Reference Pricing and Consumption Inequality

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Stanford University Macro Lunch

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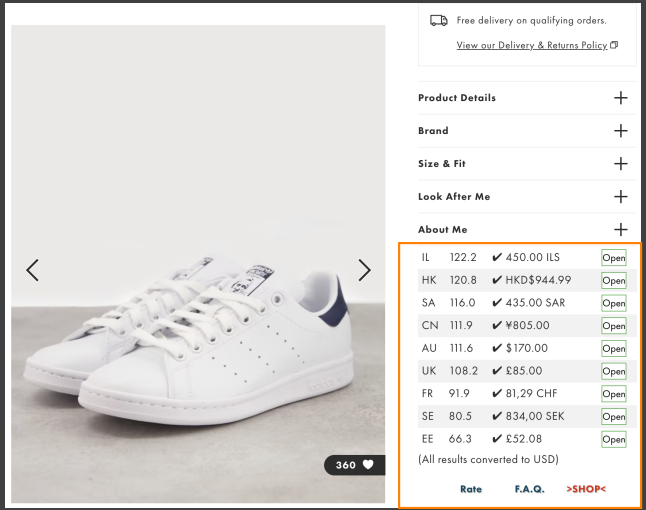
Motivation

- In 2015, the EU proposed the Digital Single Market Strategy
  - Stipulates that virtual borders across Europe be removed
  - Further imposes that retailers charge identical prices to all EU customers
  - Advocates of this policy cite increased competition and market access
  - Distributional concerns of such policies have not been seriously considered
- Even without this policy, digital store borders are typically not enforced
  - Individuals are able to select their virtual location
  - Yet retailers choose to maintain different cross-country prices
  - Retailers are pushed to standardize prices across countries

Key Mechanism: Endogenous Market Choice

- Price sensitive customers can change their digital market and access cheaper prices
- Cheaper international markets allow for price discrimination *even within the same country*
- Closest analogy is pharmaceuticals



This Paper

- Documents new empirical patterns where firms use imperfect geo-blocking as a tool to price discriminate in wealthy markets
- Rationalizes the firms' decision to allow this arbitrage
- Motivated by the empirical patterns, develops a model that embeds the endogenous location choices of heterogeneous customers
- Estimates the model on the video game market

Literature Review

- Violations of Law of One Price
  - Simonovska (2015), Crucini and Yilmazkuday (2014), Fajgelbaum et al (2011)
  - Contribution: in digital settings, cheaper markets enable price discrimination
- Reference Pricing
  - Dubois, Gandhi, and Vasserman (2022), Danzon and Chao (2000)
  - Contribution: cheaper online markets can act as reference prices
- Allocative Effects of Exchange Rate Shocks
  - Engel (2006), Drenik and Perez (2021), Cravino (2018), Gopinath et al (2011)
  - Contribution: exchange rate shocks change *where* goods purchased

Empirical Application

The Video Game Market

- Steam is the largest PC video game retailer in the world, holding a 75% market share
  - "Amazon" of video games
- Video games are the largest global digital media market.
- Steam operates in many countries, including pricing in over 40 currencies

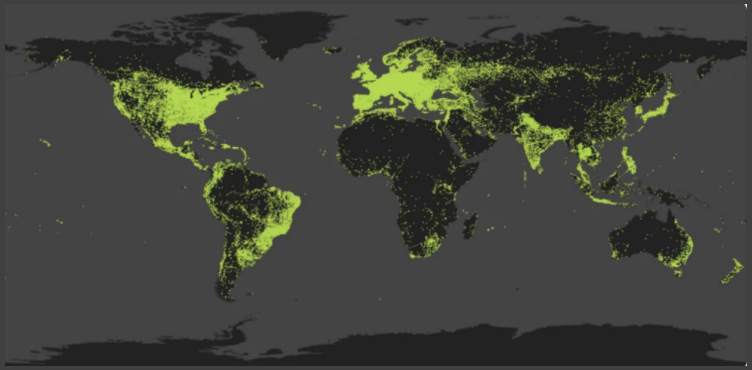


Figure: Map of Steam Users (2016)

Model Assumptions

- My model generates predictions when:
  - Customers are heterogeneous Heterogeneity
  - Exchange rate shocks occur Currency Volatility
- On the supply side, the model assumes:
  - No transport costs
  - Provision of identical products across markets
  - Extreme nominal price rigidity Rigidity
  - Goods cannot be resold across consumers

