What can online prices teach us about exchange rate pass-through and the law of one price?

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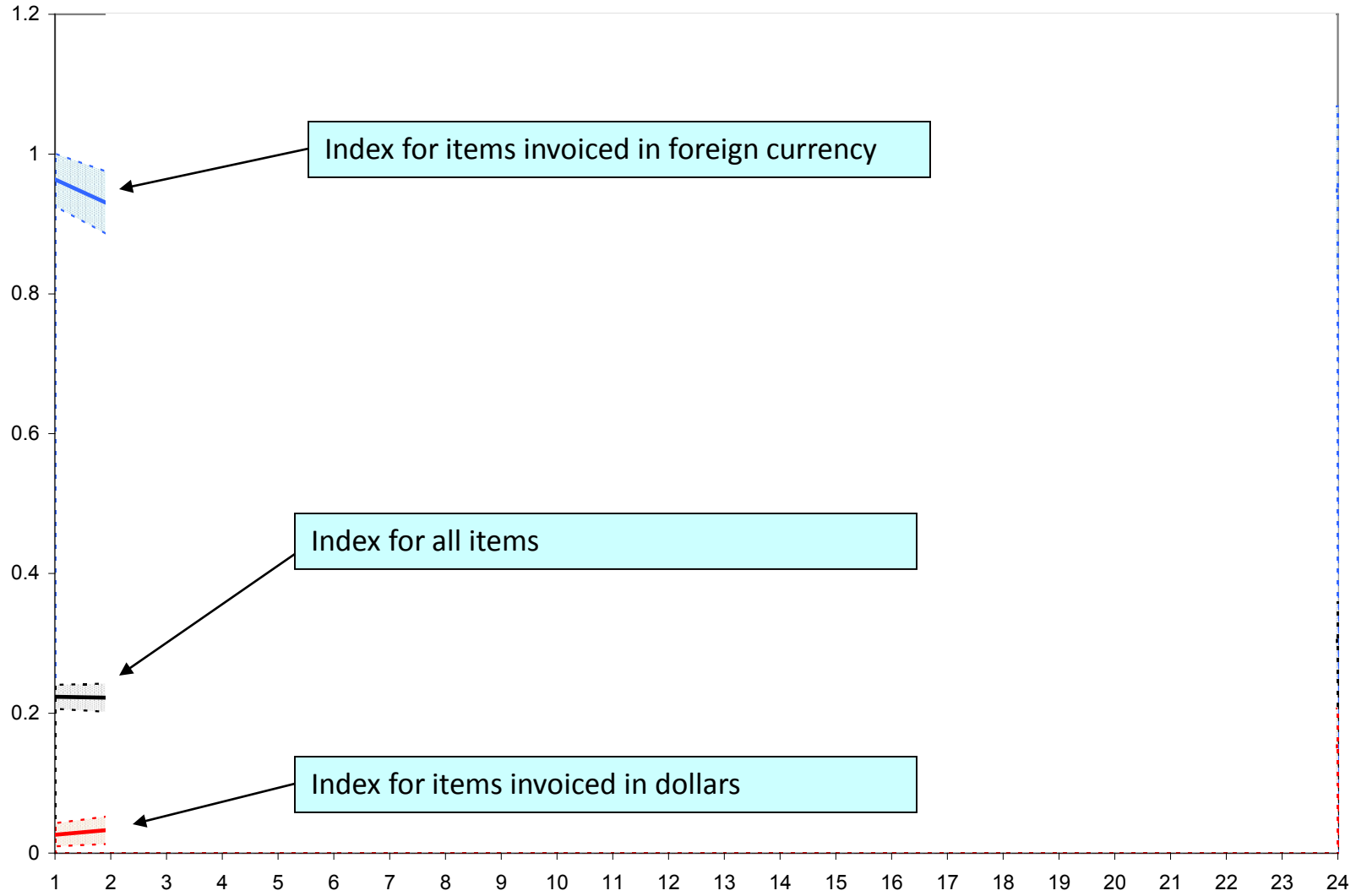
What have we learned?

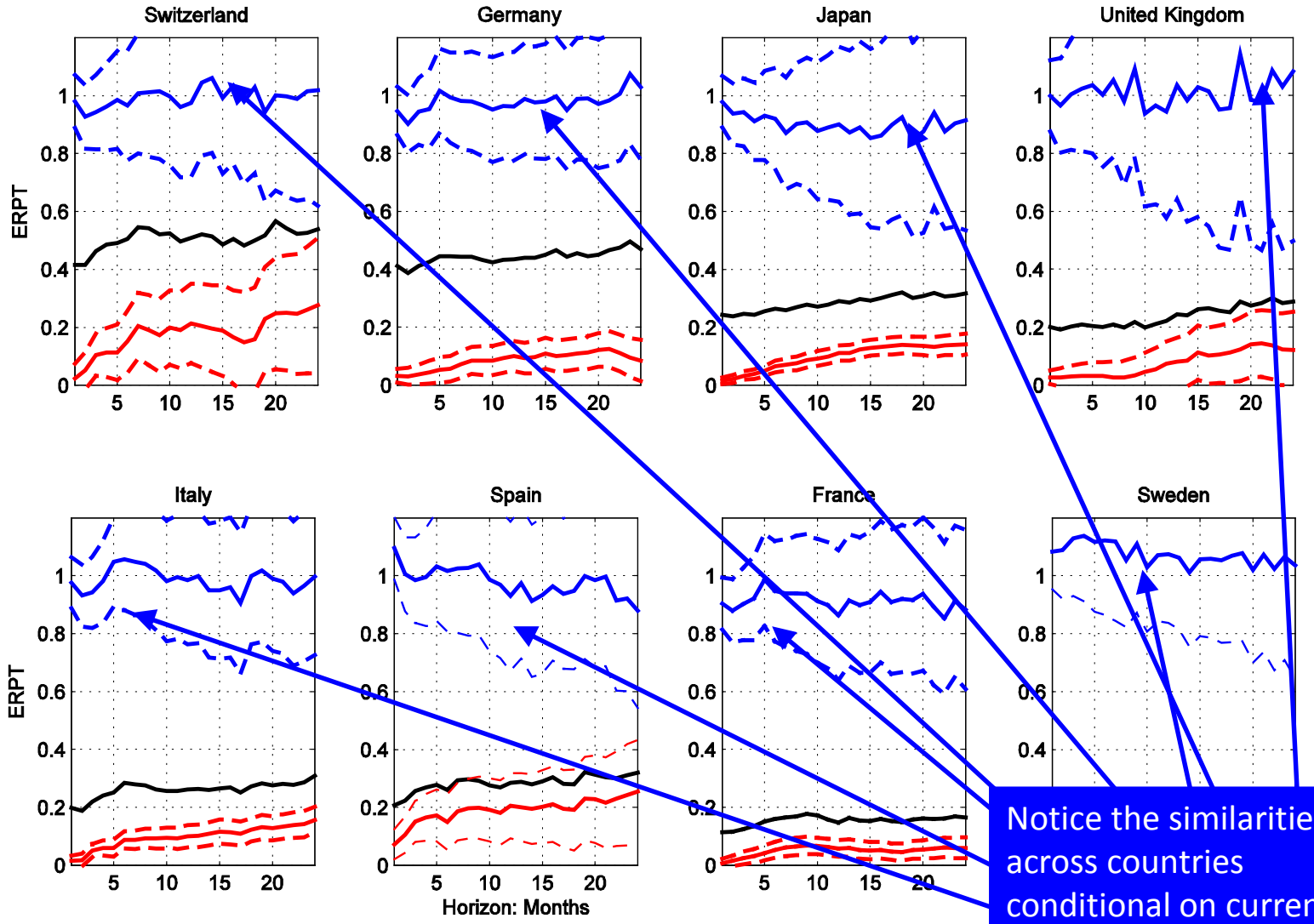
- Aggregate indexes
  - Small responses and slow
- Micro Data
  - Heterogeneous responses
  - PT conditional on tradability
  - PT tends to be non-linear
  - PT conditional on the currency of denomination
  - PT conditional on the exchange rate regime
  - PT at product introduction: mixed evidence
- Marketing aspects largely ignored!
  - Quantum Prices

