Competition and Investment in Telecommunications: Evidence from CRTC's Third-Party ISP Access

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Motivation

General Appeal:

1. Markets in which a network is necessary for provision of goods and services present particular challenges for regulators.
    - Dilemma: Increase market competition at the cost of future network investment.

IO/Telecom appeal:

2. How successfully does regulated access pricing fix market distortions?

Research Question

- Does regulated wholesale access pricing improve market outcomes for consumers in the Canadian Broadband market?
  - Do market prices respond to increased entry due to RWAP?
  - How is consumer welfare impacted?
  - To what degree is the incentive to invest in the network diminish?

Organization

1. Literature & Contribution
2. Industry Context
3. Structural Model
4. Data
5. Estimation
6. Results & Counterfactuals
7. Conclusion

Literature & Contribution

- Literature:
  - Besanko and Cui 2019 - Analyzes the welfare performance of Regulated Access pricing against privately negotiated access pricing.
  - Wilson, Xiao, and Orazem 2021 - Estimates the effect of delayed entry due to threat of many entrants on local market outcomes.

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  - Wilson, Xiao, and Orazem 2021 - Estimates the effect of delayed entry due to threat of many entrants on local market outcomes.
- Contribution:
  - Policy: Provide evidence of the competitive outcomes of the TPIA legislation in the Canadian Broadband market.
  - Literature: Provide novel empirical evidence of market outcomes and equilibrium effects of regulated access pricing in a telecom market.

Industry Context

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- The TPIA ruling allows the CRTC to set wholesale access prices at which non-network-owning third parties rent bandwidth from network-owning ISPs and resell to consumers.
- Now, the Canadian market is characterized by:
    - A few large multi-provincial ISPs that own and operate their own physical broadband network.
    - Many local third-party resellers who rent network bandwidth from network-owning ISPs.

Industry Context

Company	2011-2016	2016-2019	2019-2021
Bell MTS	2213	94.92	57.81
Bell Canada	2213	149.08	102.48
Shaw	-	296.10	251.14
RCCI	1251	319.68	224.32
Cogeco	2695	323.73	233.49
Videotron	1890	395.36	227.05
Eastlink	-	353.35	212.10

Table: Wholesale rate per 100 Mbps service in Canadian Dollars

- Takeaway: Government has been steadily and greatly decreasing wholesale access prices.

Model - Timing

- Three stage static game where:
  1. The regulator commits to a wholesale access price, w.
  2. The ISP commits to a level of bandwidth investment, $\bar{Q}$.
  3. The ISP and resellers compete in prices in the consumer market.
     - Consumers choose an internet plan and usage.

Model - Supply

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- There is 1 incumbent ISP (j) who chooses a level of investment, $\bar{Q}$, and their plan price, p_j, to maximize profits

$$\Pi_j(p, \bar{Q}) = p_j s_j(p, \bar{Q}) + w \sum_k s_k(p, \bar{Q}) - \gamma(\bar{Q})$$

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- There are n possible identical Reseller firms, k, who choose plan prices, p_k, to maximize their profits

$$\Pi_k(p, \bar{Q}) = (p_k - w) s_k(p, \bar{Q}) - \phi$$

where ϕ is the fixed cost of entry. Resellers enter until $\Pi_k(p, \bar{Q}) < 0$.

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Model - Demand

I use a Nested Logit model of demand under the following specification:

$$v_{ij} = E[u_i(q_i|\lambda_i)] - \alpha_i p_j + \beta_i \mathbb{1}_{incumbent} - \frac{\kappa_i}{\psi_j c(\frac{Q}{\bar{Q}})} + \epsilon_{ij}$$

$$u_i(q_i|\lambda_i) = q_i - \frac{q_i^2}{2\gamma_i}, \ \ \gamma_i \sim exp(\lambda_i)$$

- $E[u_i(\lambda_i)]$ is expected utility of internet usage.
- κ_i is the preference for speed.
- ψ_j is the download speed for plan j.
- $\psi_j c(\frac{Q}{\bar{Q}})$ is realized speed when congested (engineering relationship).
- ϵ_{ij} is the condensed nested logit error term.

Data

- Plan choice and usage data from a Canadian ISP, Jan. 2020 - May 2022, from a representative sample of consumers.
  - Plan Data: Download/Upload Allowance, monthly price of plan, plan switches. All observations are residential consumers.
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  - Plan Data: Download/Upload Allowance, monthly price of plan, plan switches. All observations are residential consumers.
  - Usage Data: 5 minute averages of megabits downloaded over the entire sample period.
- Biweekly aggregate reseller data, Jan. 2020 - Sep. 2021, from the entire network
  - Plan speeds and prices.
  - Number of reseller customers using network during peak usage.
  - Total network burden (in Mbps) of reseller customers.
  - Percent of traffic reseller customer's represent on the network during peak times.

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  1. Discretize the parameter space and start with a uniform prior belief across candidate types (i.e., a $(\lambda_i, \alpha_i, \beta_i, \kappa_i)$ four tuple).
  2. For each household in the data, compute likelihood that plan and usage choices are generated by each candidate type.
  3. Calculate posterior distribution over candidate types for each household.

