"Measurable Dimensions of Product Differentiation in International Trade"

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“Measurable Dimensions”

- Recent work in IO provides techniques for richly describing product space
- Unfortunately, these techniques require highly detailed data on product characteristics
- Trade data are much more sparse. At best, one can find p, q, for each bilateral partner

- Question: can we find ways to characterize product space without product characteristics?

What distinguishes major models?

- How are goods differentiated?
  - Horizontal (type) v. vertical (quality)
  - Evidence: vertical IIT (many); within-sector price differences (Schott, Hallak); quality as a demand residual (Hummels-Klenow)
- Who does the differentiation?
  - Firms (Krugman) v. Countries (Armington)
  - Evidence: variety expansion (Hummels-Klenow); home market effects (Head-Ries)

Armington, Krugman v. Facts

Variable	Armington	Krugman	Facts
Number of Varieties	Constant	Proportional to the market size	a 1% ?in GDP ? 0.5% ?in varieties, 0.5% ?output per variety (HK, 2004)
Output per Variety	Proportional to Market Size	Constant	
Cross-Importer Prices	Same for all markets	Same for all markets	PTM: prices vary across destinations
Price Elasticity of Demand	Constant	Constant	No direct evidence

How do consumers value differentiation?

Dixit-Stiglitz, 1977 “love of variety” approach

- Representative consumer demands all varieties
- Marginal utility of new varieties doesn’t decline with entry.
- Product space never “fills up”

Lancaster, 1979 “ideal variety” approach

- Each consumer has strong preference for one (“ideal”) variety
- Product space is finite (circle) and fills up. MU of new varieties declines with entry.

A generalized ideal variety model

- The model generates predictions regarding quantities and number of varieties, which provide a *better* fit to empirical facts than “love of variety” models

- We show theoretically that the price elasticity of demand (and therefore prices) vary systematically across importers :
  - Elasticity increases with market size
  - Elasticity decreases with productivity level

- Key empirical question: does variety space “fill up”, i.e. do goods become closer substitutes as the number of varieties grows.

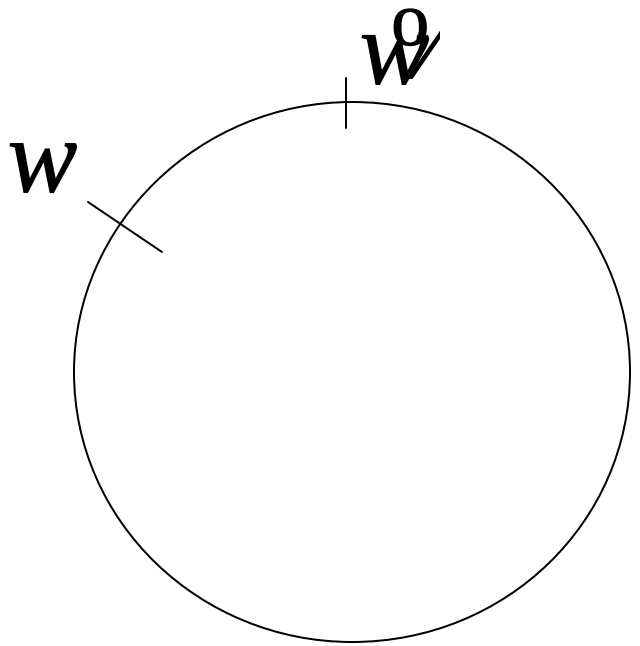
Closed Economy

- Utility: $$U = q_0^{1-m}\left[u\left(q_w\right)\,|\,w \in \Omega\right]^m$$

q_0 is a normalized homogeneous good produced with CRS
q is a differentiated product indexed by a continuum of varieties $w \in \Omega$

- Subutility

$$u\left(q_w\right) = \frac{q_w}{h(q_w^g, v_{w,w_0})}$$



Lancaster compensation function

- Assumes strength of preference for ideal variety is independent of quantities consumed

- Example:
  - Consumer chooses between his ideal variety (Apple Juice) and less preferred variety (water)
  - Price(AJ) = 5 Price(Water)
  - If consumer chooses 5 cups of water over 1 cup of AJ; he will also choose 5 gallons of water over 1 gallon of AJ

Generalized Ideal Variety Model

- Allows the strength of preference for the ideal variety to depend on quantities consumed
  - as consumption volume rises, consumers place greater value on the proximity to their ideal variety

Lancaster	Generalized
$h(v) = 1 + v^b$	$h(v,q) = 1 + v^b q^g$
$b > 1,\ 0 \le g \le 1$	