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  - Goods cannot be resold across consumers
- The video game market is an *ideal setting* Market Size

Cross-Country Price Variation

Currency ↓↑	Current Price	Converted Price ↓↑	
U.S. Dollar	$59.99	$59.99	
Uruguayan Peso	$U1649	$39.33	-34.44%
CIS - U.S. Dollar	$39.99	$39.99	-33.34%
LATAM - U.S. Dollar	$39.99	$39.99	-33.34%
MENA - U.S. Dollar	$39.99	$39.99	-33.34%
South Asia - USD	$39.99	$39.99	-33.34%
Indian Rupee	₹ 3399	$40.64	-32.25%
Taiwan Dollar	NT$ 1299	$41.00	-31.64%
Philippine Peso	₱2299.00	$41.12	-31.45%
Japanese Yen	¥ 5990	$41.23	-31.26%
Ukrainian Hryvnia	16998	$41.32	-31.12%
Kazakhstani Tenge	19900₸	$41.60	-30.65%
Hong Kong Dollar	HK$ 329.00	$42.29	-29.50%
Peruvian Sol	S/.159.00	$42.44	-29.25%
Chinese Yuan	¥ 298	$42.49	-29.16%
Kuwaiti Dinar	13.00 KD	$42.59	-29.00%
Colombian Peso	COL$ 179000	$42.70	-28.81%
Indonesian Rupiah	Rp 649999	$42.92	-28.45%
U.A.E. Dirham	159.00 AED	$43.28	-27.84%
Mexican Peso	Mex$ 849.99	$43.30	-27.82%
South African Rand	R 749.00	$43.47	-27.53%
Vietnamese Dong	1090000₫	$44.31	-26.12%
South Korean Won	₩ 59000	$44.76	-25.39%
Singapore Dollar	S$59.00	$45.92	-23.45%
Thai Baht	฿1499.00	$46.24	-22.90%
Chilean Peso	CLP$ 43000	$47.46	-20.88%
Saudi Riyal	179.00 SR	$47.72	-20.45%
Qatari Riyal	175.00 QR	$48.07	-19.86%
Malaysian Ringgit	RM199.00	$48.27	-19.53%
Costa Rican Colon	₡27900	$53.21	-11.30%
Israeli New Shekel	₪199.00	$53.91	-10.13%
Australian Dollar	A$ 79.95	$54.99	-8.32%
Canadian Dollar	CDN$ 74.99	$55.60	-7.32%

Data Sources

- Game price histories scraped from SteamDB in various currencies
  - Currencies: USD, Euro, Turkish Lira, Argentinian Peso, Brazilian Real, Colombian Peso, Japanese Yen, Uruguayan Peso, Chilean Peso, British Pound, Israeli New Shekel, and the Chinese Yuan
  - Characteristics: International release dates, developer, genre, AAA status

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- Household Consumption Survey from Argentina
  - includes demographic information and expenditures
  - explicitly asks about video game purchases

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- Country-Level Quantities* from Steam Spy and Google Trends
  - I observe country-level purchases of each game over time in the US
  - I observe aggregate purchases over multiple smaller markets (e.g. Argentina)
- Currency data from FRED

Model

Customer Location Choice

- Each period, customers observe a good's characteristics, a global menu of prices, and exchange rates (e_t)
- Customers choose a good-market pair
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- For good j, the home customer solves:

$$U_{ijt} = \max\{\underbrace{u_{ij} - \alpha \underbrace{p_{hj}}_{\text{H price}}}_{\text{Purchase at home}}, \underbrace{u_{ij} - \alpha \underbrace{\frac{p_{fj}}{e_t}}_{\text{F price}} (1+\kappa_i) - \tau_i}_{\text{Purchase in foreign}}\}$$

Incentive Constraints

- Suppose home is a larger, wealthier market
- Let η be the observed gap in prices $p_h = (1+\eta)p_f$
- A separating equilibrium obtains when:

$$\alpha p_f \left(1 + \eta - \frac{(1+\kappa_i)}{e_t}\right) \leq \tau_i$$

- This is a threshold rule on τ_i Comparative Statics
- The firm internalizes the customer's incentive constraints in determining their price veector
- Customer heterogeneity motivates the firm to price discriminate