Currency of Denomination and Exchange Rate Regime

Pass-Through: Polled Data



Pass-Through: By Country

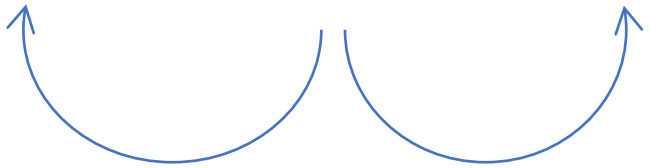


Notice the similarities across countries conditional on currency of invoicing

Real Exchange Rate at good-level

- $p_i(z,t)$ is log price of z in country i in week t
- $e_{ij}(t)$ is log exchange rate (units of currency i per unit of j's)
- $q_{ij}(z,t)$ is the log of the good-level RER:

$$q_{ij}(z,t) = p_i(z,t) - e_{ij}(t) - p_j(z,t)$$

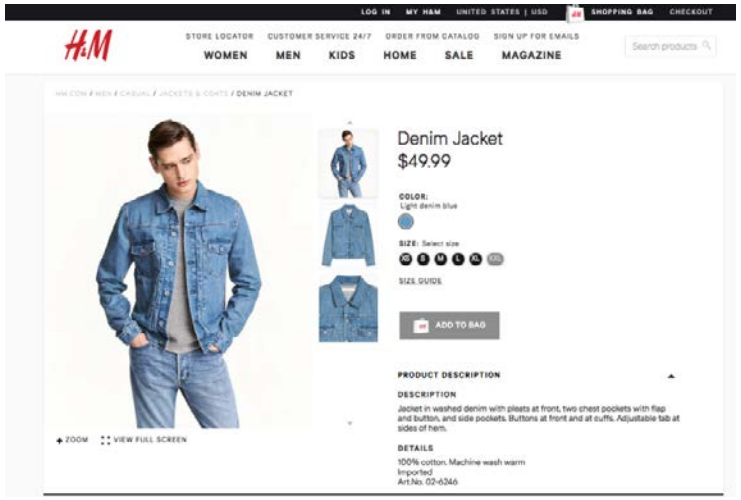


Relative Prices

Price: 49.90
Product: 4081762

Price: 29.99
Product: 4081762

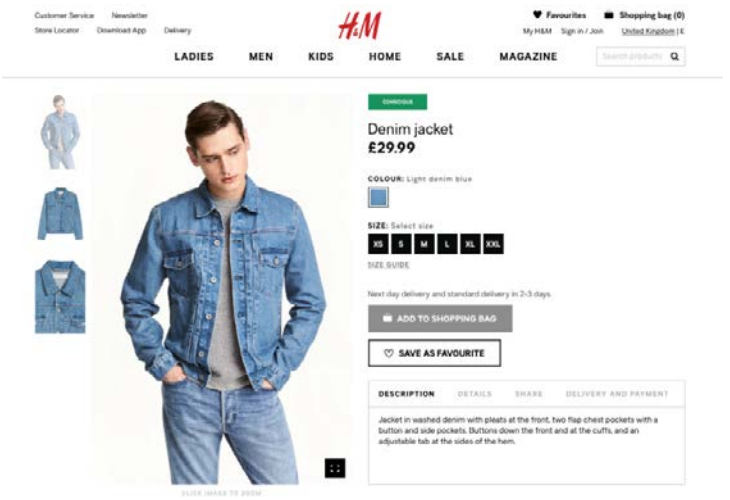
$\frac{49.90}{29.99}=1.664$



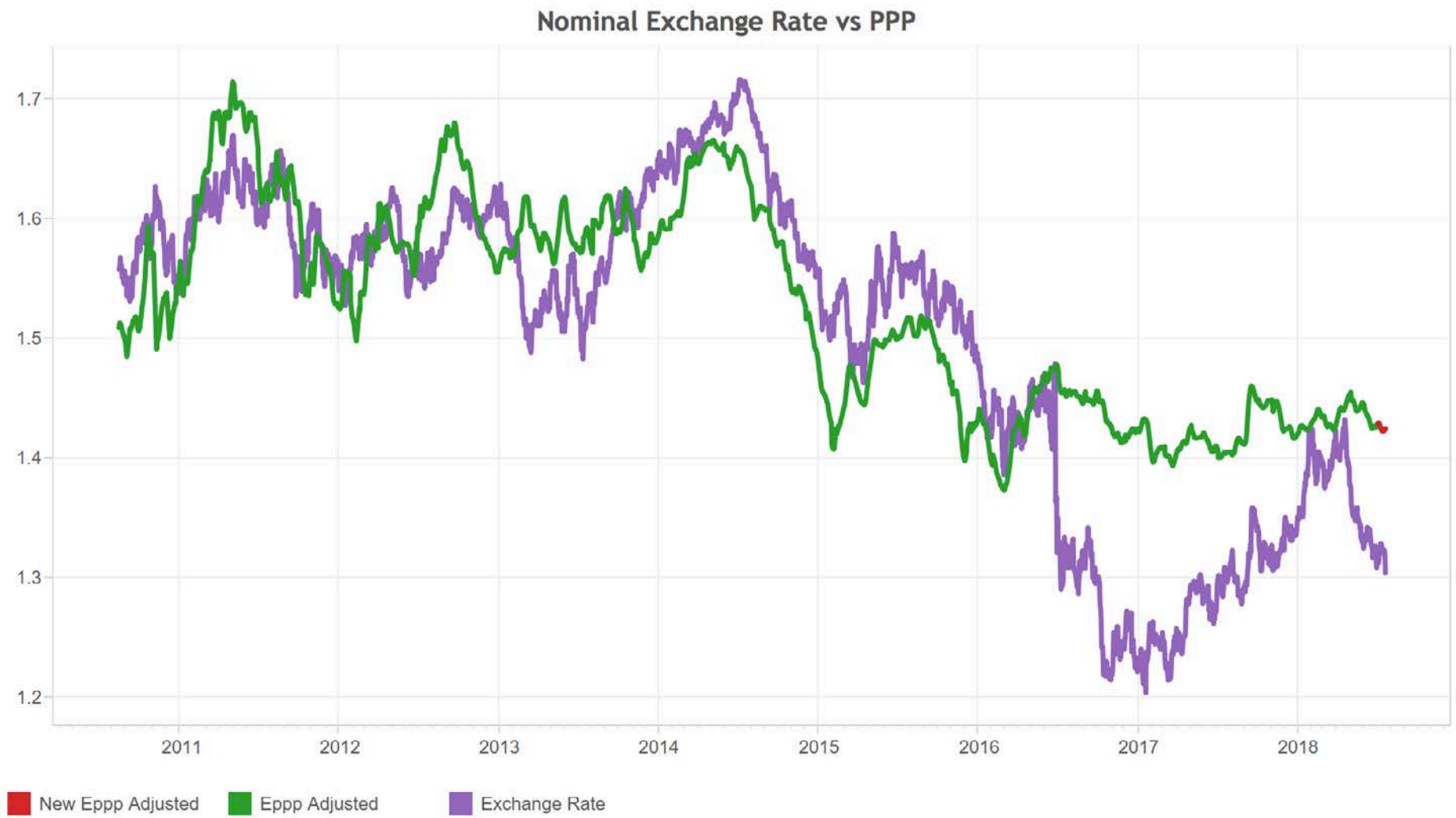
Price: 49.99
Product: 70136

Price: 29.99
Product: 70136

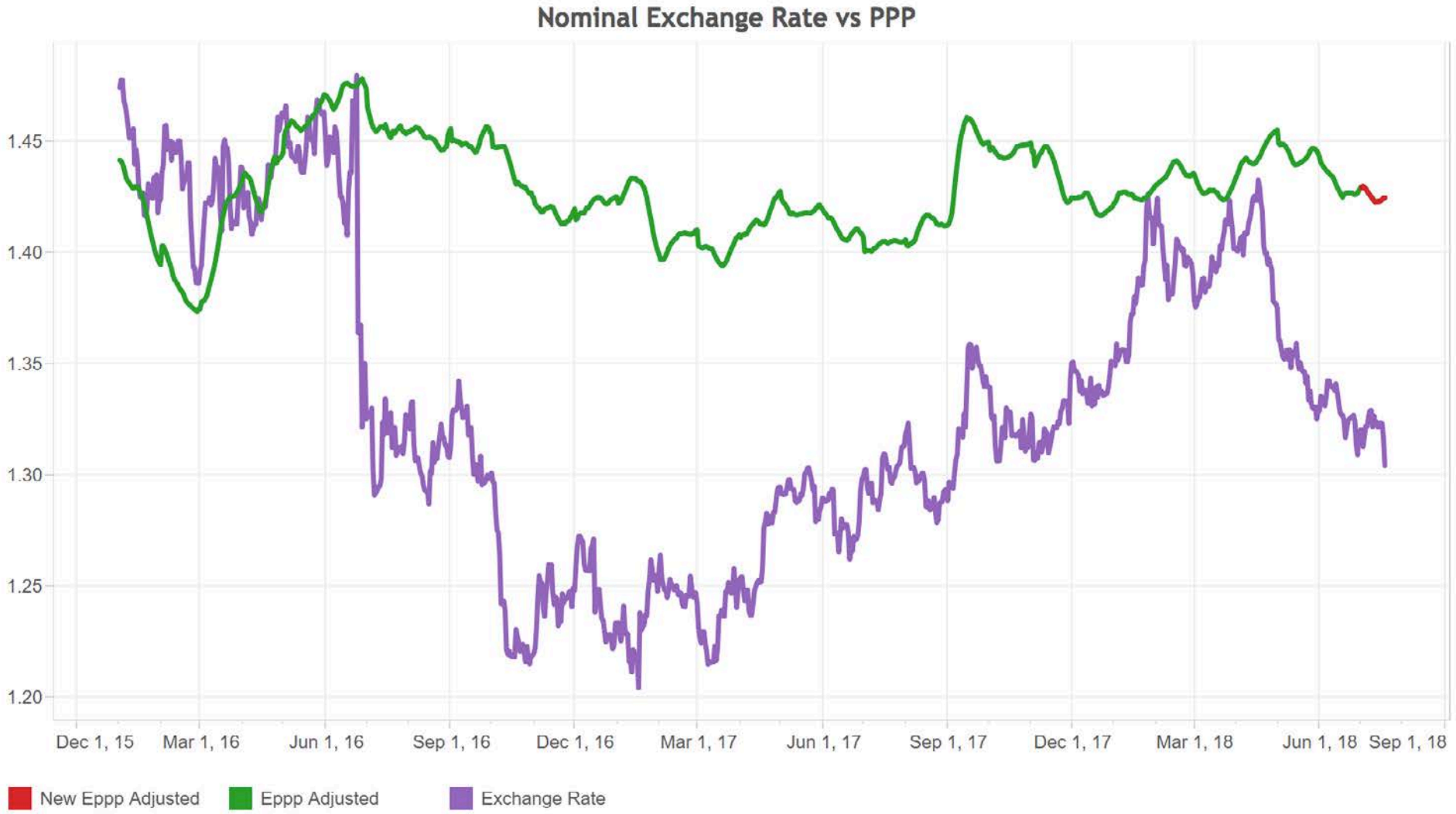
$\frac{49.99}{29.99}=1.667$



UK


Nominal Exchange Rate vs PPP
1.7
1.6
1.5
1.4
1.3
1.2
2011
2012
2013
2014
2015
2016
2017
2018
New Eppp Adjusted
Eppp Adjusted
Exchange Rate

UK (3 years)


Nominal Exchange Rate vs PPP
1.45
1.40
1.35
1.30
1.25
1.20
Dec 1, 15
Mar 1, 16
Jun 1, 16
Sep 1, 16
Dec 1, 16
Mar 1, 17
Jun 1, 17
Sep 1, 17
Dec 1, 17
Mar 1, 18
Jun 1, 18
Sep 1, 18
New Eppp Adjusted
Eppp Adjusted
Exchange Rate

Decomposing Pass-Through

- Construct real exchange rates at narrowly defined categories

$$\ln\left(rp_t^{yz}\right) = \alpha^{yz} + \beta \ln\left(e_t^{zy}\right) + \epsilon_t^{yz},$$

- How much is due to identical items?
- How much is due to extensive margin?

PPP decomposition