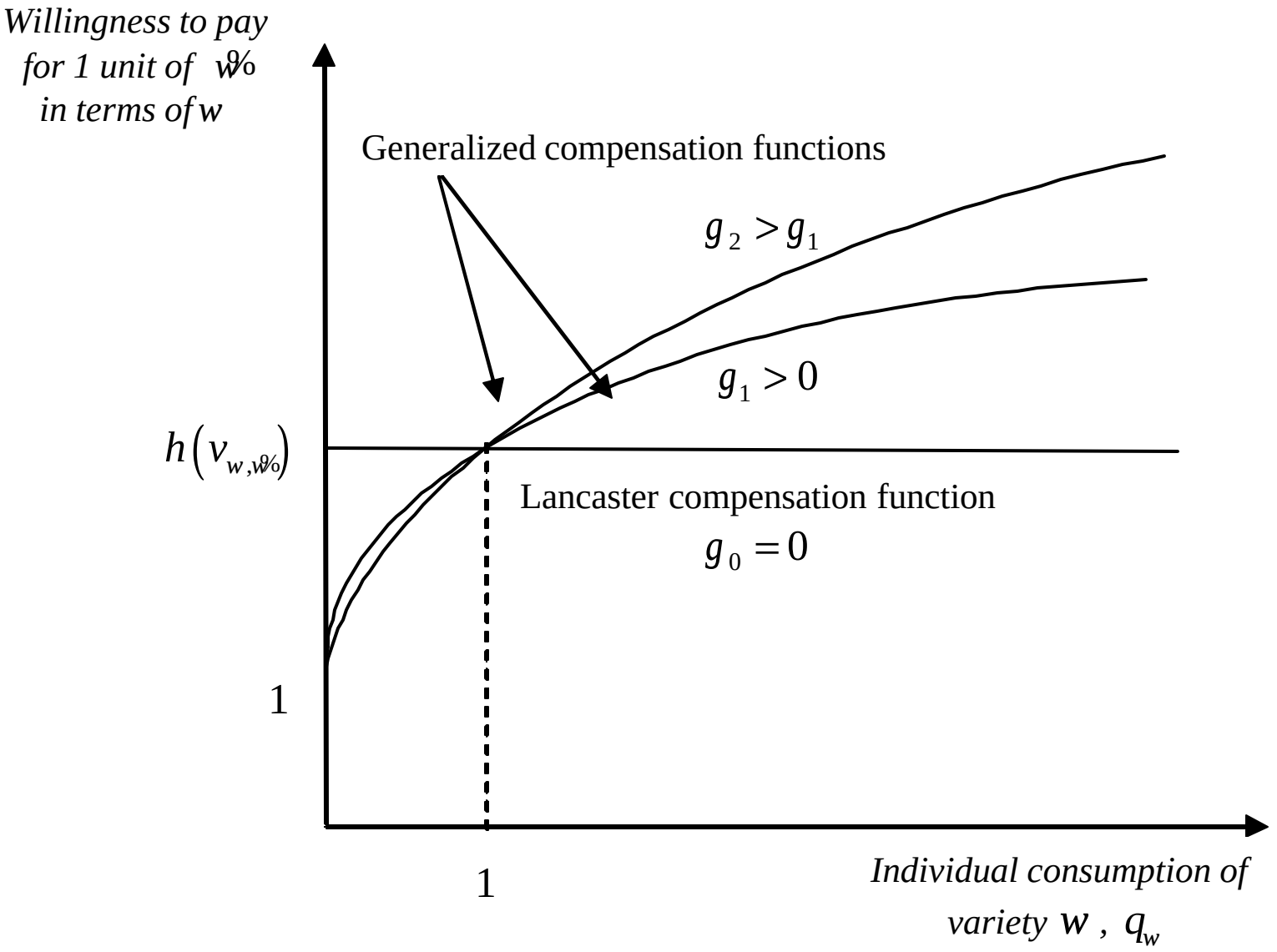


Figure 1. Lancaster and generalized compensation functions.

Predictions for Equilibrium Variables

- Prices: $$p = c\frac{e}{e-1}$$
- Quantity per variety $$Q = \frac{a}{c}(e-1)$$
- Number of varieties $$n = \frac{mzL}{ae}$$

Equilibrium Intuition

- As economy grows larger, variety space fills up, varieties become closer substitutes ? price elasticity rises.

- As economy grows richer (cond on size), willingness to pay for ideal variety rises ? price elasticity falls.

Note: in this case, higher income alters consumer perceptions of variety space

Equilibrium Price Elasticity of Demand

$$e = 1 + \frac{1}{2b}\left[\frac{p}{mz}\right]^{g}\left(2n\right)^{b} + \frac{1-g}{2b}$$

	DS	Lancaster	Generalized	Empirical facts
$\partial e / \partial z_L$	0	?	?	?
$\partial e / \partial z \big\|_{z_L=Const}$	0	0	?	?

Intuition (2)

- Sign predictions for prices are inverse of price elasticity
  - Market size increases ? elasticity rises ? firms' pricing power drops.
- Implies: output per variety must rise in order to cover fixed costs of entry.

- Implies: number of varieties increases with market size, but less than proportionally.

Equilibrium Quantity per Variety

$$Q = \frac{a}{c}(e-1)$$

	Krugman DS	Lancaster	Generalized	Empirical facts (HK, 2004)
$\partial Q / \partial L$	0	?	?	?
$\partial Q / \partial z \mid_{zL=Const}$	0	0	?	?

