Multidimensional Screening: Online Computation and Limited Information

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Screening problem

- Basic model of asymmetric information (incentives)

- Applications in pricing, regulation and auctions

- Economically, game theoretically, and computationally interesting problem

Application in quality pricing

- Firm designs bundles $(q_1, \ldots, q_K; p)$ for each buyer, where $q_1, \ldots, q_K$ are qualities and p price of product

- Buyers are indexed by $i \in I = \{1, \ldots, n\}$ and their utilities are $U_i(q, p) = V_i(q) - p$, $i \in I$, where $V_i(q)$ is buyer i's surplus

- Buyers SELF-SELECT the bundle they wish to consume by maximizing their utility U_i

Optimization problem

$$\max_{q,p} \quad \pi(q,p) = \sum_{i=1}^{n} f_i[p_i - c(q_i)]$$

$$s.t. \quad V_i(q_i) - p_i \geq 0, \ \forall i \in I \qquad (IR)$$

$$V_i(q_i) - p_i \geq V_i(q_j) - p_j, \ \forall i,j \in I, j \neq i, \ (IC)$$

where $\pi(q,p)$ is firm's profit, f_i weight of buyer i, and $c(x)$ cost of producing product with quality q.
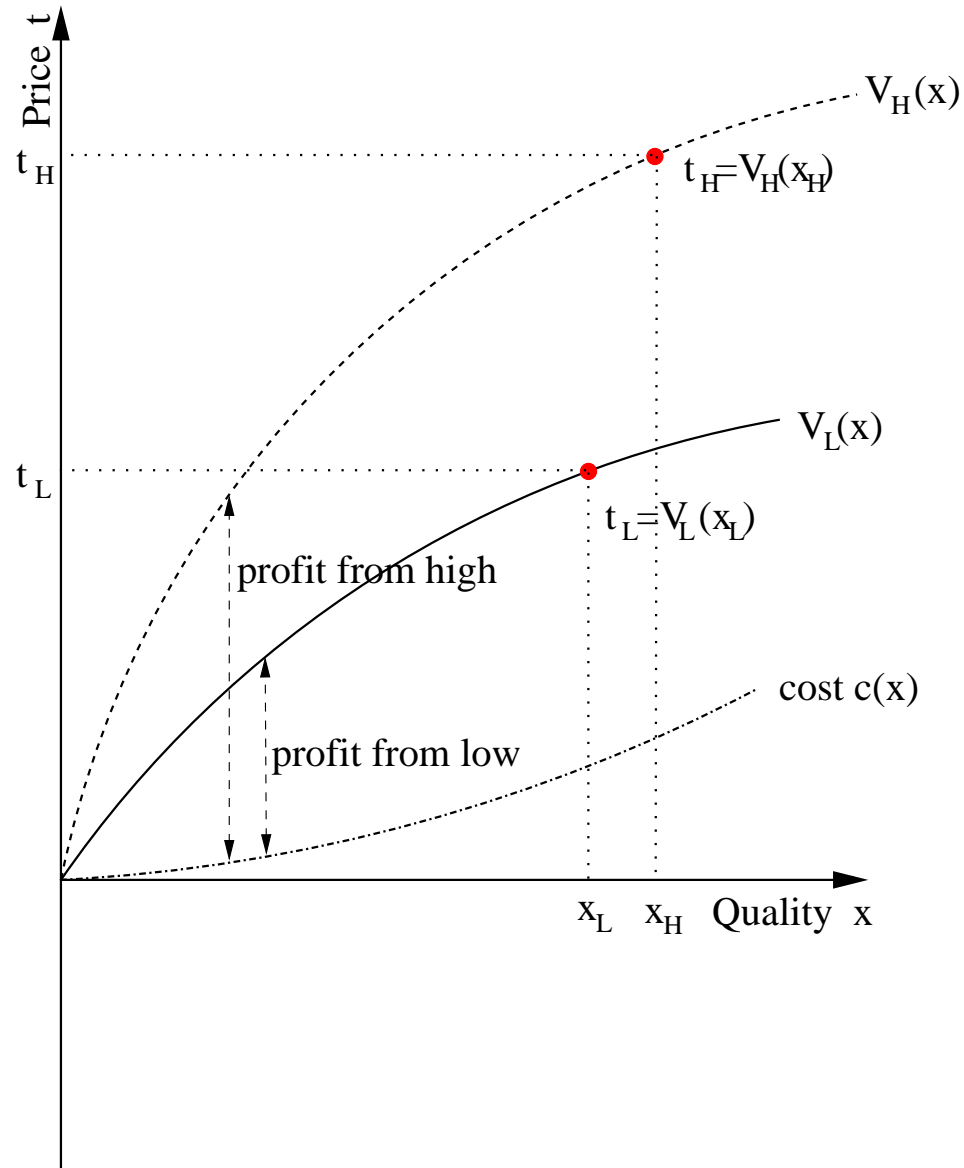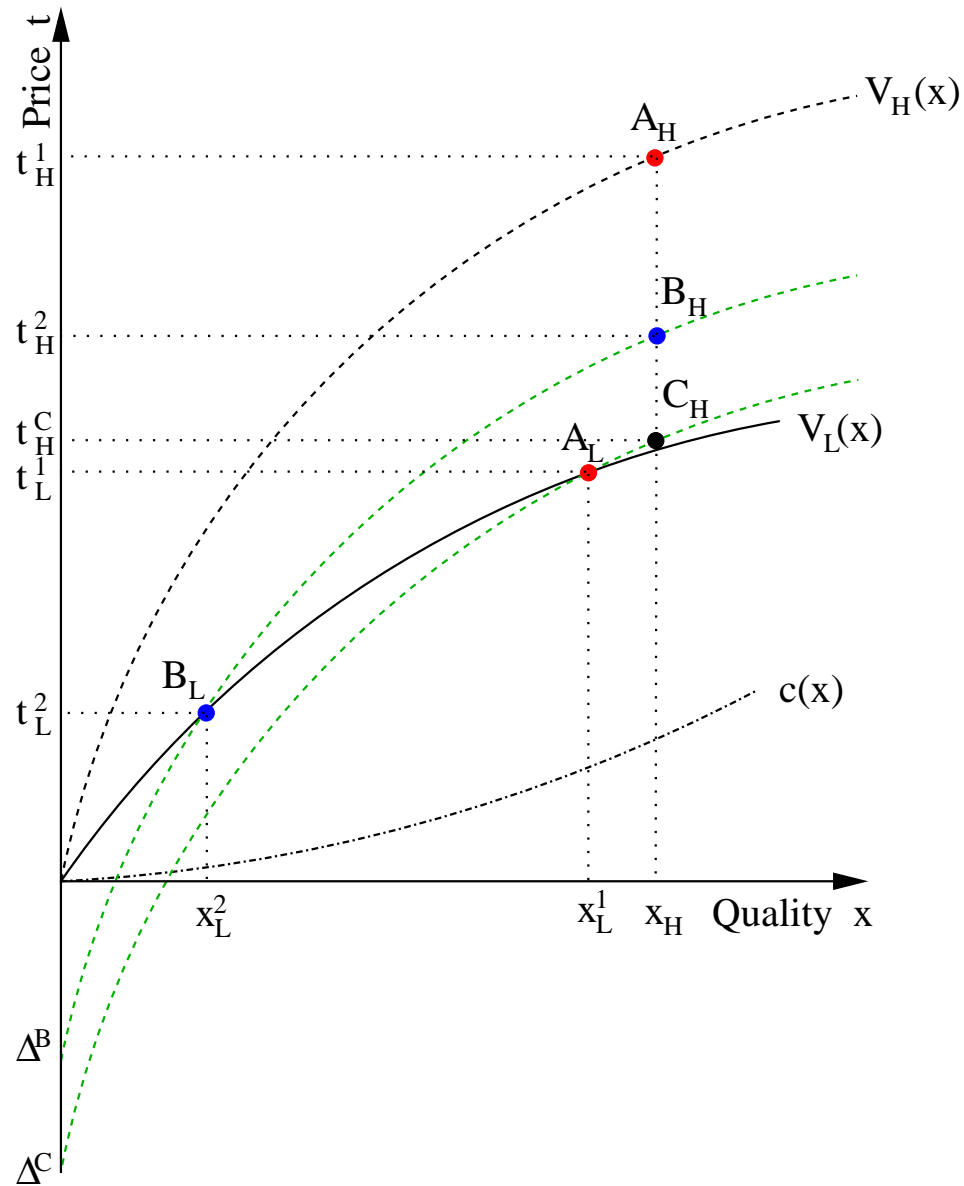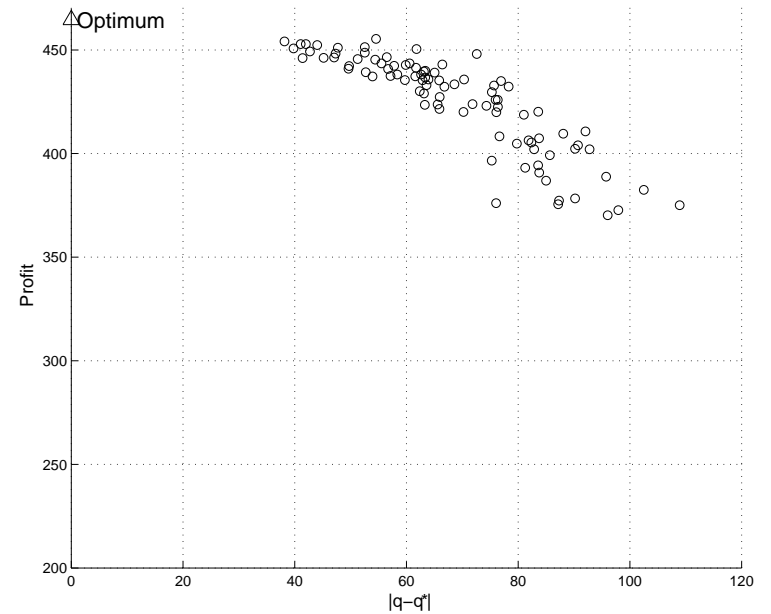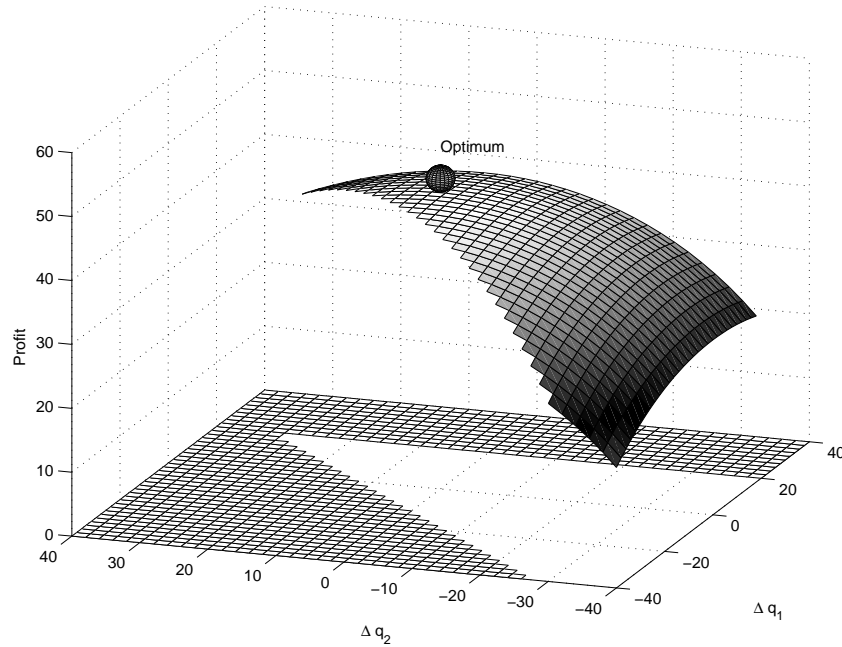
Illustration of nonlinear pricing