Price Measure	Relative Price Regressions					Price Regressions
	3 Sectors	Ex-Fuel	Food	Fuel	Electronics	3 Sectors
	(1)	(2)	(3)	(4)	(5)	(6)
(1) CPI All items	-0.296					-0.374
	(0.007)					(0.007)
(2) CPI 1-Digit	-0.344	-0.269	-0.251	-0.452	-0.183	-0.361
	(0.008)	(0.013)	(0.014)	(0.010)	(0.023)	(0.008)
(3) CPI 3-Digit	-0.414	-0.299	-0.278	-0.743	-0.219	-0.357
	(0.011)	(0.015)	(0.015)	(0.021)	(0.031)	(0.010)
(4) CPI 3-Digit Fisher	-0.376	-0.268	-0.268	-0.701	-0.194	-0.344
	(0.010)	(0.015)	(0.014)	(0.019)	(0.028)	(0.010)
(5) PPP Matched Model	-0.638	-0.475	-0.513	-0.948	-0.117	-0.557
	(0.013)	(0.024)	(0.022)	(0.016)	(0.040)	(0.019)
(6) PPP Overall	-0.749	-0.721	-0.738	-0.955	-0.553	
	(0.013)	(0.025)	(0.027)	(0.016)	(0.031)	
(7) PPP Overall Branded		-0.662	-0.661		-0.586	
		(0.026)	(0.028)		(0.033)	
(8) PPP Overall Unbranded		-0.69	-0.736	-0.955	-0.348	
		(0.026)	(0.028)	(0.016)	(0.047)	

Table 5: Passthrough Decomposition - All countries

Notes: All bilaterals calculated with respect to the United States.

Quantum Prices

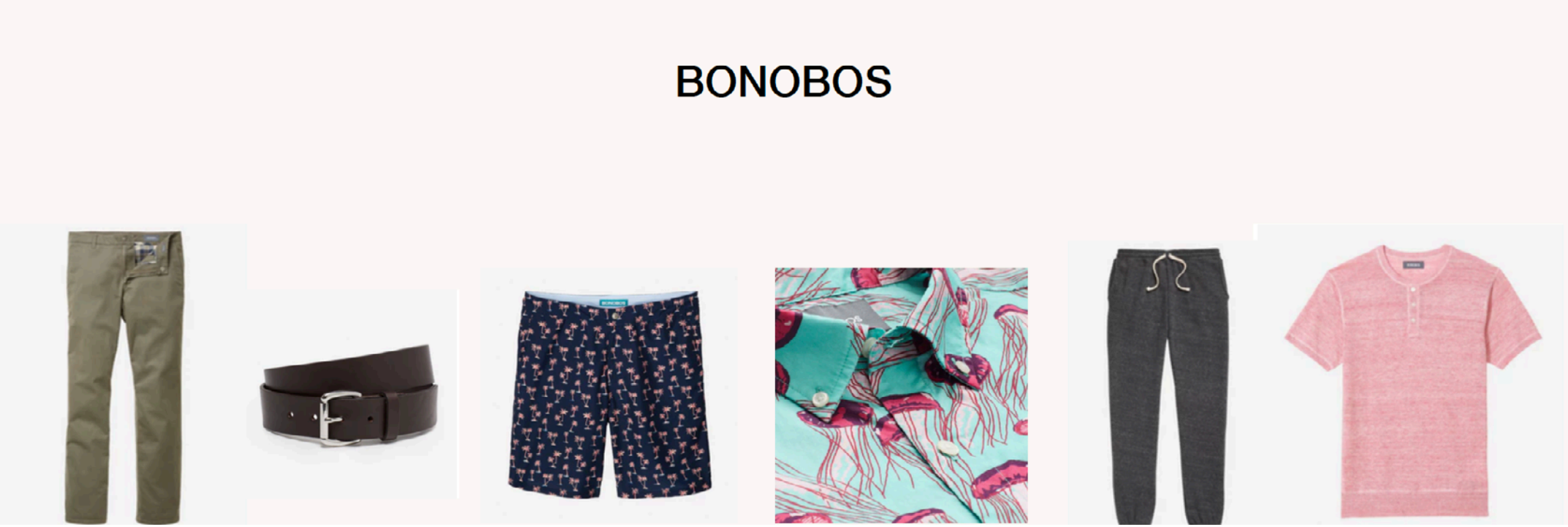
Diego Aparicio

Quantum Prices

- Adds a new dimension of stickiness
  - Price Choice set is sparse
  - Quantum Prices are separated by large – economically meaningful – distances
    - Stores use very few prices
      - Uniqlo – 4k items distributed in less than 20 prices
      - McDonald's – 25 sandwiches in 20 prices

- Macro implications:
  - Affects representativeness of micro data and construction of indexes
  - Potential spurious heterogeneity of micro data

What do this products have in common?