Equilibrium Number of Varieties

$$n = \frac{mzL}{ae}$$

	Krugman DS	Lancaster	Generalized	Empirical facts (HK, 2002)
$\partial n / \partial L$	? proportionally	? Less than proportionally	? Less than proportionally	? Less than proportionally
$\partial n / \partial z \mid_{zL=Const}$	0	0	? Less than proportionally	? Less than proportionally

Empirical Exercise

- We know from existing empirical literature that generalized ideal variety framework matches predictions on how varieties, output per variety expand with size, income.

- Can we find direct evidence that
  - variety space fills up, i.e. larger markets have higher price elasticity of demand
  - perceptions of variety space vary by income; richer markets have lower price elasticity of demand

Data

- UNCTAD TRAINS database: 59 importers; all exporters worldwide
- Bilateral trade value, tariff measured at 6 digit level of the Harmonized Classification System (5000+ categories) in 1999
- GDP, GDP per capita from WDI

Estimating Technique

- Estimate commodity-level import demand as a function of relative prices
  - All variables are differenced with respect to their exporter x commodity means; takes out exporter size, quality effects.
  - Price variation comes from bilateral variation in tariff rates in cross-section
  - If price elasticity is constant, it is given by the coefficient on price (tariff)

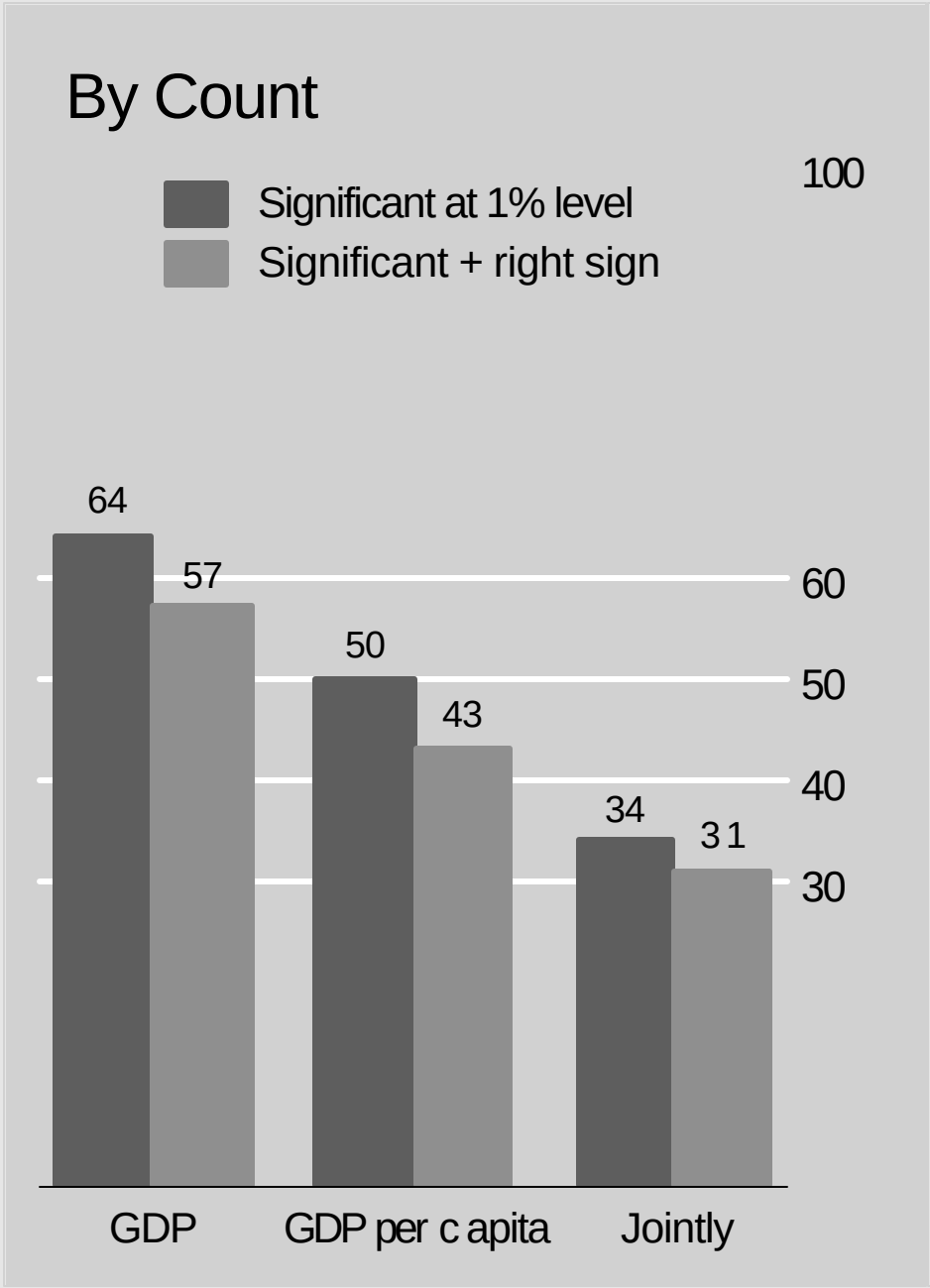
- Interact tariffs with Y, Y/L to see if elasticity varies across importer characteristics