Global Prices and Consumer Surplus

- Total revenue can be decomposed into contributions from four "types"

  Total Revenue

- The firm solves for a global price vector via a fixed point that trades off:
  - Market expansion effect from the price sensitive group: home customers attracted by the lower prices
  - Decreased revenue decrease from the savvy group: home customers that instead purchase in foreign
- Both savvy and price sensitive customers gain from unified markets
- The price sensitive group consumes *more* similarly to other home market customers
- Consumer surplus of foreign customers *decreases* relative to fully segmented markets

Exchange Rate Shocks

- Sticky prices $\rightarrow$ exchange rates move relative prices
- Suppose there is a shock to exchange rates at time t, i.e. e_t rises:

$$\alpha p_f \left(1 + \eta - \frac{(1+\kappa_i)}{e_t}\right) \leq \tau_i$$

- Under an exchange rate shock, the incentive constraint is *harder* to satisfy

Simulations

Dollarization and Steam's Policy Change

- The model predicts that the incentive constraints become more difficult to satisfy when there are exchange rate shocks
- When exchange rate shocks are more frequent than price changes, the firm anticipates possible exchange rate trends
- To reduce arbitrage, the firm can either:
  1. Reduce price gap η Model
  2. Price in the home currency (e.g. dollars)
- Under a stable exchange rate, (2) is never optimal Proof
  - Firm cedes currency exchange frictions that customers face

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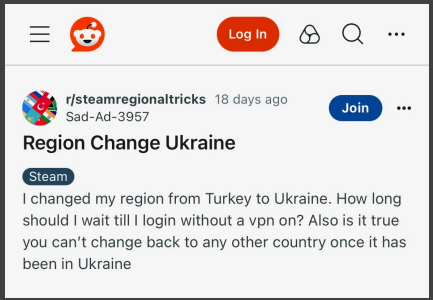
- October 25, 2023: Steam announces that all sales in Argentina and Turkey will be in US Dollars starting November 20, 2023
- The policy change reset cross-country price gaps *and* currency simultaneously

Parameterization

- I estimate α in both countries using logit Estimate α
- I estimate η from the empirical distribution of price gaps between the US and Argentina post-policy change Estimate η
- I estimate κ from the empirical distribution of price gaps between the US dollar and Argentinian peso prices in the month prior to the policy change Estimate κ
- I also estimate κ by comparing the price gaps between the US and Argentina at the time of the game's release with the price gaps following the dollarization policy change

Post Dollarization

- Since Argentina and Turkey dollarized their prices, they are no longer the cheapest locations
- I am currently scraping the "r/steamregionaltricks" subreddit
- Captures perceptions of the cheapest exchange rate-weighted market
- Currently, Ukraine is the cheapest such market



Conclusion

- I document a new empirical pattern that firms intentionally allow price-sensitive consumers to access lower developing-market prices
- I show that customers select their digital purchase "location" according to a cross-country menu of prices
- I develop a model to rationalize these new empirical findings
- In progress: counterfactuals
  - Fully segmented market benchmark
  - Digital Single Market benchmark

Appendix

EU's Digital Single Market

- The EU's Single Digital Market prohibits geoblocking to ensure equal access to digital goods.
- Cross-country price differences for video games remain substantial, despite regulatory efforts.
- Increased competition and access to consumer goods are key goals of the Single Digital Market.