Not only one store…

BONOBOS

$88 $88 $88 $88 $88 $88

UTERQUE

£120 £120 £120 £120 £120 £120

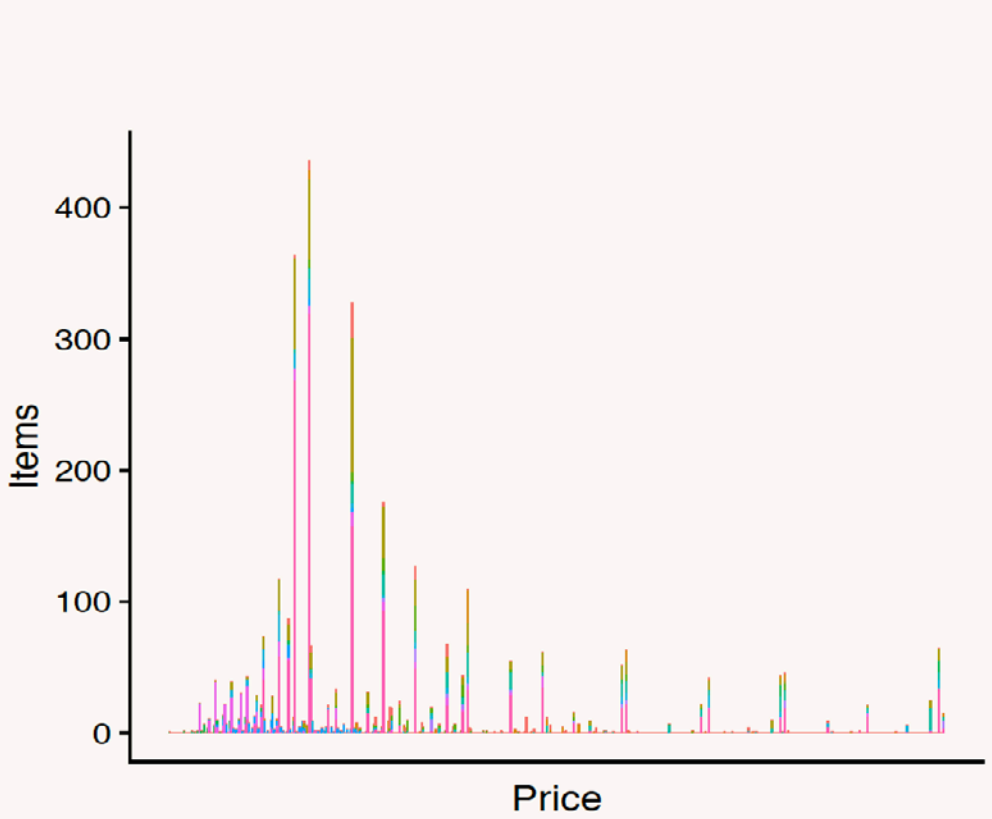
ZARA

$69.90 $69.90 $69.90 $69.90 $69.90 $69.90

ABERCROMBIE (1990s)

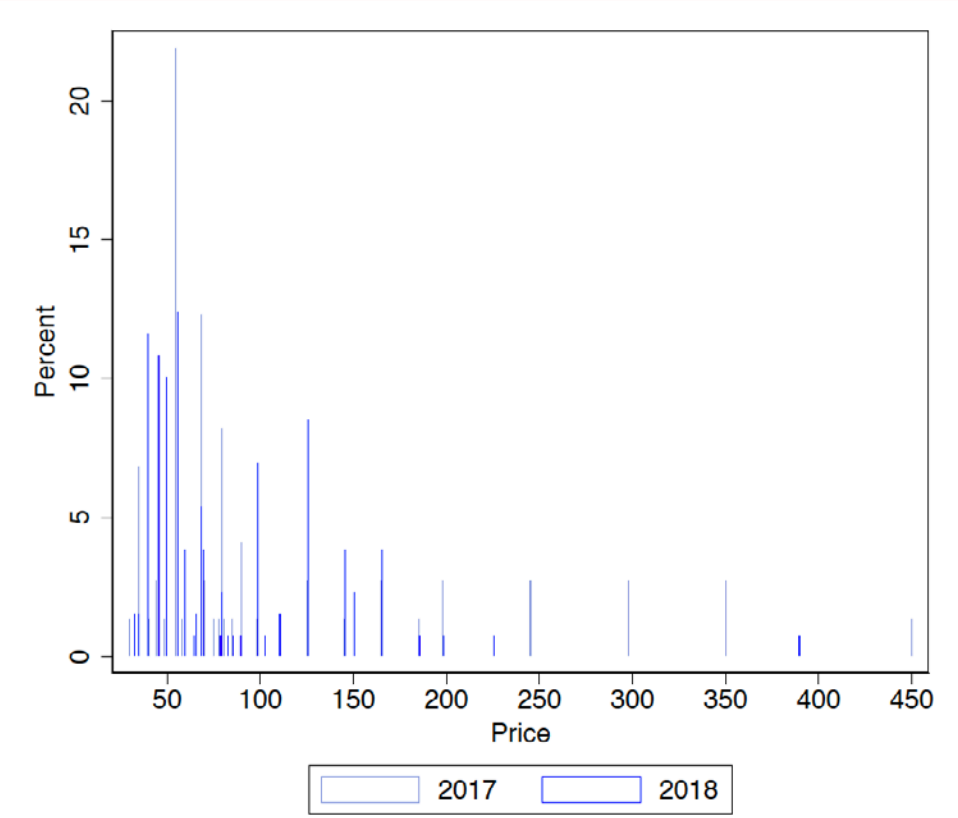
$54.50 $54.50 $54.50 $54.50 $54.50 $54.50

Massive Price Clustering



Ralph Lauren

Inflation Dynamics



Ralph Lauren

Implications

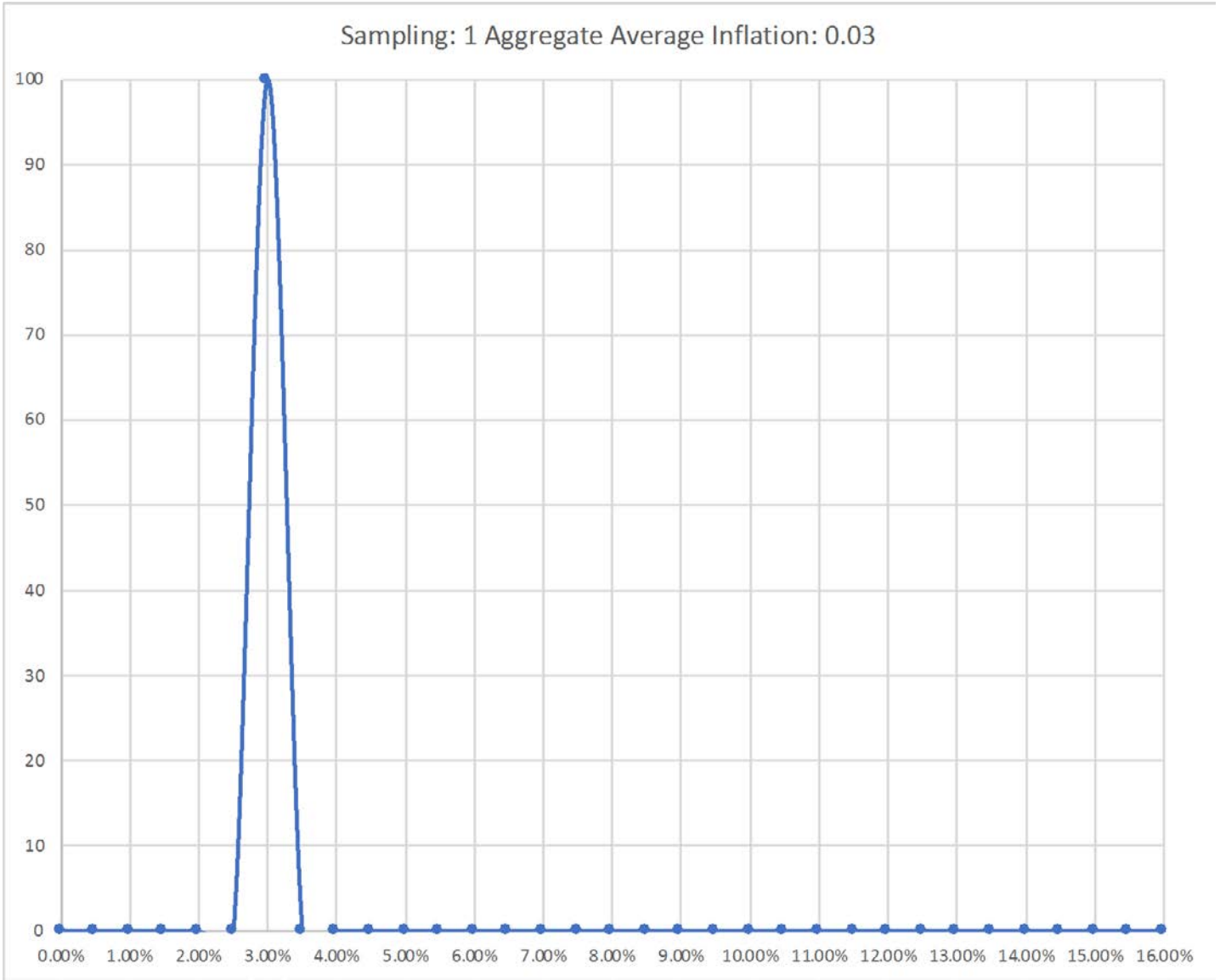
- What is the subsample that is actually representative of the population's behavior?
  - How many items are needed to construct an index?
  - How representative each firm is?