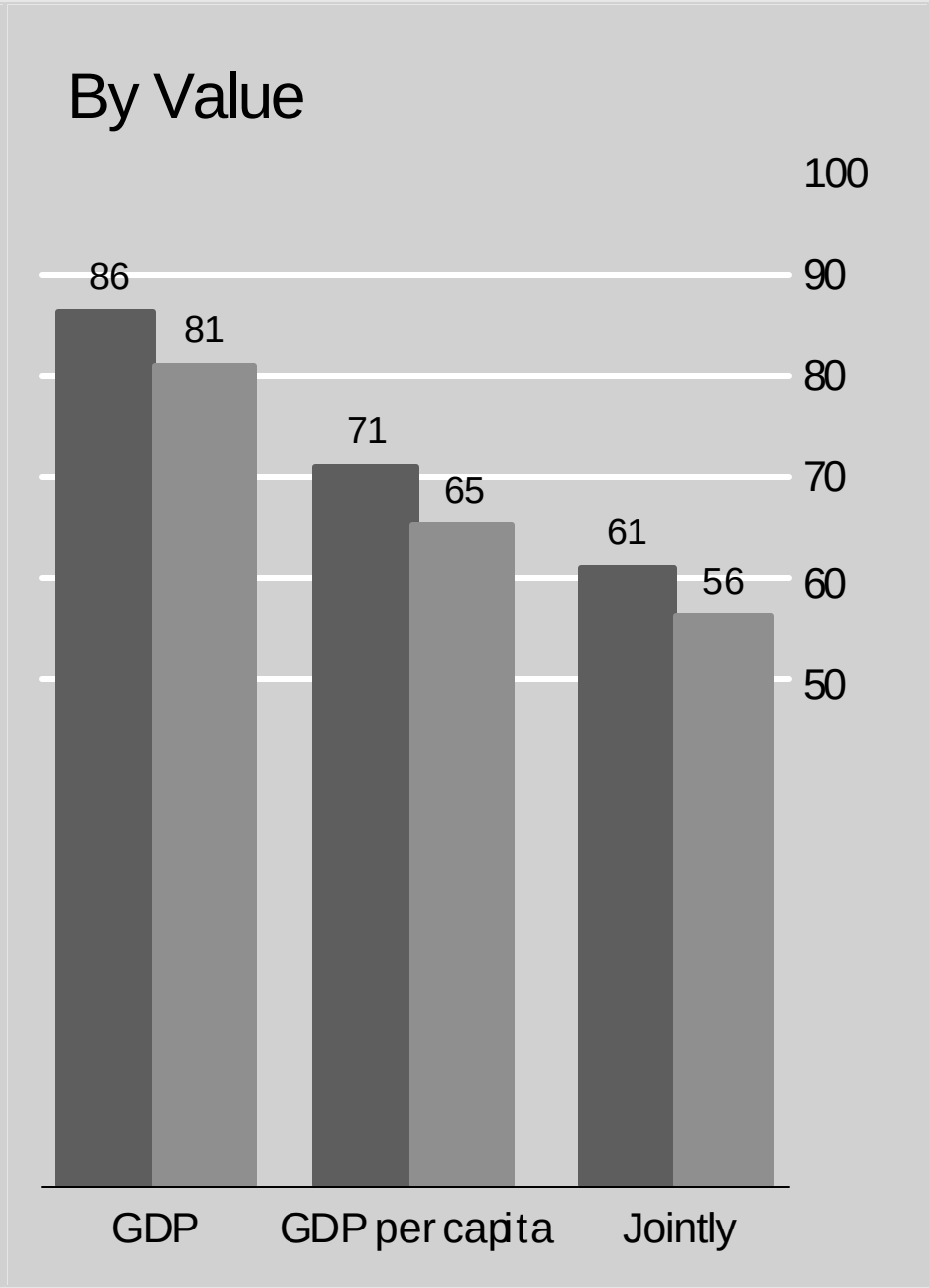
Fixed Effect Estimates of Import Demand

$$\ln M_{ijk} = d_{jk} + b_0 + b_1 \ln tar_{ijk} + b_2 \ln Y_i + b_3 \ln\left(Y/L\right)_i + b_4 \ln tar_{ijk} \ln Y_i + b_5 \ln tar_{ijk} \ln\left(Y/L\right)_i + e_{ijk}$$

