Using Administrative Data to Calculate Export Price Indexes

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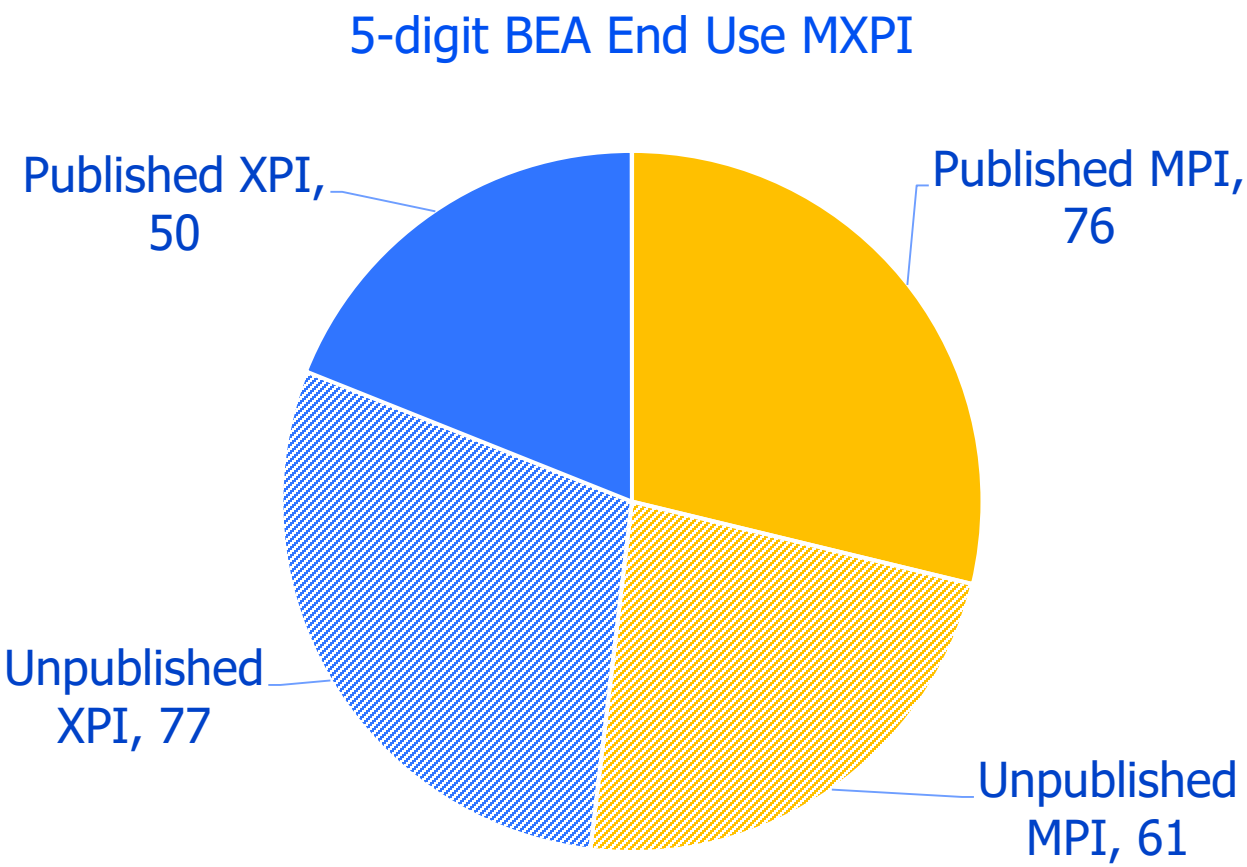
Official Import & Export Price Indexes – The Basics

Official Import & Export Price Indexes

- Challenges
  - Staff reduction → Sample size constraints
    → Half of detailed price indexes not publication quality
  - Concentration of large companies
    → High impact on nonresponse rate
- Opportunities
  - Administrative Trade Data
    → Exponentially more items and prices
    → Expand number and deepen coverage of indexes

Published Share of All 5-digit MXPI



Using Administrative Trade Data for Price Indexes

Recent prototype of 2 UV indexes adresses:

- Not unique items, just similar items
- Not able to track across months
- Use an ‘average price’ concept
- Shipment records don’t provide detailed product information

Not yet addressed:

- Not timely enough for news release

Research Questions

- Can average prices and unit value indexes be used in MXPI?
- If so, which ones?