- How is the product designed affected by the pricing strategy?
  - If products are design to match price points characteristics of the consumers, pass-through is not detected at the micro level data, but it is at the properly constructed aggregate index.

Quantum Prices and Sub-sample problem

- Indexing needs large subsample in the category to compute accurate inflation rate.
  - Assume quantums separated by 30% (smaller than usual).
  - Assume the category has 1000 items all equally weighted.
  - Assume the aggregate inflation when all items are taken into consideration is 3 percent a year
  - A random sub-set of the identical items are the ones that increase their prices
  - Assume we subsample the population
- Question: How large has to be the subsample so the micro data is representative of the aggregate behavior?

Distribution of Inflations



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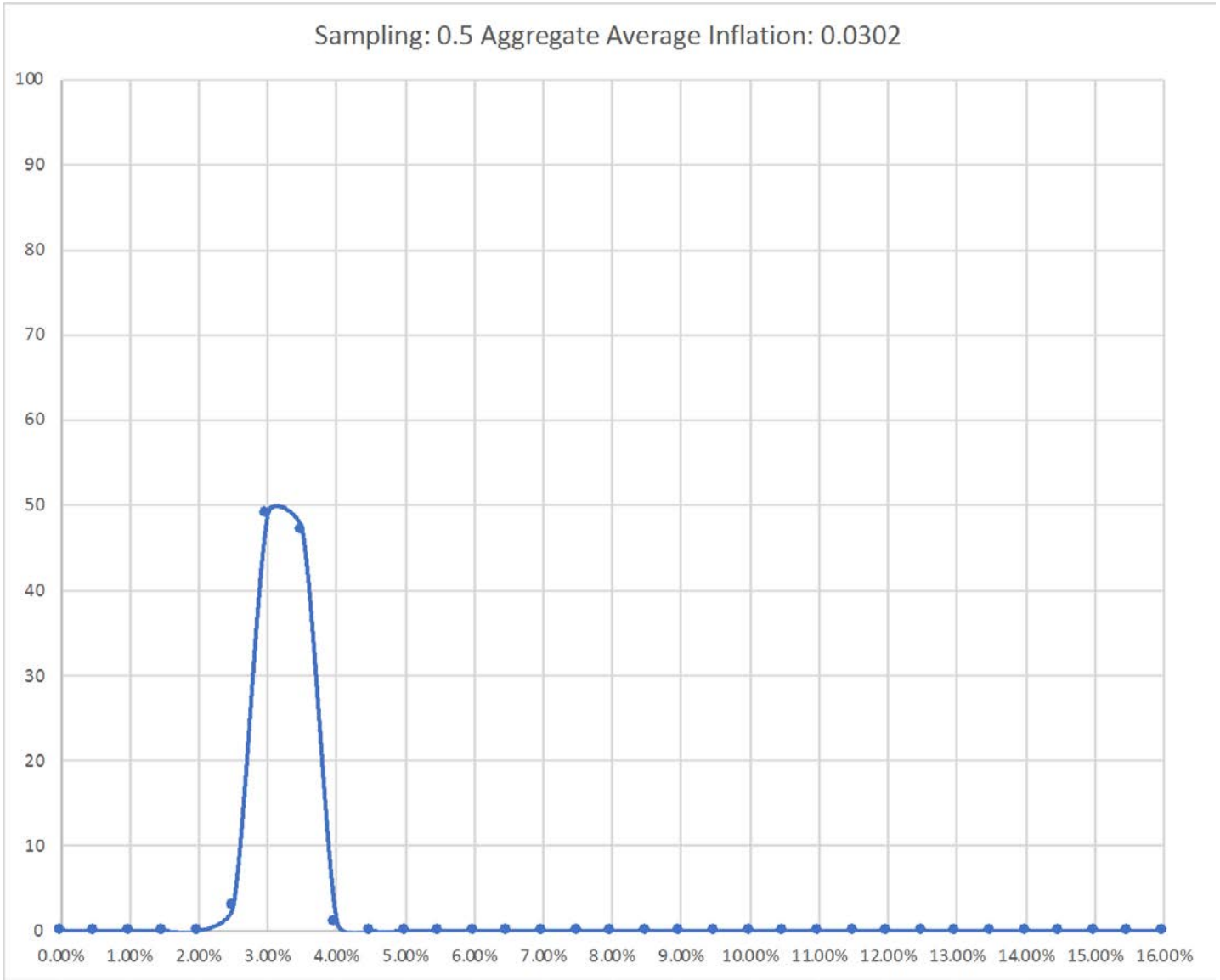
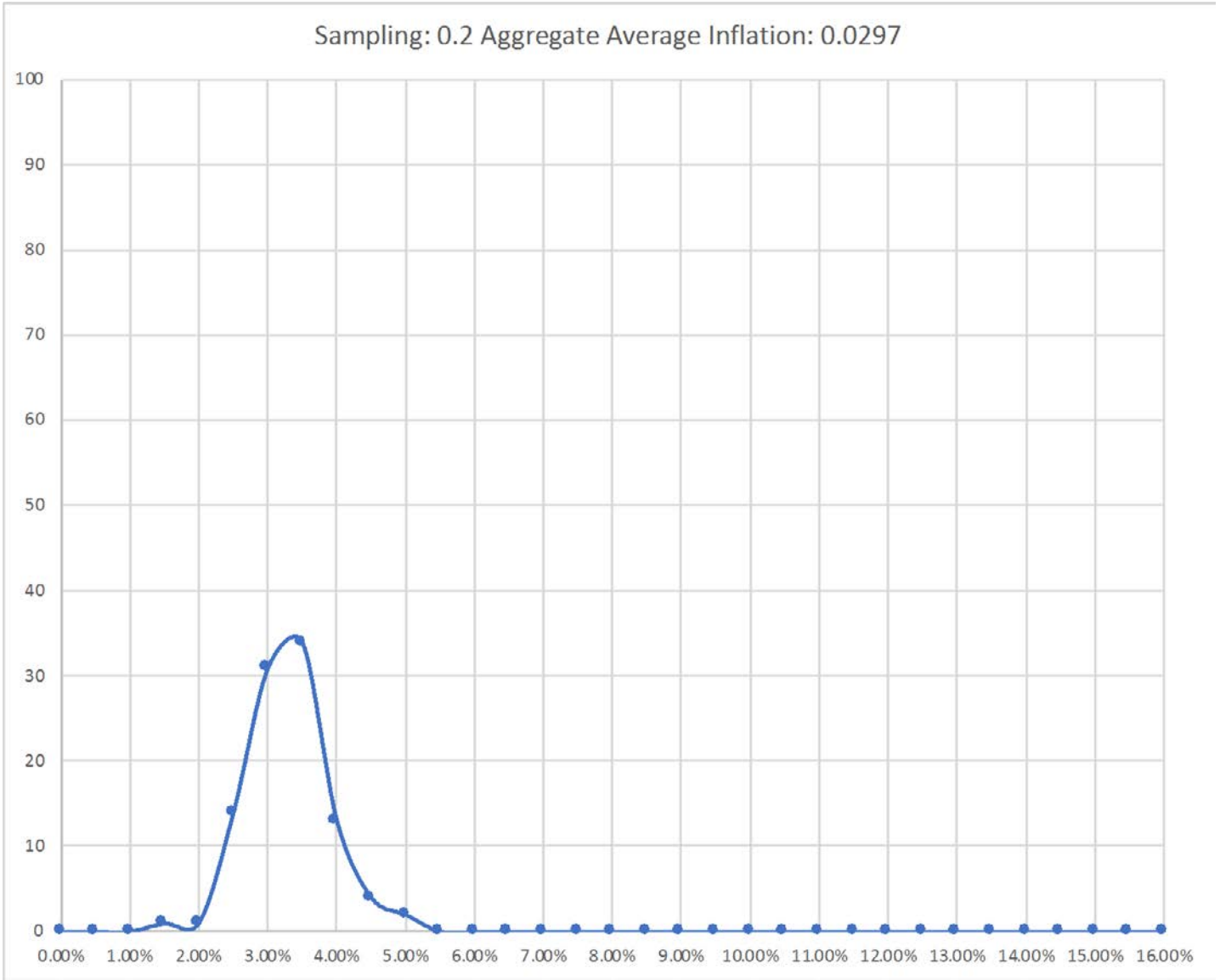