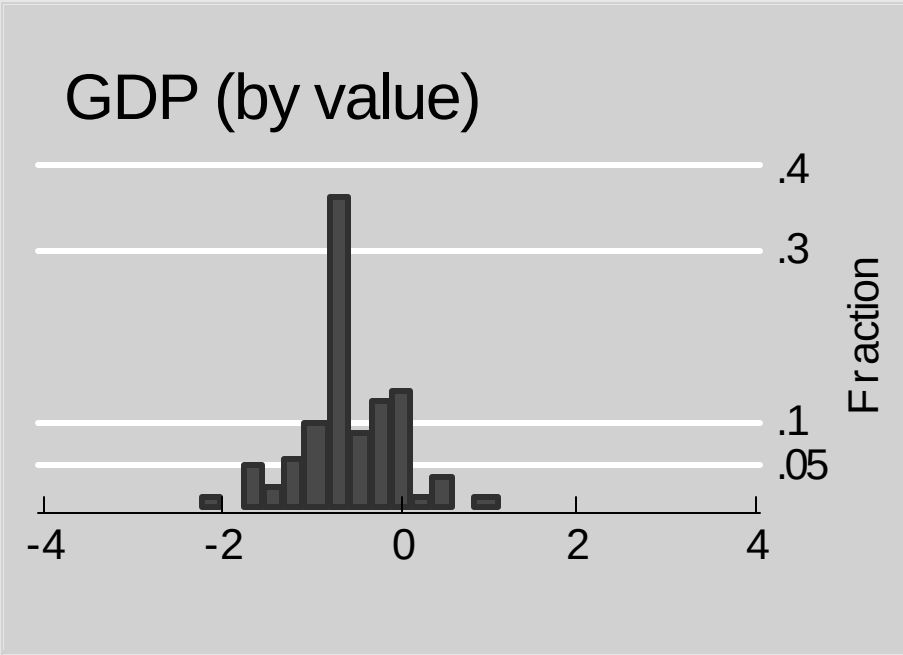
Dependent variable: ln(import)	Variables (in logs)					R^2	Obs.
	Tariff rate	GDP (importer)	GDP per capita (importer)	GDP and tariff interaction term	GDP per capita and tariff interaction term		
	t_{ijk}	Y_i	$\left(Y/L\right)_i$	$Y_i \times tar_{ijk}$	$\left(Y/L\right)_i \times tar_{ijk}$		
coeff (se)	13.2** (.29)	.45** (.001)	-.08** (.002)	-.68** (.01)	.35** (.02)	.16	986,756
Estimated price elasticity of demand (evaluated at means) = -1.43							

