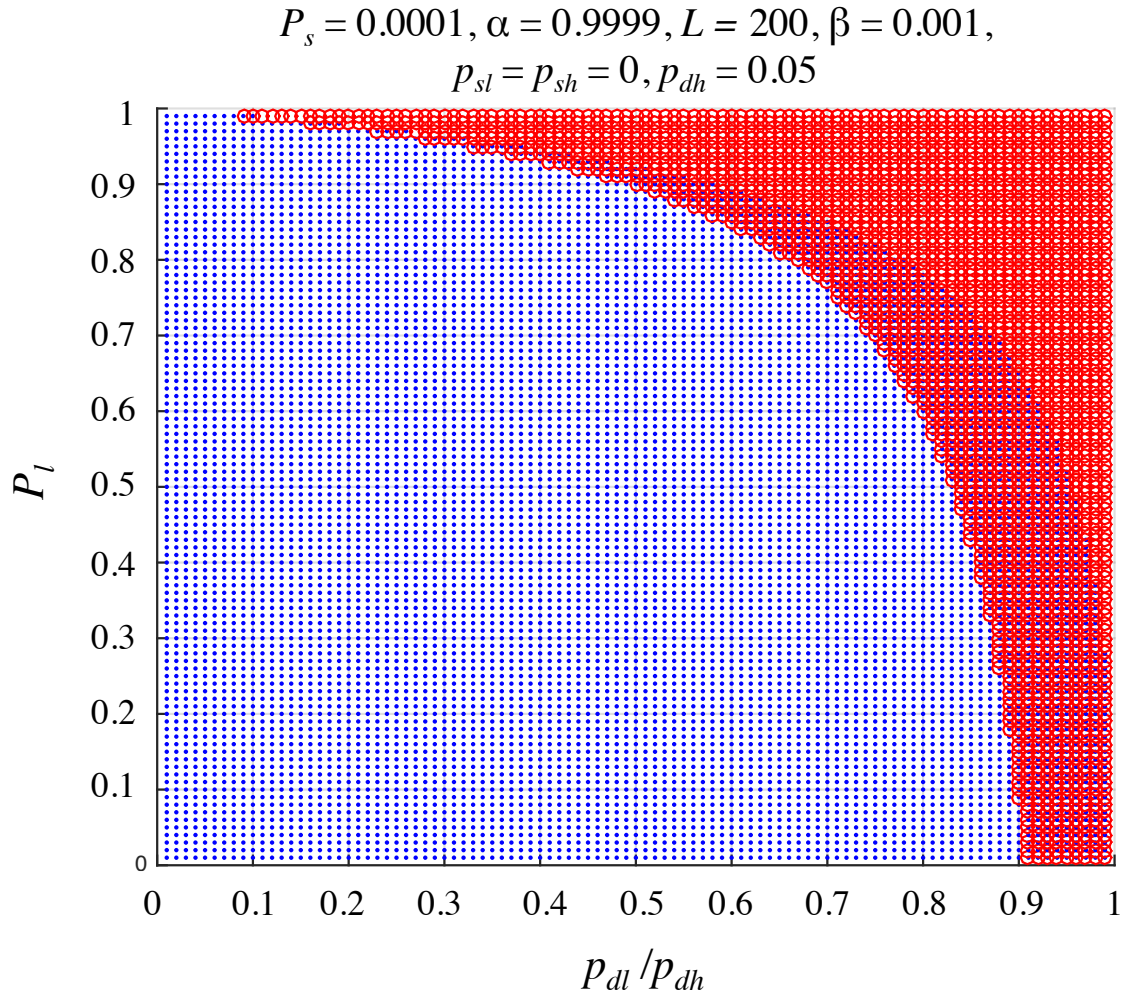


Figure: Existence of non-informative pooling equilibria (in red) and Rothschild-Stiglitz equilibria (in blue) in the plane P_l-p_{dl}/p_{dh}

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