Distribution of Inflations



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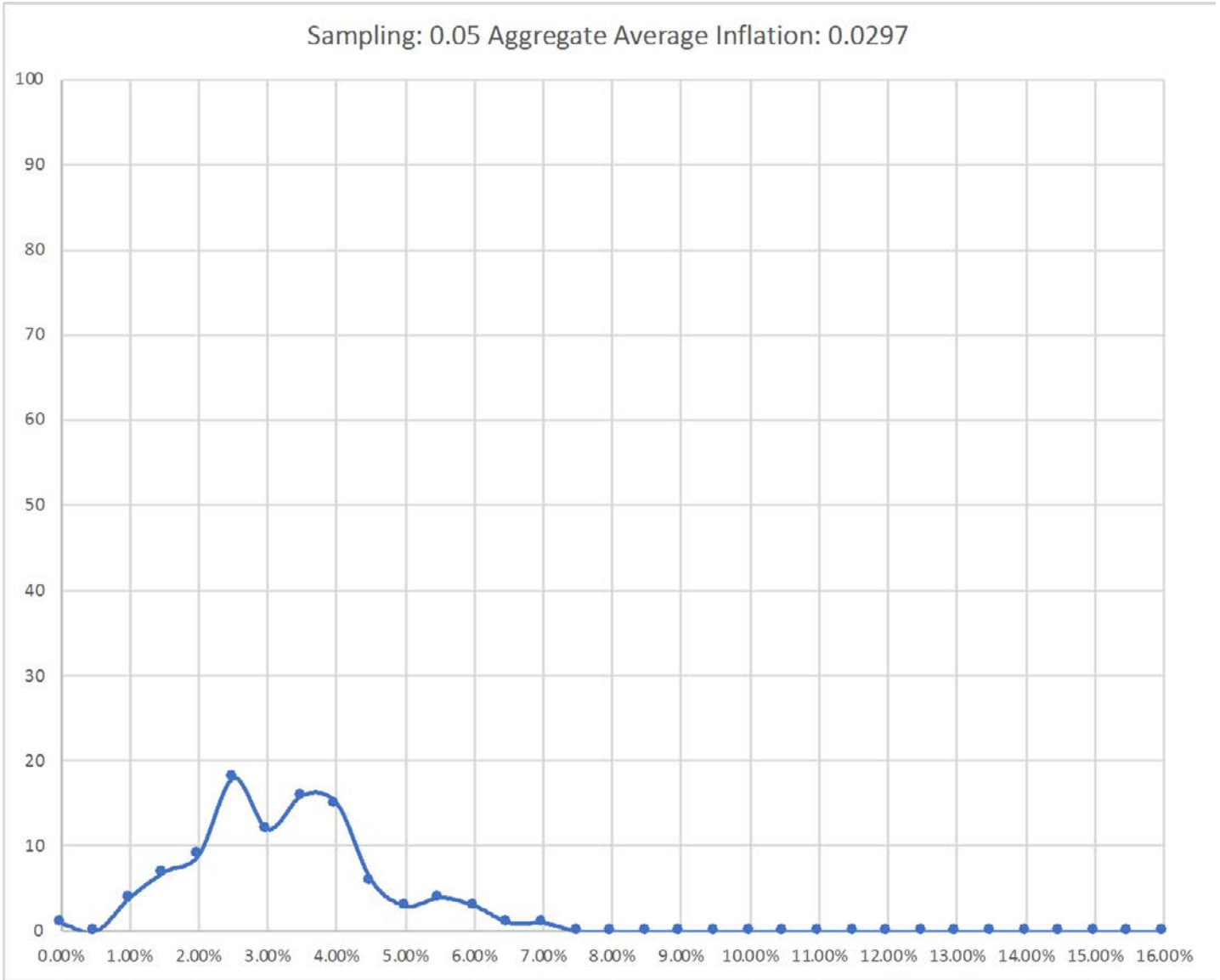

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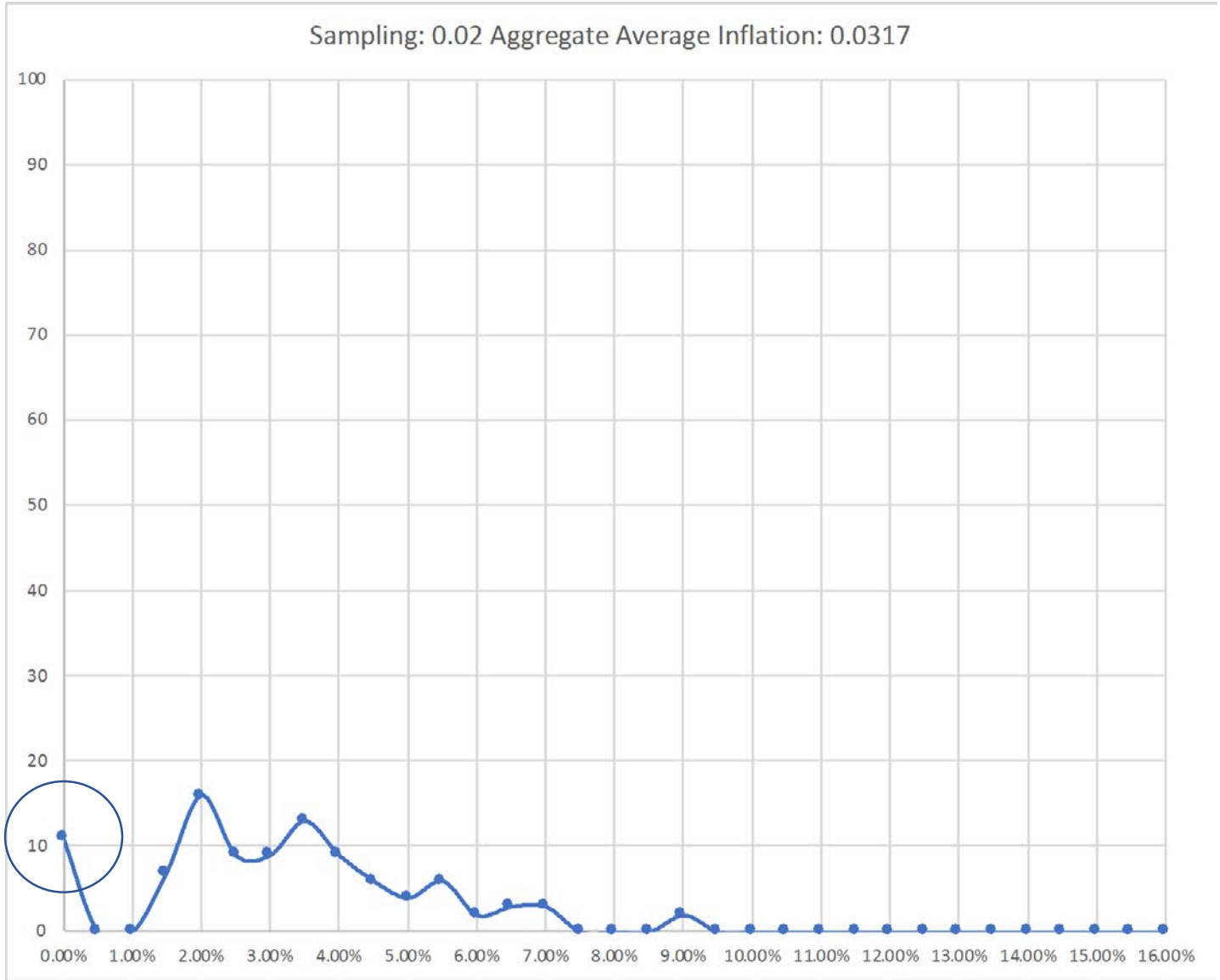