Unit Value Bias

Matched Model – Actual Price of Unique Item

Unit Value – Average Price of Similar Groups of Items

MXPI Survey vs. Admin Data

MXPI Survey

- Matched model
- Current actual Price
- Sample size limits representative coverage
- 20k items/month
- Nonresponse rate and participation

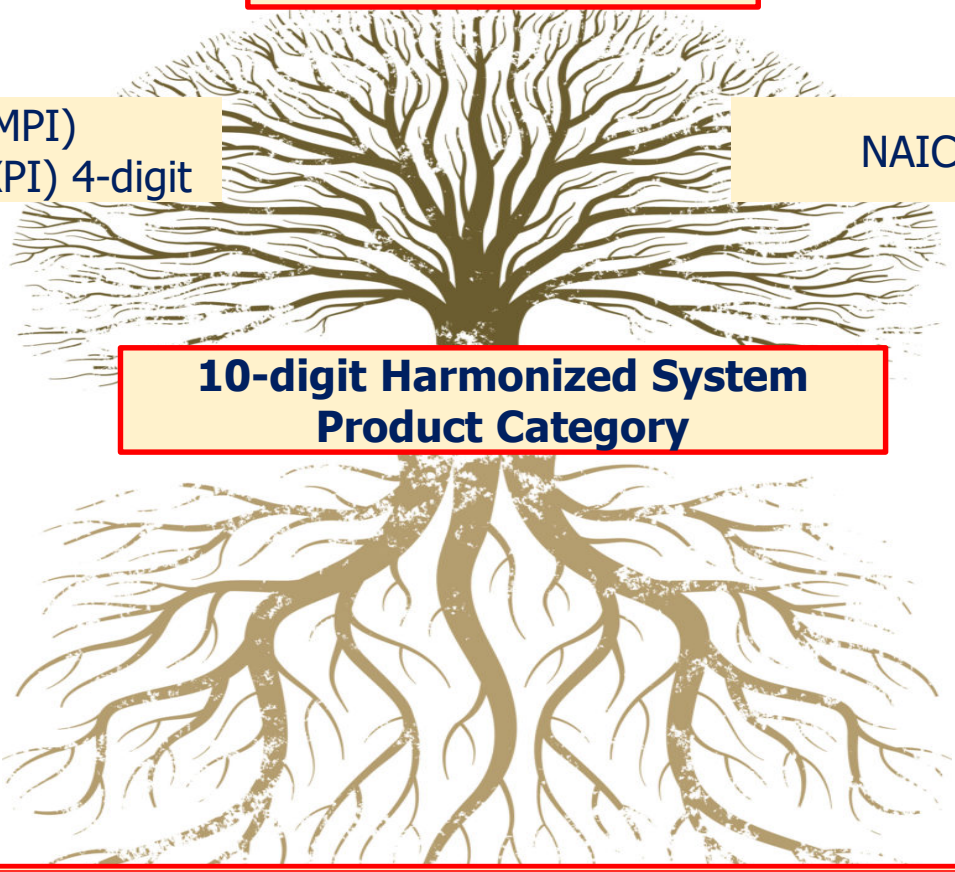
Administrative Trade Data

- Unit values – Total $ value & Q
- Current avge price and Quantity
- No constraint on representative coverage
- Millions of items/month
- Unit value bias and outliers

Research Questions

- How do we select unit value indexes without unit value bias?
- What is the impact of administrative trade data source and new BLS methods on GDP measurement thru Net Trade?

Import & Export Price Indexes



Upper Level Strata

Lower Level Strata

Entry Level Item

Unit Value Calculation - ELI

$$p_{K_i}^{(j,t),H} = \frac{\sum_{z \in i} p_{K_{i,z}}^{(j,t),H}}{|z|}$$

$$p_{(j,t)}^{H} = exp\left(\frac{\sum_{i \in j}\left[w_{K_i}^{(j,t),H} \cdot ln\left(p_{K_i}^{(j,t),H}\right)\right]}{\sum_{i \in K} w_{K_i}^{(j,t),H}}\right)$$

Lower Level Strata Calculation

- Tornquist

$$I_{t,0}^{T} = \left\{ \prod_{i} \left(\frac{P_{i,t}}{P_{i,0}} \right)^{\frac{(W_{i,0}+W_{i,t})}{2}} \right\} * 100$$