Back

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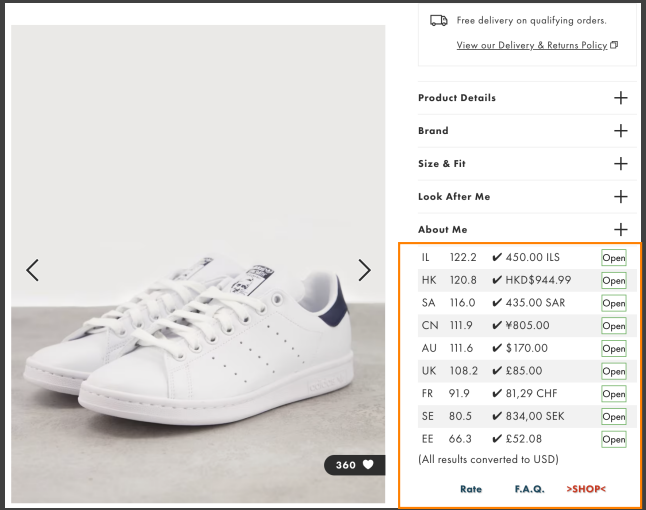
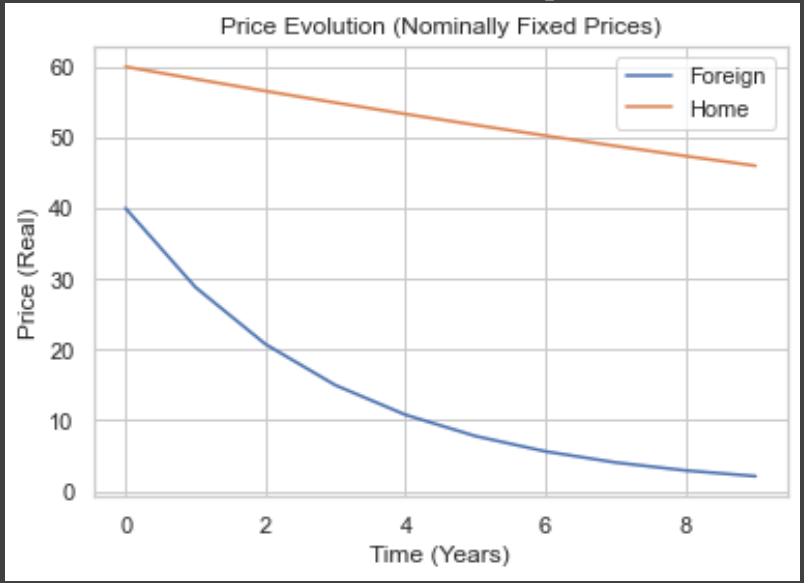


Movements of Relative Prices Example



Back

Total Revenue

- The firm chooses prices p_H and p_F to maximize total revenue:

$$M_H \sum_t \beta^t p_H \int_i \underbrace{1\left\{\alpha p_F \left[1+\eta-\frac{(1+\kappa_i)}{e_t}\right] \leq \tau_i\right\}}_{\text{Arbitrage is not profitable}} \underbrace{1\left\{u_i \geq \alpha p_H\right\} d_i}_{\text{Buy at H price}}$$

Well-behaved home market customers

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Home customers that would buy at home, but instead buy abroad – savvy group

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Home customers that won't buy at home, but will buy at foreign prices – price sensitive group

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Home customers that won't buy at home, but will buy at foreign prices – price sensitive group

$$+ M_F \sum_t \beta^\dagger \frac{p_F}{e_t} \underbrace{\int_i \mathbb{I}\{u_i \geq \alpha p_F\}}_{\text{Buy at F price}}$$

Well-behaved foreign customers Back

Microfounding τ_i

- τ_i is the hassle cost of accessing a foreign market's prices
- τ_i is a linear combination of the true hassle cost to change the store location and the possibility of getting purchases revoked
- In empirical application, some share of accounts get flagged as purchasing in the incorrect region
- These account holders have to produce a credit card that corresponds to the region of purchase to "verify" their eligibility
- The punishment for getting flagged is losing access to library for some period of time
- This is costlier for users with a larger library, which suggests the policy may be well targeted

Back

Simulation Results

- I simulate time to first arbitrage opportunity for the full matrix of κ-τ pairs within the reasonable range of parameters
- κ does not matter much relative to the fixed hassle cost τ Back