Estimation Details

The likelihood that type i is generated by plan and usage choices is:

$$\mathcal{L}_h(\theta_i) = \prod_{t=1}^{T} P(J_{ht} = j|\theta_i) \times P(q_{ht} = q|\theta_i)$$

$$P(J_{ht} = j|\theta_i) = \frac{exp\left(\frac{V_{ij}}{1-\sigma}\right)\left[\sum_{k \in B_g} exp\left(\frac{V_{ik}}{1-\sigma}\right)\right]^{-\sigma}}{1 + \sum_{k \in B_g} exp\left(\frac{V_{ik}}{1-\sigma}\right)^{1-\sigma}}$$

$$P(q_{ht} = q|\theta_i) = f(q_{ht}|\lambda_i)$$

The posterior probability that household h is type i:

$$\omega_{hi} = \frac{\mathcal{L}_h(\theta_i)}{\sum_{m=1}^{I} \mathcal{L}_h(\theta_m)}$$

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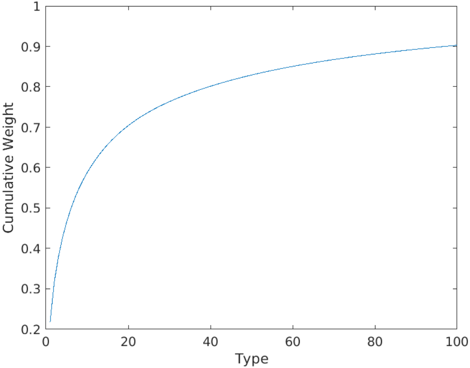
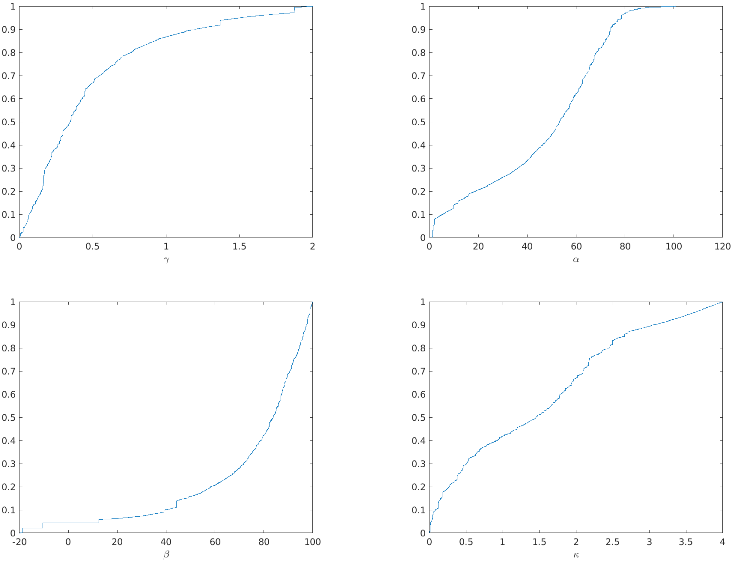
Results - Posterior Distribution



- The top 100 out of 10000 most likely types account for about 90% of likelihood mass.

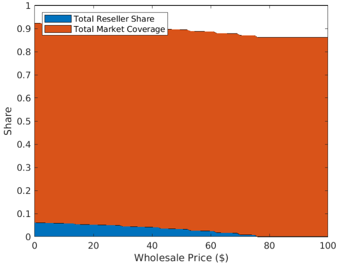
Results - Marginal Distributions of Parameters

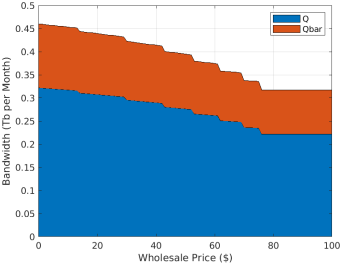


Counterfactuals

- Now with estimated parameters in hand:
  1. Feed the parameters back into the structural model.
  2. Simulate equilibria for varying levels of wholesale price only allowing the firms to offer one 300 Mbps plan each.
  3. Report equilibrium outcomes under different wholesale prices.

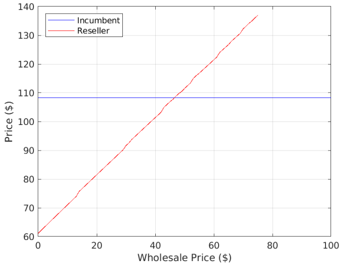
Counterfactuals





- At the lowest wholesale price ($0), resellers do not garner more than 8% market share.
- The loss in resellers at higher wholesale prices leads to a marginal loss of lower value/high volume users.

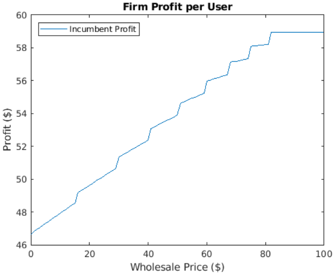
Counterfactuals

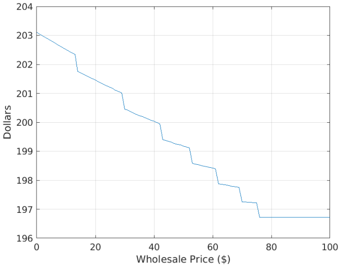


Figures/Resellerspng.png

- As wholesale price increases, the # of resellers in equilibrium decreases.
- Competitiveness of reseller prices are highly dependent on w.
- The incumbent's price is affected minimally by reseller competition.

Counterfactuals





- Low wholesale prices have a significant impact on profit per user.
- Due to the consumers pushed out of the market being those with low surplus, consumer surplus only marginally decreases.

Conclusions

- Overall, the TPIA has seems to have little positive impact for the majority of consumers in this market.
- Regulated access pricing does succeed in providing a lower cost alternative.
- However, due to low market uptake of reseller plans and the low marginal surplus of those that switch to the outside option, consumer surplus was not significantly impacted.
- Nor does the incumbent significantly compete in prices with the resellers.
- Next Steps:

Next Steps

- Additional Counterfactuals:
  - What happens to equilibrium outcomes if the incumbent does not have a large preference advantage over resellers?
  - Simulate equilibrium behavior for a scenario in which the regulator introduces RWAP after the investment decision.