- where $W_{i,t} = \left(\frac{P_{i,t}Q_{i,t}}{\sum_i P_{i,t}Q_{i,t}} \right)$ $W_{i,0} = \left(\frac{P_{i,0}Q_{i,0}}{\sum_i P_{i,0}Q_{i,0}} \right)$

Upper Level Strata Calculation

- Laspeyres

$$I_{t,0}^{L} = \left(\frac{\sum_i P_{i,t} Q_{i,0}}{\sum_i P_{i,0} Q_{i,0}} \right) * 100$$

Admin Data Address Criticisms of Current Methodology

- Lower Level Substitution Bias
- Upper Level Substitution Bias
- Product Bias
- Country Substitution Bias
- Quality Bias
- Outsourcing Bias

Research Approach

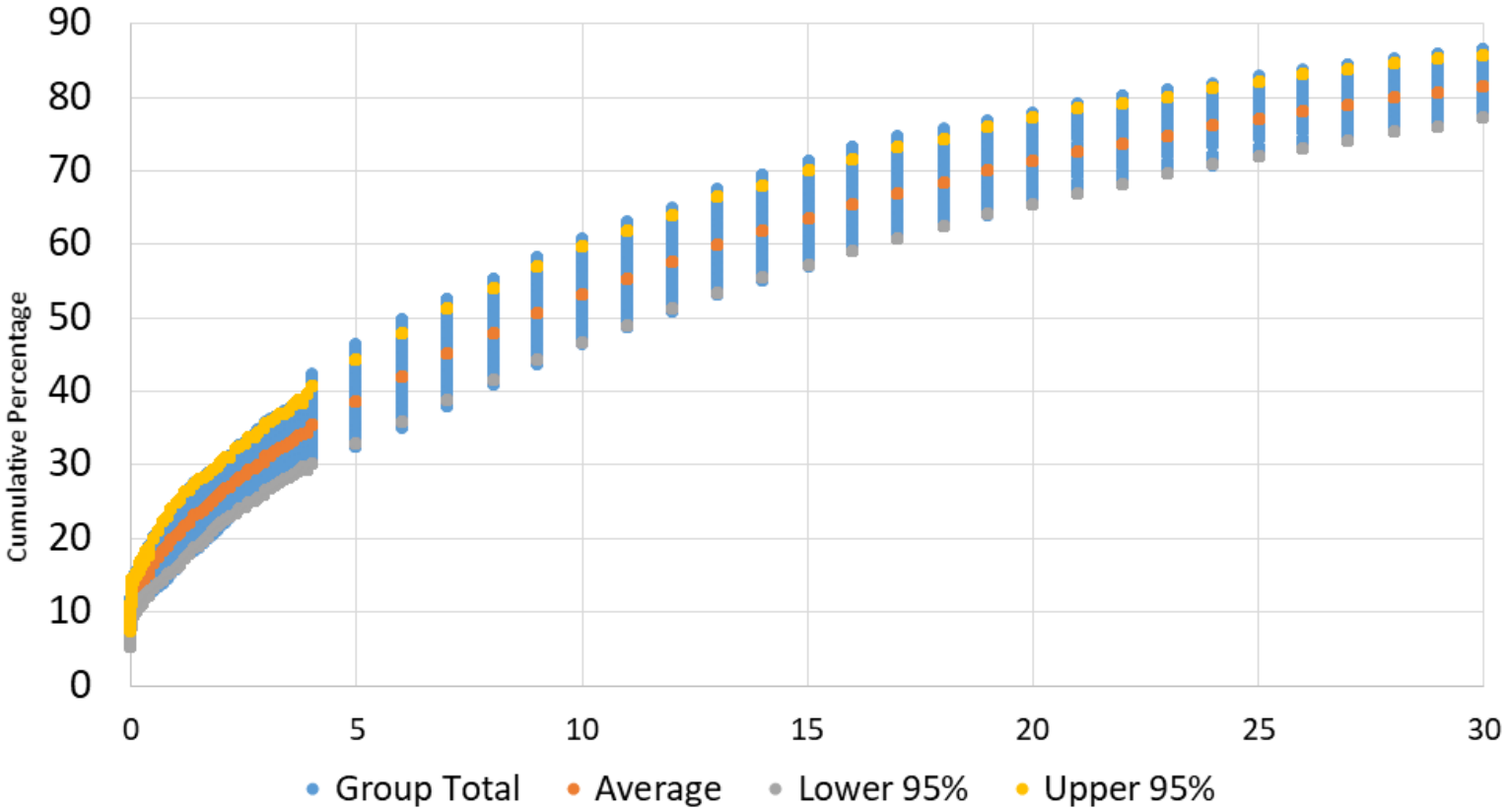
- Jan 2012-Dec 2017
- 200 million trade records
- Create monthly STRs w/ new methodology
- Create LTRs w/ current methodology