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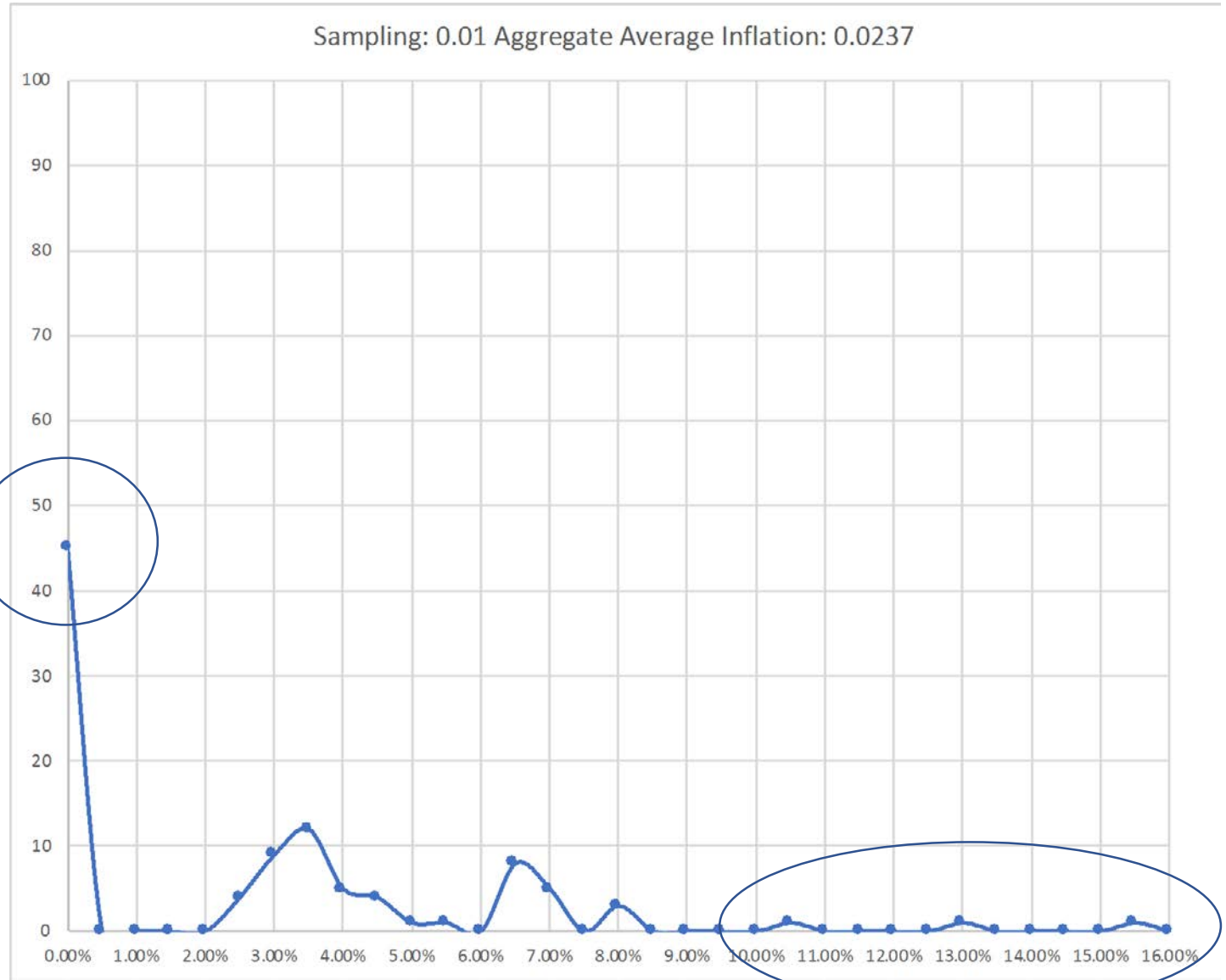

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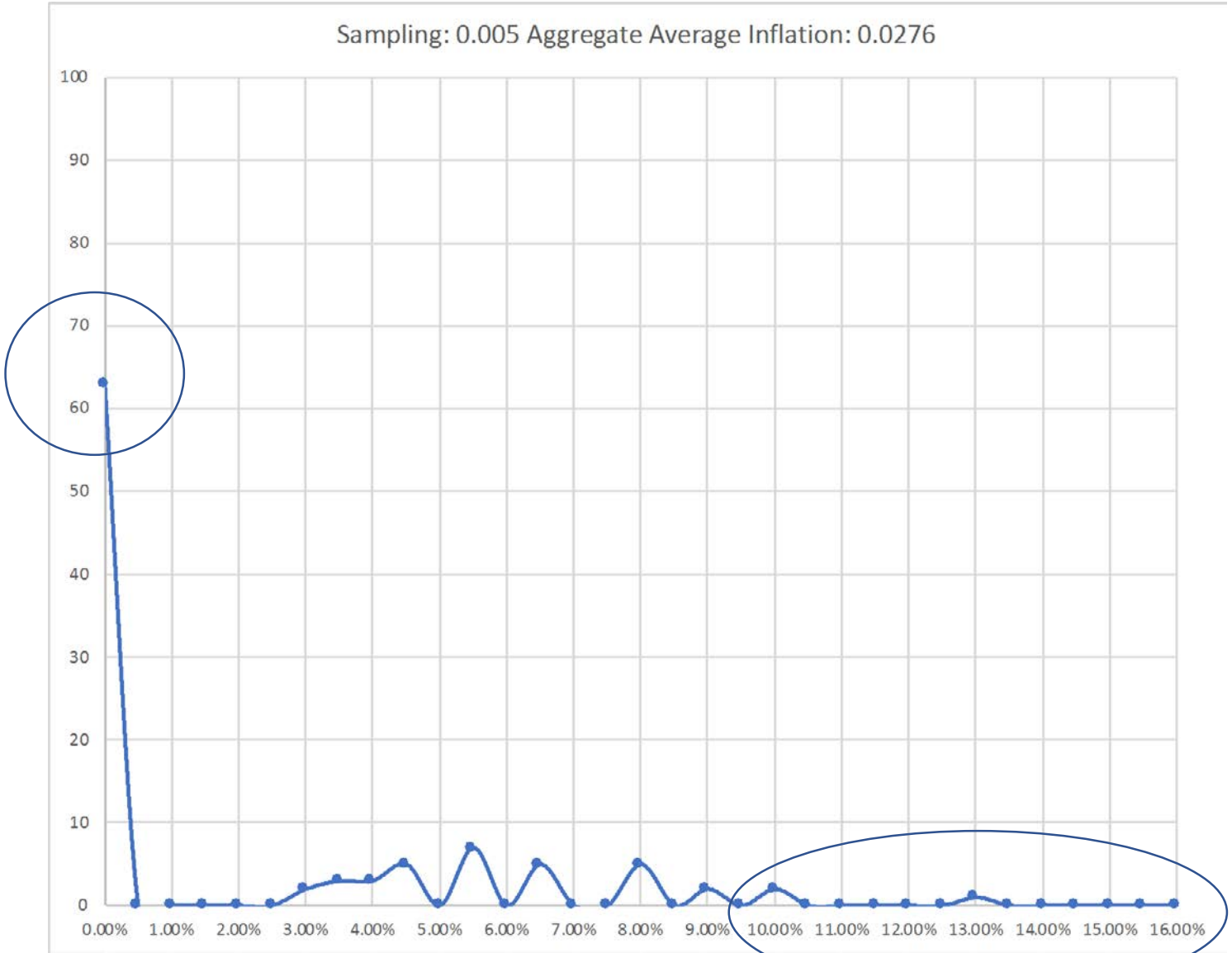
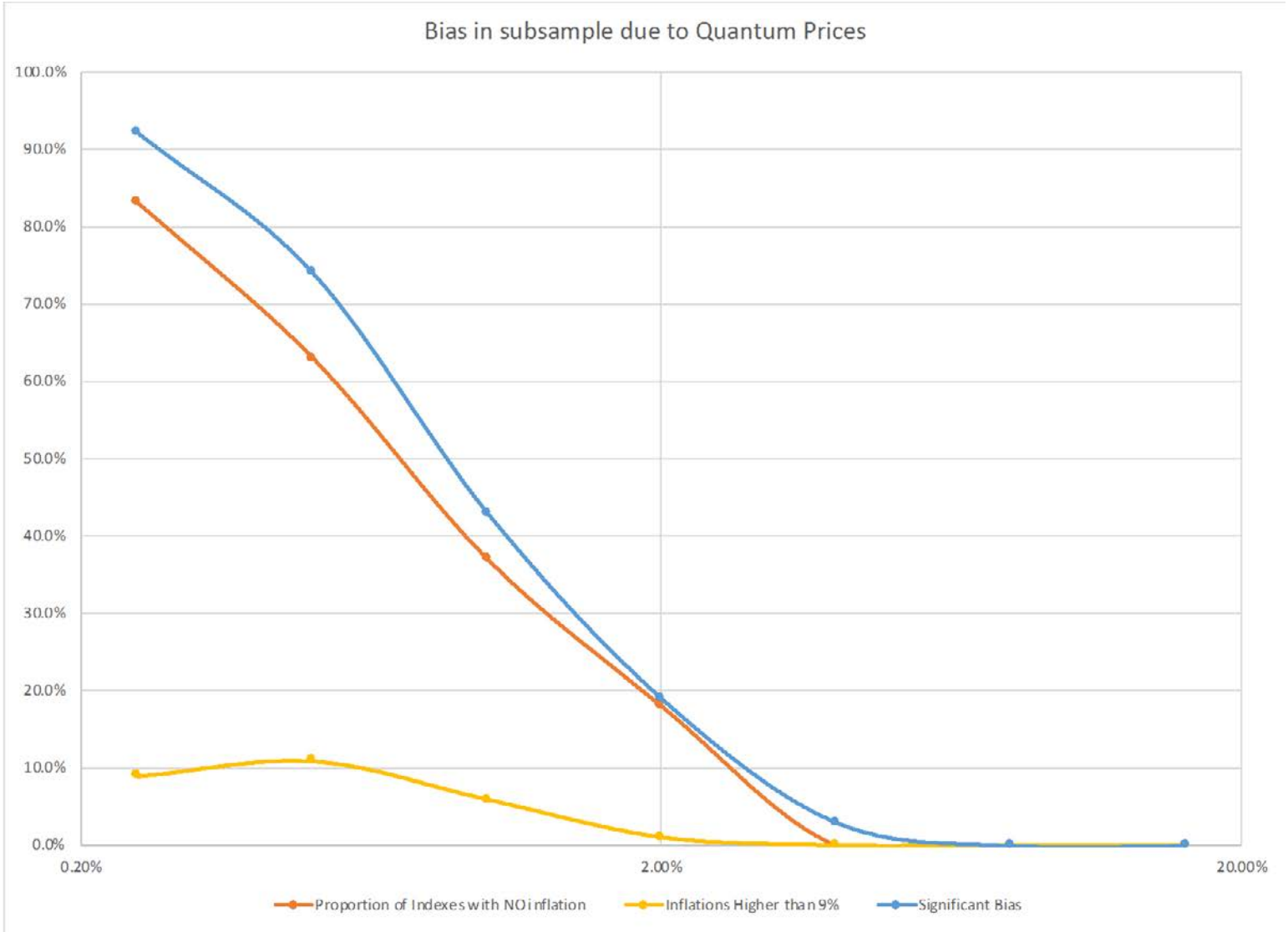