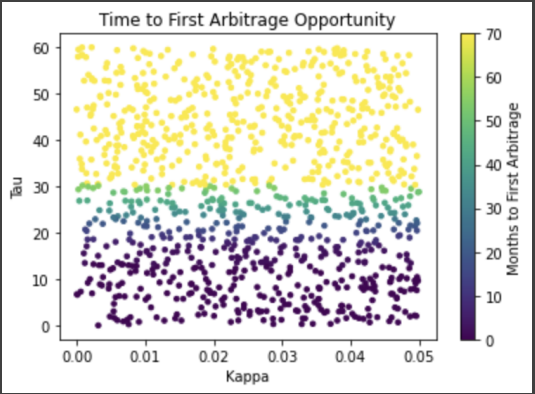
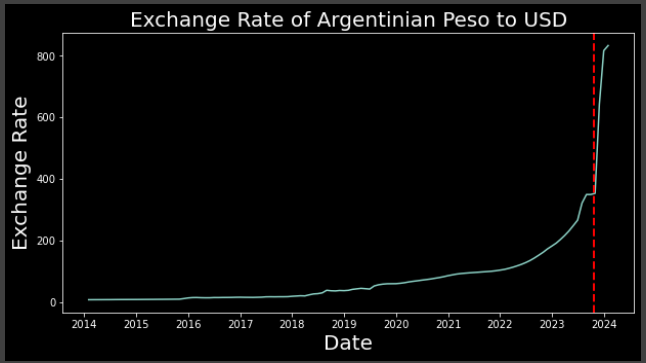


Figure: May change this

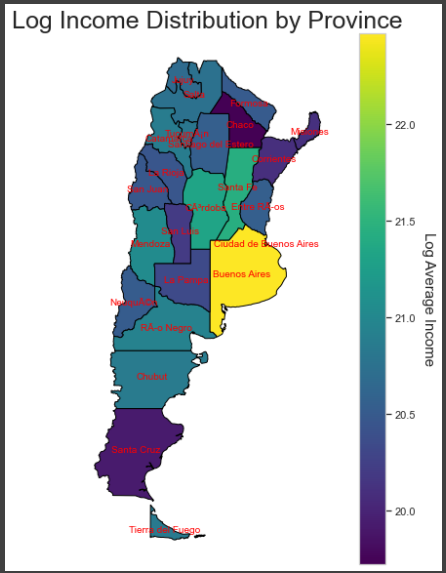
Demand-Side Assumption: Volatility

- Currency volatility exacerbates the tradeoff between arbitrage and price discrimination
- Consider Argentina Back



Demand-Side Assumption: Heterogeneity

- Customer heterogeneity creates price discrimination motives
- US customers are heterogeneous
- Argentinian customers also exhibit high heterogeneity Back



Demand Estimation Results: Argentina

Table: Estimation Results

	Coefficient	Confidence Interval
constant	-3.597***	
	(0.258)	[-4.102, -3.092]
AAA	1.316***	
	(0.261)	[0.804, 1.828]
price	-0.600***	
	(0.092)	[-0.781, -0.420]

Table: *

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses.
Developer-level fixed effects are included.

Back

Demand Estimation Results: US

Table: Estimation Results

	Coefficient	Confidence Interval
constant	-3.191***	
	(0.188)	[-3.561, -2.821]
AAA	.636***	
	(0.114)	[0.412, 0.860]
price	-0.051***	
	(0.009)	[-0.070, -0.033]

Table: *

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses. Developer-level fixed effects are included.

Back

Incentive Constraints: Implications

$$\alpha p_f \left(1 + \eta - \frac{(1+\kappa_i)}{e_t}\right) \leq \tau_i$$

- u_{ij} drops out because goods are *identical* across markets
- Reducing η slackens the incentive constraint
- Given draws of κ_i, τ_i, the firm can set prices to satisfy the incentive constraint
  - Customer heterogeneity motivates the firm to price discriminate Back

Home vs Foreign Pricing

- Under a stable exchange rate, if the firm prices in home's currency, the IC is:

$$p_h \leq p_f + \frac{\tau_i}{\alpha}$$
$$(1+\eta)p_f \leq p_f + \frac{\tau_i}{\alpha}$$

$$\alpha p_f \eta \leq \tau_i \tag{1}$$

- Under a stable exchange rate, if the firm prices in foreign's currency, the IC is:

$$p_h \leq p_f(1+\kappa_i) + \frac{\tau_i}{\alpha}$$
$$\alpha p_f \left(1+\eta-(1+\kappa_i)\right) \leq \tau_i$$

$$\alpha p_f(\eta-\kappa_i) \leq \tau_i \tag{2}$$

- For κ_i positive, (2) is a smaller area than (1)