- Unique ELIs share
  - 10-digit Harmonized System code
  - Employer ID
  - Domestic/Foreign Content
  - State of Origin
  - Country of Destination
  - Unit of Measure
  - Intercompany Trade

Research Approach

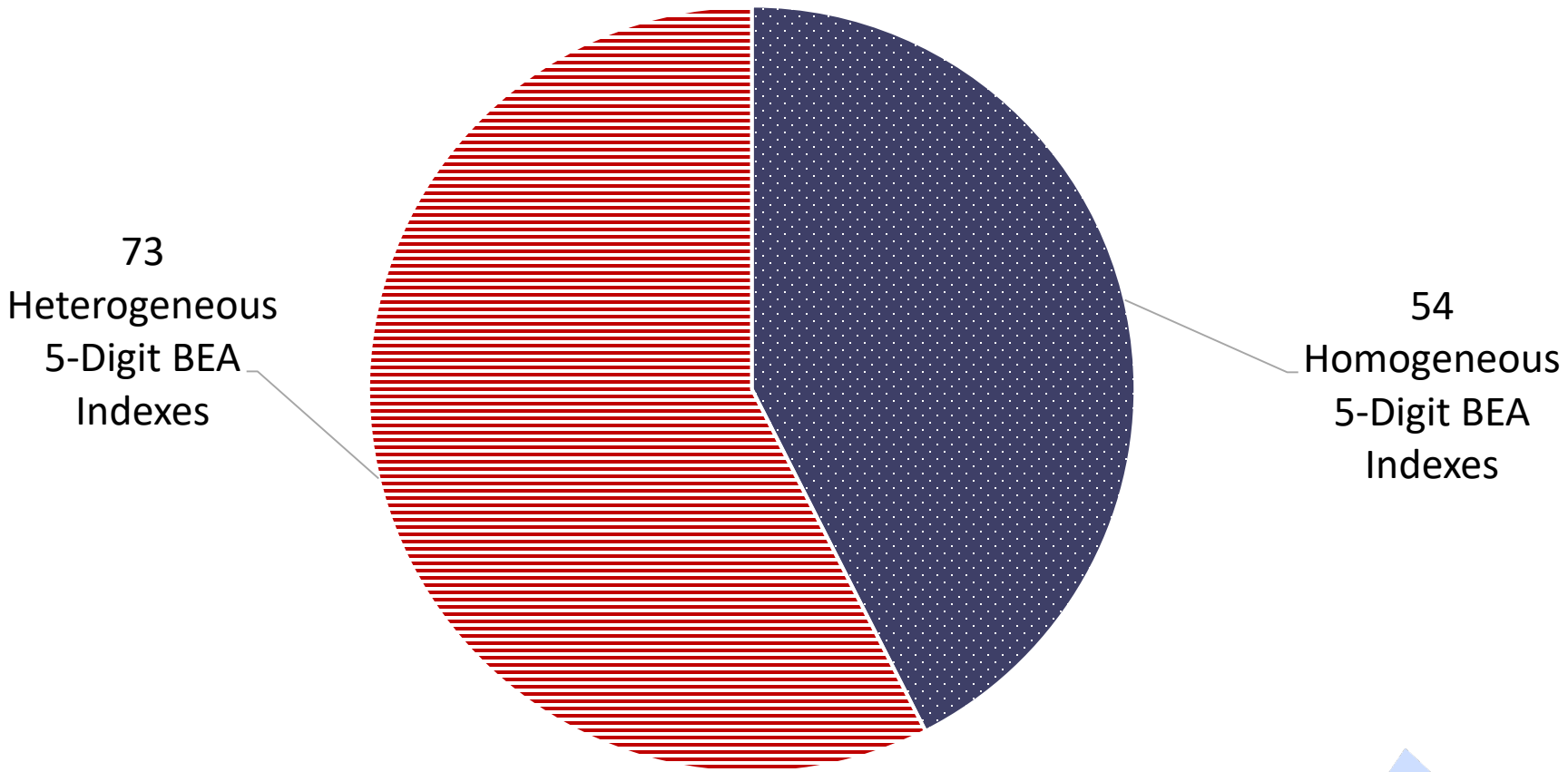
- Calculate 127 5-digit BEA End Use unit value indexes
- Test for homogeneity
- Test other ‘best fit’ characteristics vs. official comparable price index
- Group unit value indexes by quality
- Determine impact on real value of exports