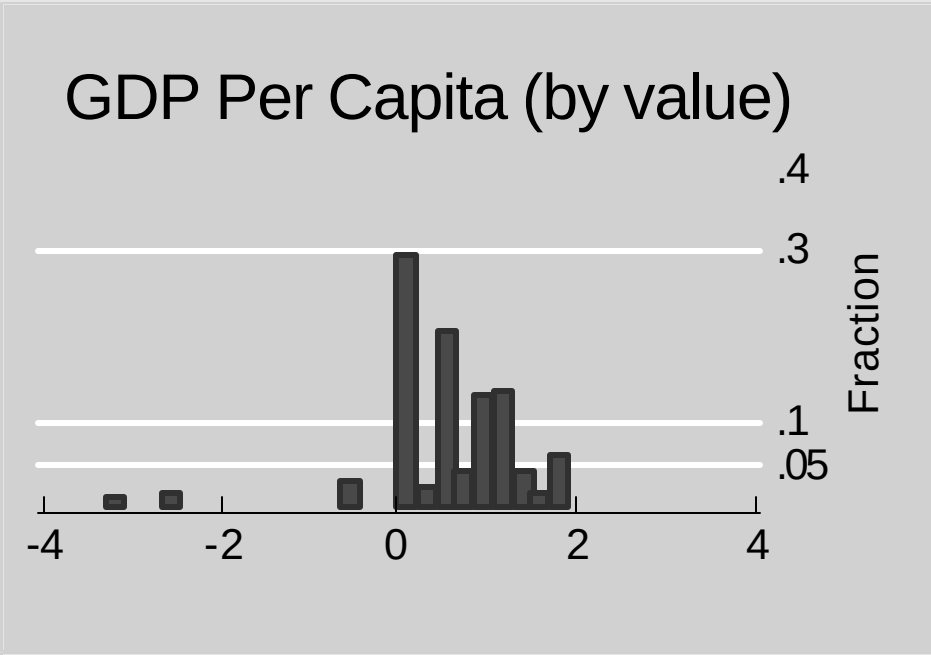
Interaction Terms Significance

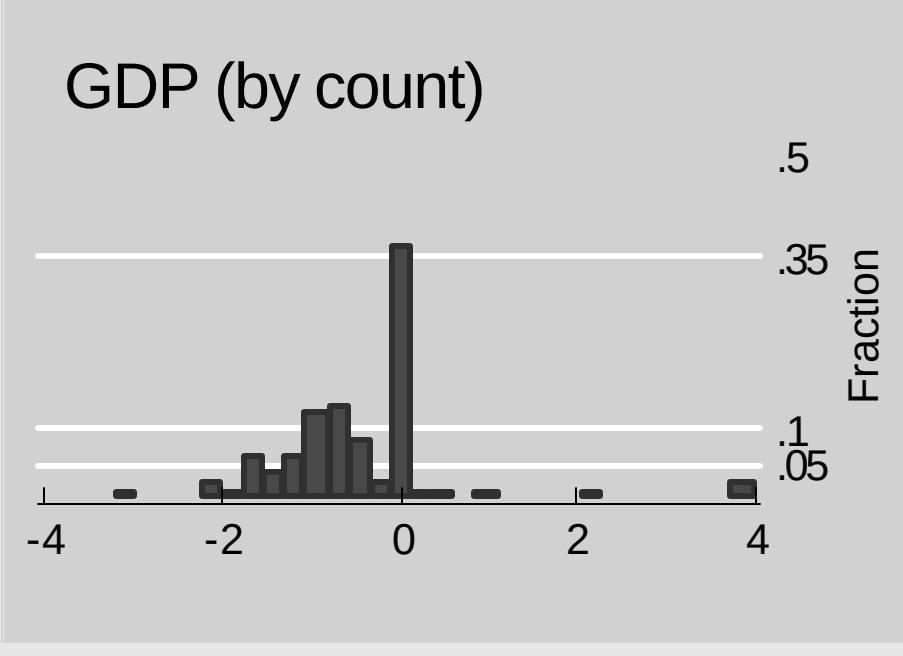


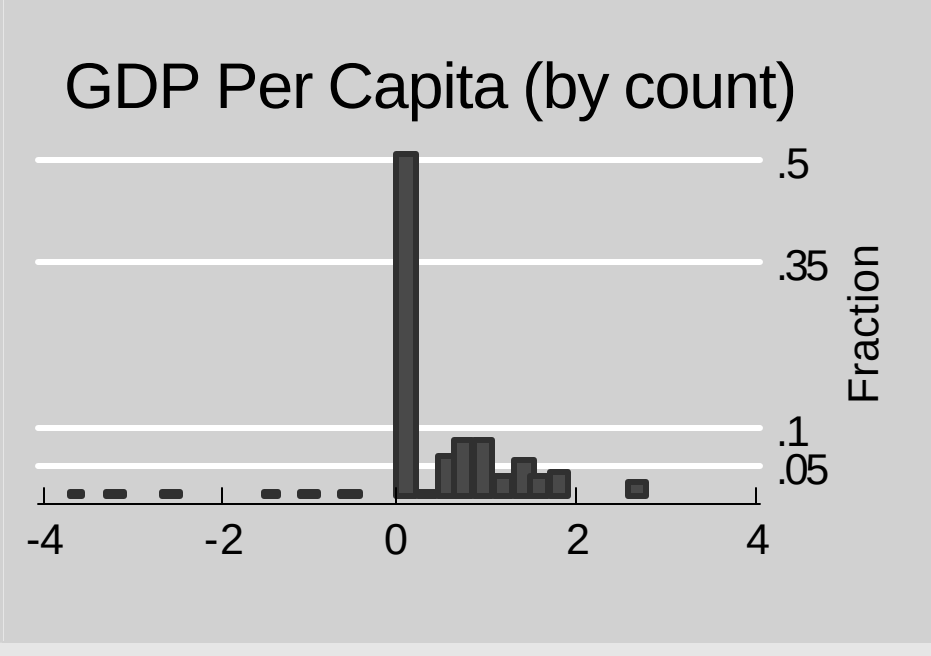


Industry Regressions: Distribution of the Interaction Terms

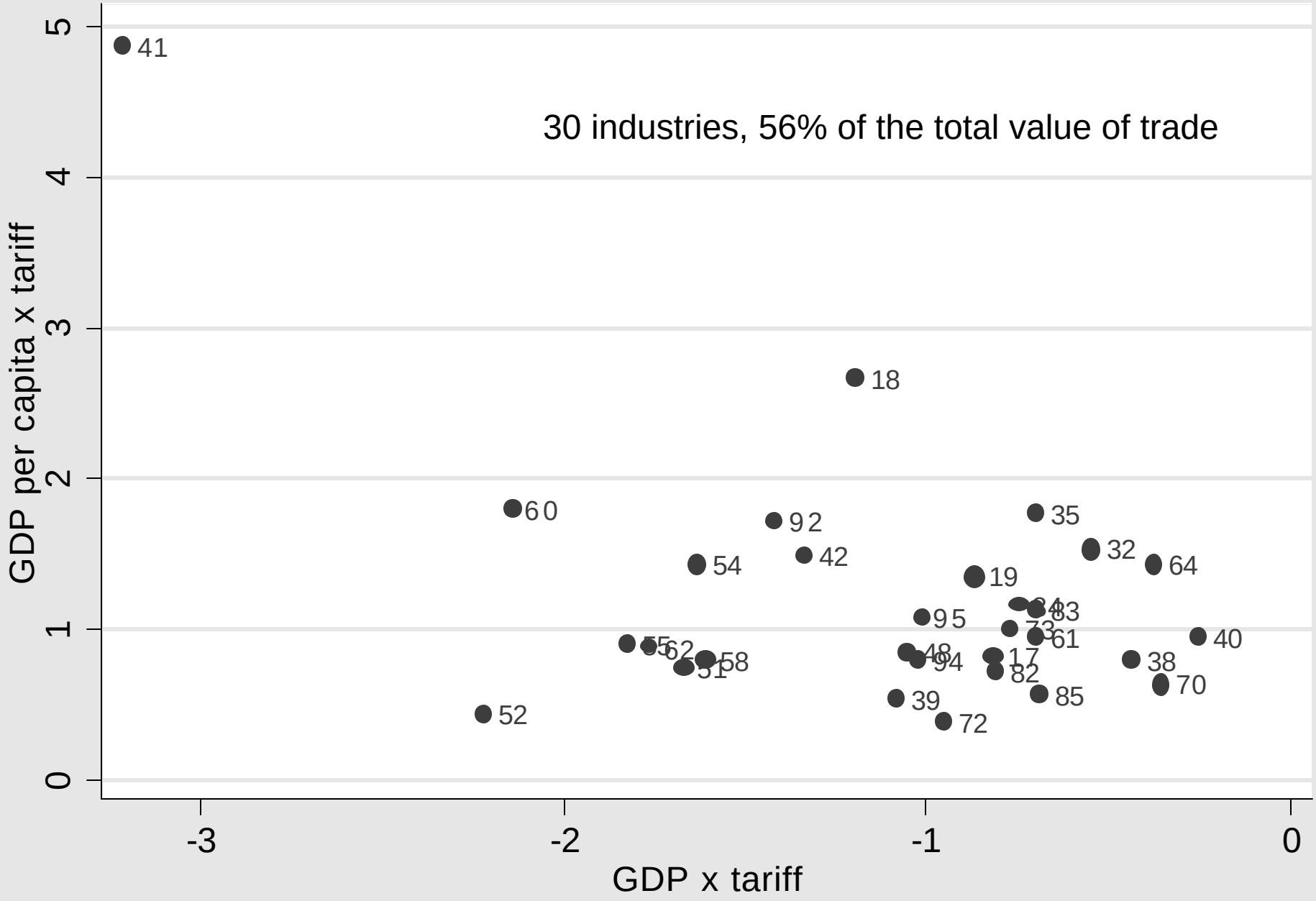


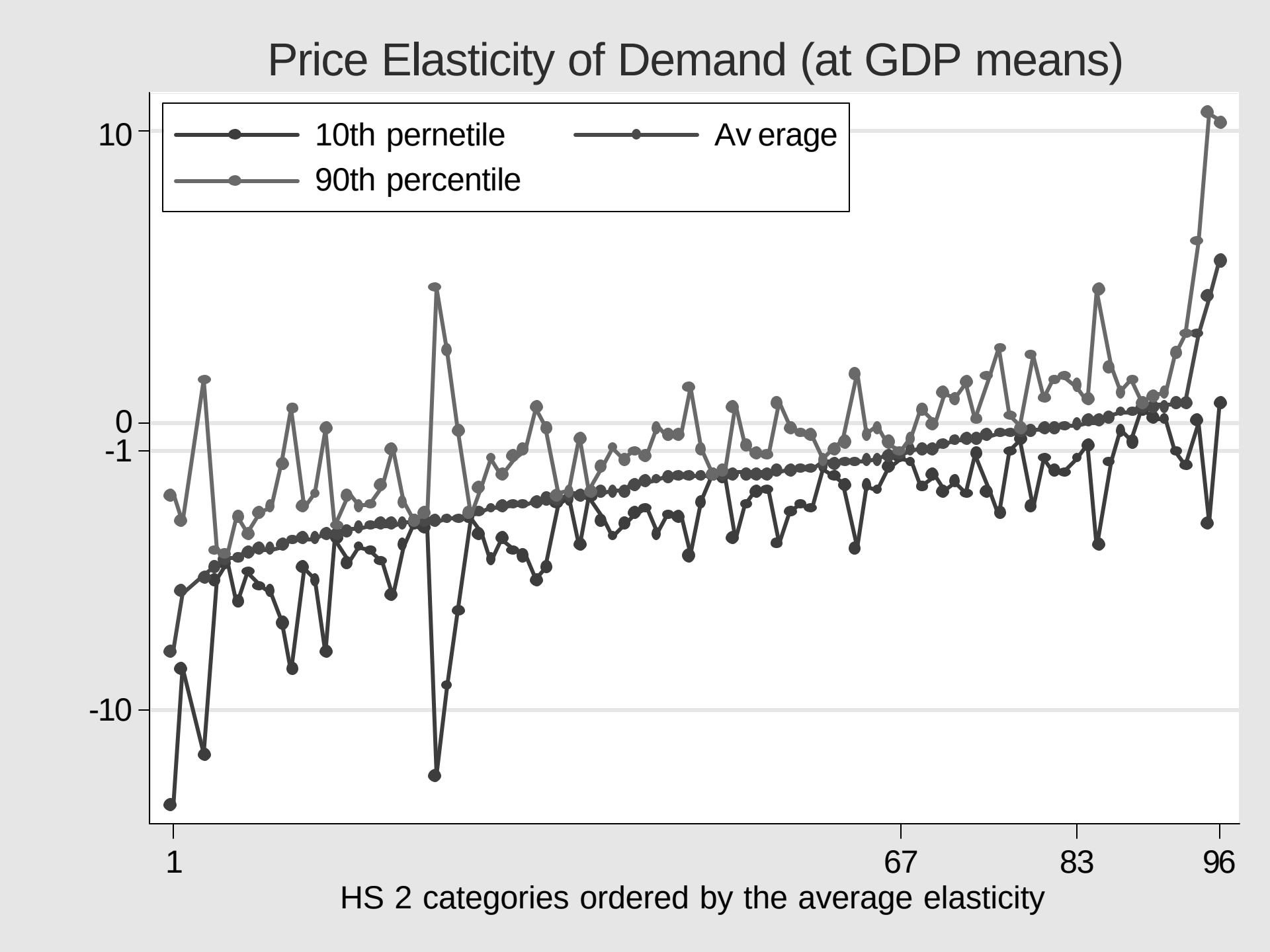


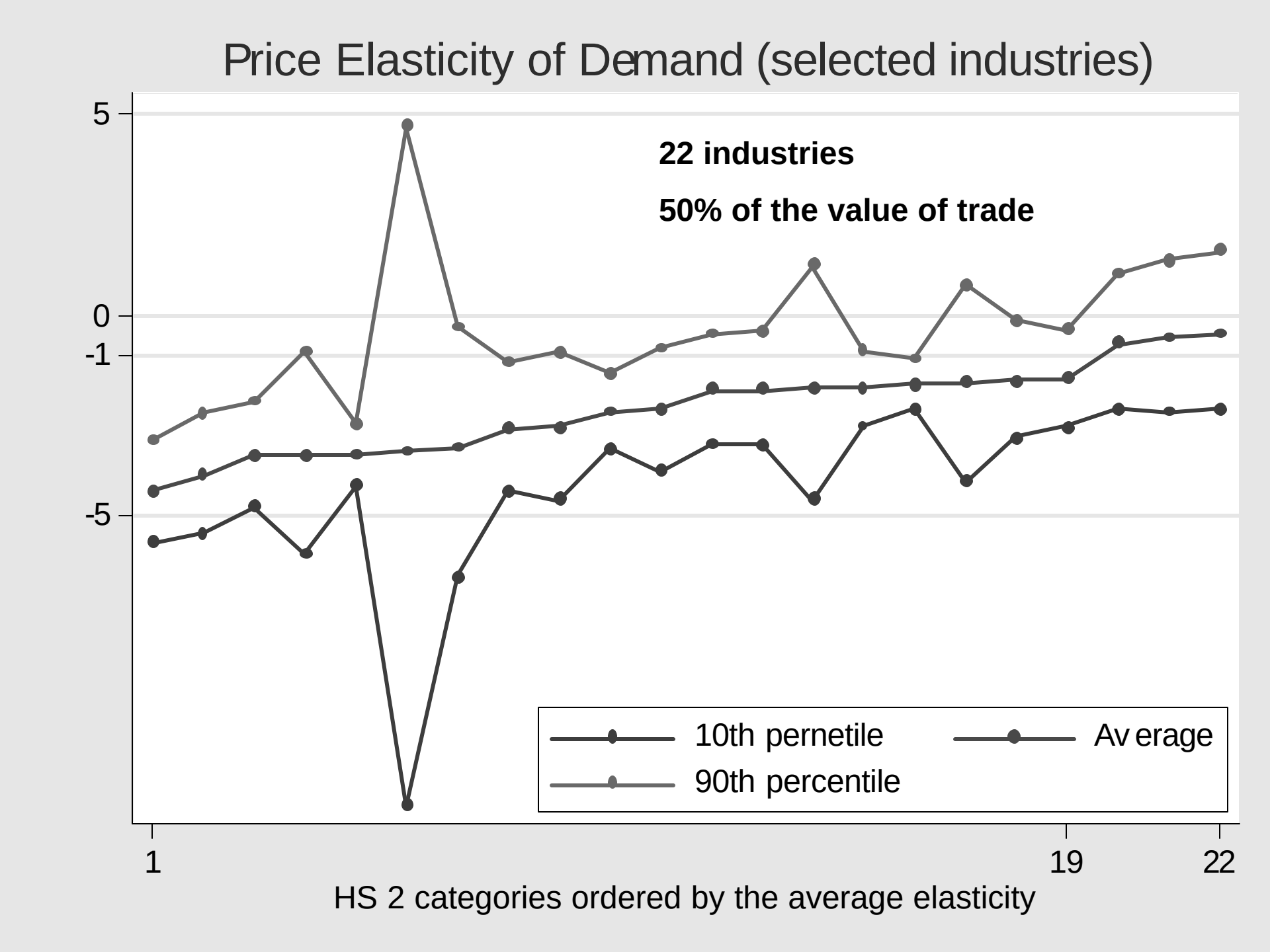




Both interaction terms are significant + correct signs




Price Elasticity of Demand (at GDP means)
10th pernetile
Av erage
90th percentile
10
0
-1
-10
1
67
83
96
HS 2 categories ordered by the average elasticity


Price Elasticity of Demand (selected industries)
22 industries
50% of the value of trade
5
0
-1
-5
10th pernetile
Average
90th percentile
1
19
22
HS 2 categories ordered by the average elasticity

Conclusions

- Love of variety models incorrectly predict variation in:
  - Prices
  - Import per variety
  - Number of imported varieties
- We generalize ideal variety framework to match existing empirical facts regarding:
  - Import per variety
  - Number of imported varieties
- New facts (matching ideal variety theory):
  - (Absolute value of) price elasticity of demand *increases* with importer GDP and *decreases* with importer income per capita.

? Variety space fills up.