Back

Argentina's Video Game Market

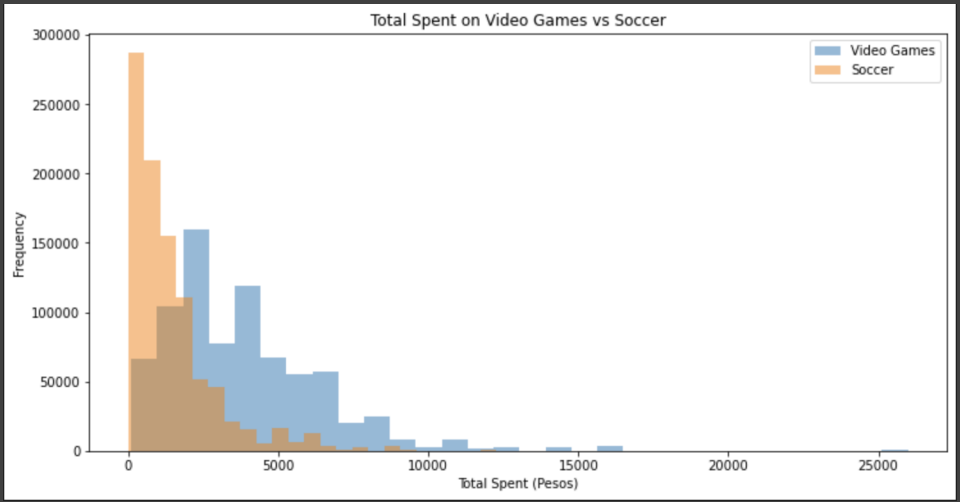
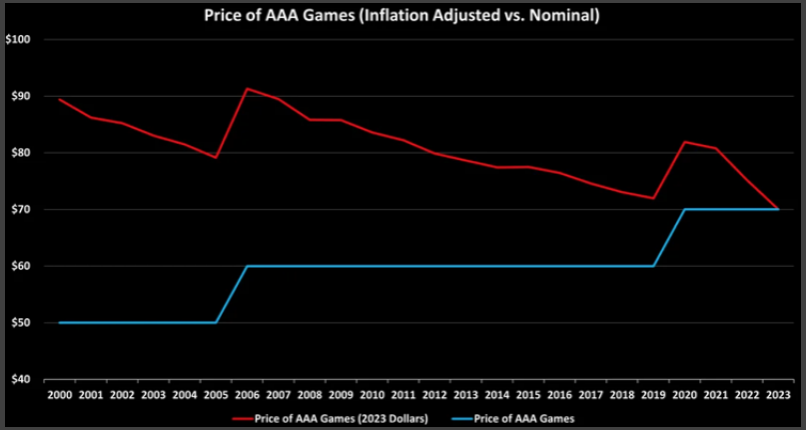


Figure: Argentinians spend more on video games than on soccer Back

Nominal Price Rigidity

- Nominal prices for AAA games do not move much over time Back



Demand Estimation: Argentina

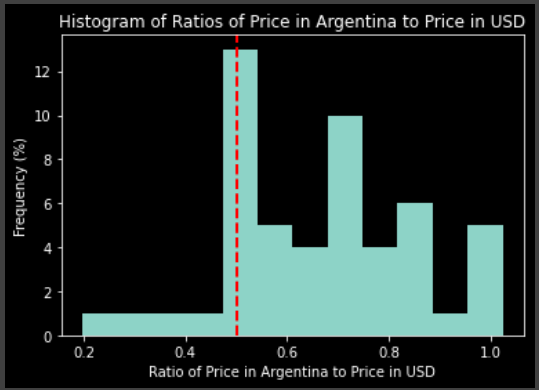
- Discrete choice in each period between buying a game or selecting the outside option
- Think of each choice as a game-market pair
- Estimate a logit demand model with indirect utility:

$$u_{idjt} = \alpha ln p_{jt} + \beta \text{AAA}_j + \phi_d + \mu_t + \xi_{jt}$$

- I estimate separately for Argentina and for the US
- Coefficient on price is -.600 (se: 0.092)
- Coefficient on AAA is 1.316 (se: 0.261)
- Full demand estimation results AR Demand Estimation Back

Recovering η

- As part of the policy change, developers were given a suggested USD price: 50% of the US price
- Even if they selected the default, the developers still had to make an active markdown choice Back



Recovering κ

- Some games posted prices both in US dollars and Argentinian pesos in the month prior to the policy change
- The hassle cost to access either of these Argentinian prices is identical
- Remaining price gaps come from κ in my model
- I use the last observed US price prior to the policy change Back