Homogeneity "Floor" – Vegetable Price STRs Coefficient of Variation

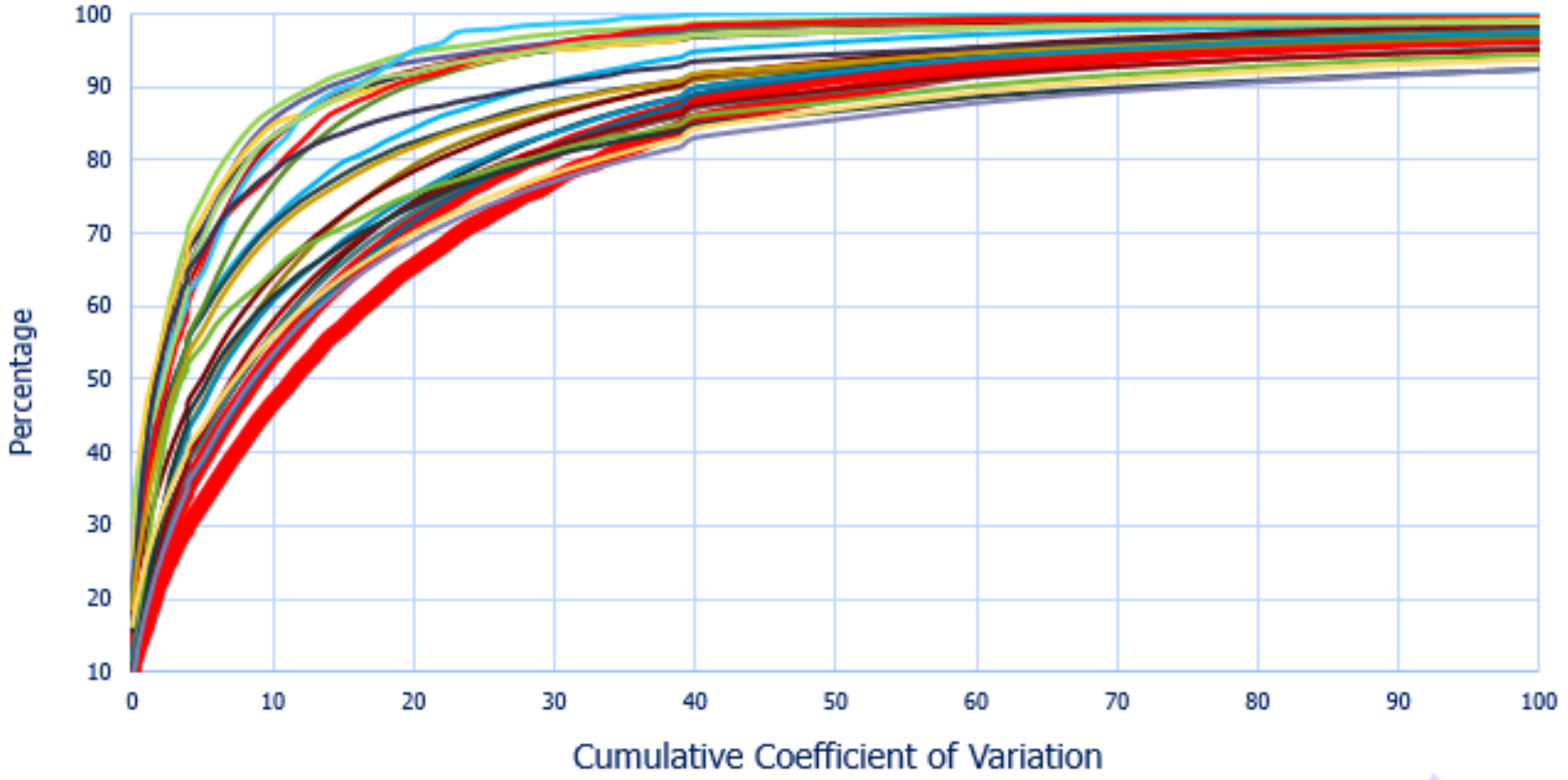


Note: STRs of ELIS based on concatenations of price related characteristics: Domestic/Foreign (F), EIN (E), State of Origin (S), Country of Destination (C), Unit of Measure (Q), Related Transaction (R) and HS