Illustration of optimal bundles

Research focus

- **Computation**: profit landscape, complexity and building features of problem to numerical method

- **Characterizing solution**: general utility functions (no single-crossing), what does the optimum look like, digraph interpretation

- **Limited information and learning**: uncertainty of buyers' utilities, finding what information is needed to solve the problem and methods producing information
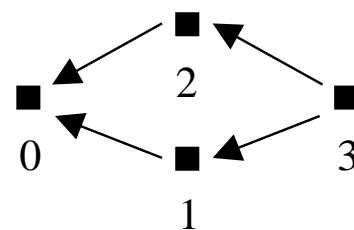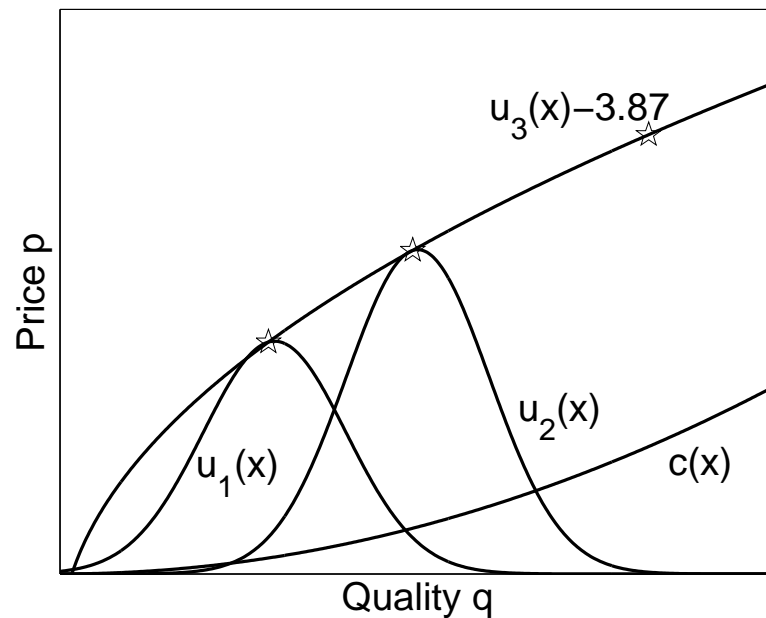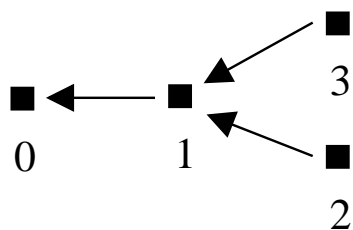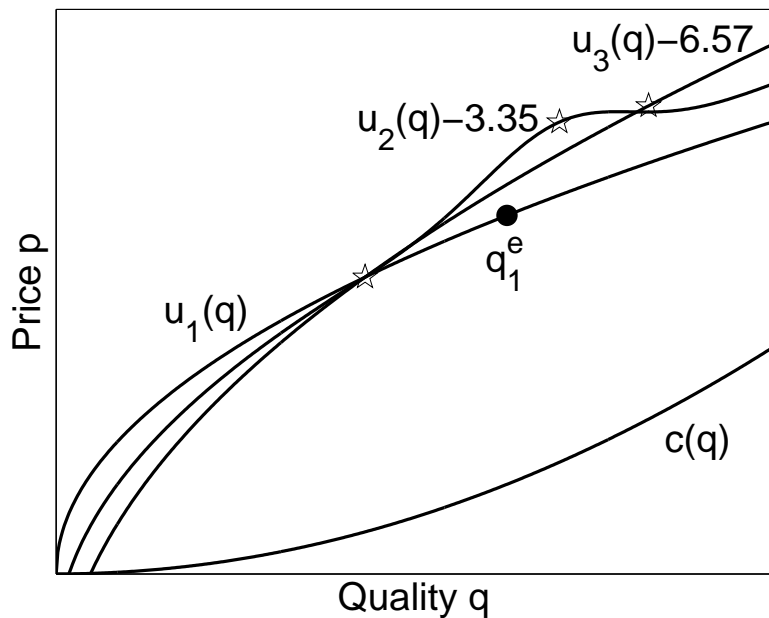
Profit Landscapes and visualization

Digraph presentation and its uses

- Structure of the solution

- Profitability and efficiency of bundles

- Sensitivity analysis

- Physical flow interpretation of Lagrange multipliers

Examples with digraphs

Demand estimation

- Uncertain about utility function shapes and parameters

- Especially in electronic commerce (few browser clicks)

- Segmenting, grouping buyers

- Inventing pricing methods that produce information

References

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- Ehtamo, Berg and Kitti. Adjustment scheme for nonlinear pricing problem with two buyers. 2008

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- Rochet and Stole. Economics of multidimensional screening. 2003