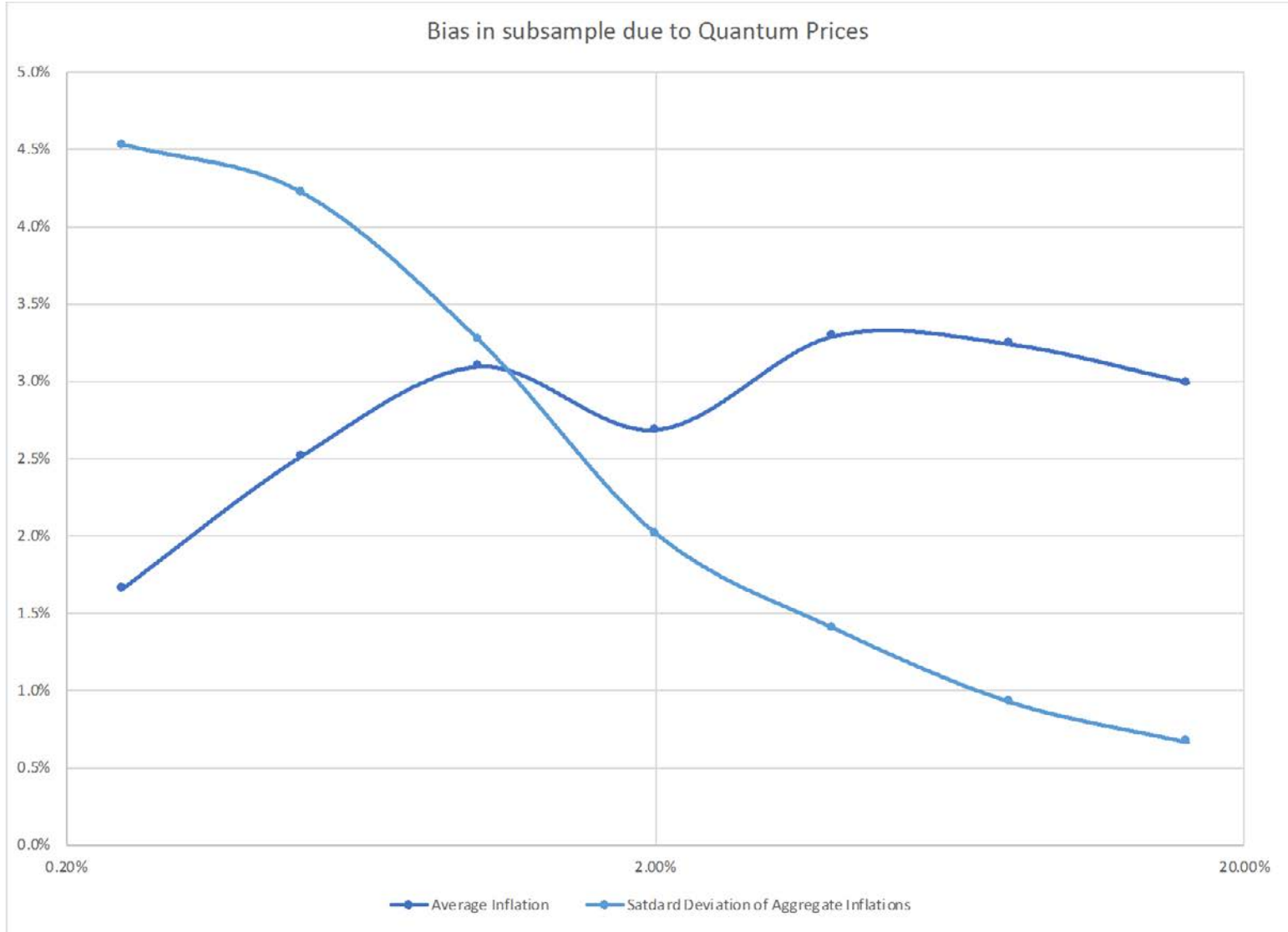
Simulations of the mis-measurements

Sample	Average Inflation	Satdard Deviation of Aggregate Inflations	Proportion of Indexes with NO inflation	Inlfations less than 1%	Inflations Higher than 9%	Significant Bias
0.25%	1.7%	4.5%	83.0%	83.0%	9.0%	92.0%
0.50%	2.5%	4.2%	63.0%	63.0%	11.0%	74.0%
1.00%	3.1%	3.3%	37.0%	37.0%	6.0%	43.0%
2.00%	2.7%	2.0%	18.0%	18.0%	1.0%	19.0%
4.00%	3.3%	1.4%	0.0%	3.0%	0.0%	3.0%
8.00%	3.2%	0.9%	0.0%	0.0%	0.0%	0.0%
16.00%	3.0%	0.7%	0.0%	0.0%	0.0%	0.0%

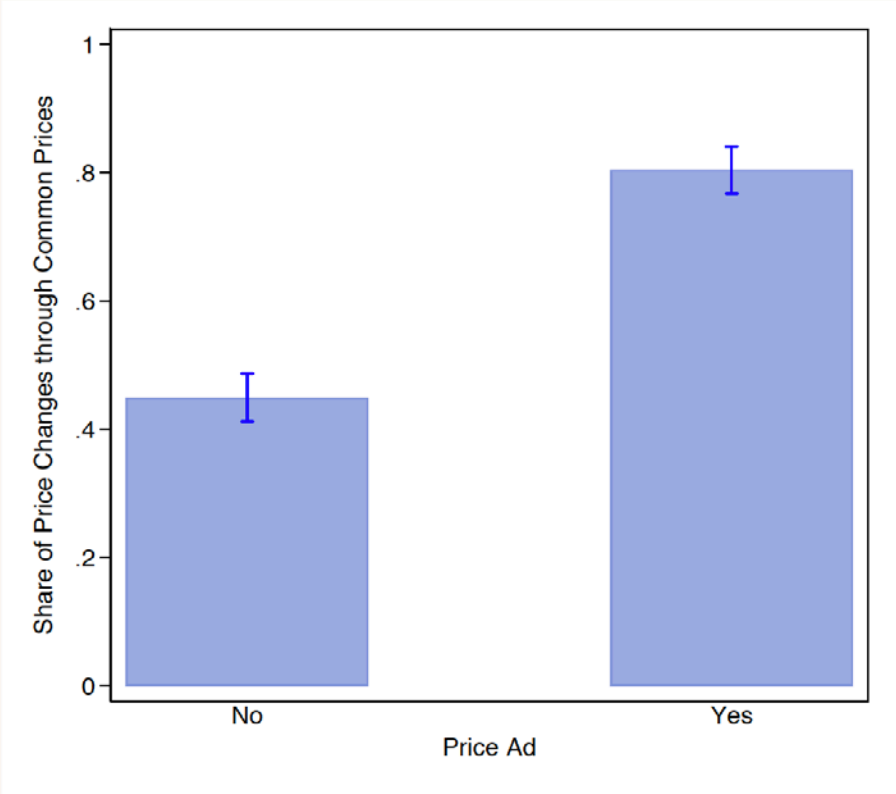
Mismeasurement due to Quantum Prices



Aggregate Noise due to Quantum Prices



Product Introductions: Extreme degree of stickiness



Price Advertisers change prices using the existing price distribution

New products are designed for specific price points. It means that the hedonic adjustment is the only procedure capable of capturing the price adjustment at introductions

Conclusions

- Quantum Prices
  - Aggregate indexes mis-measure actual behavior
  - Micro data –if subsampled– provides no solution
    - Data is non-representative
    - Heterogeneity could be spurious
  - Price adjustment at introduction

- Further Research
  - How prevalent are quantum prices?