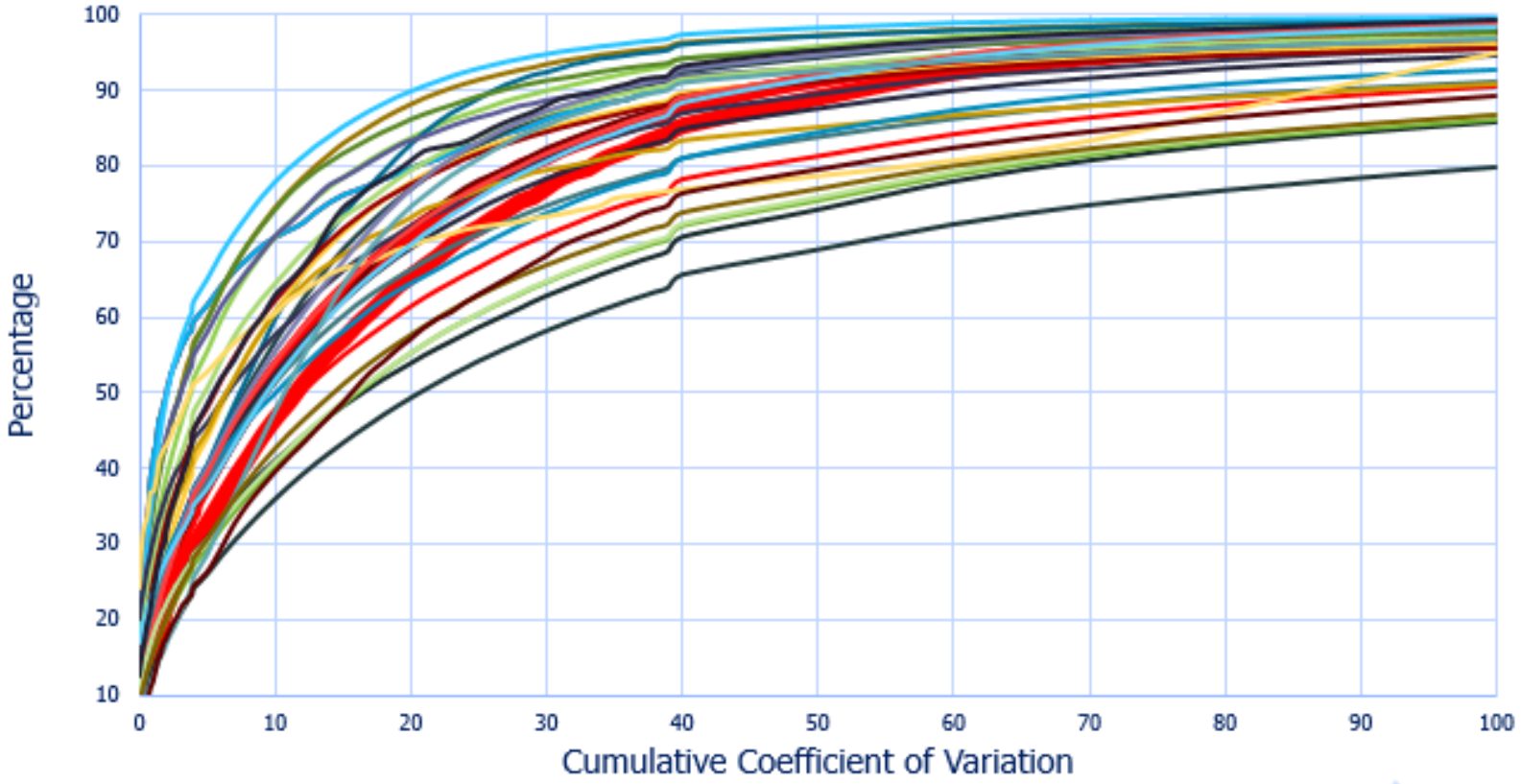
Homogeneous and Heterogeneous based upon the CV Test n=127



Coefficient of Variation for “Good" Indexes based upon the CV test



Coefficient of Variation for "Undecided" Indexes based upon the CV test



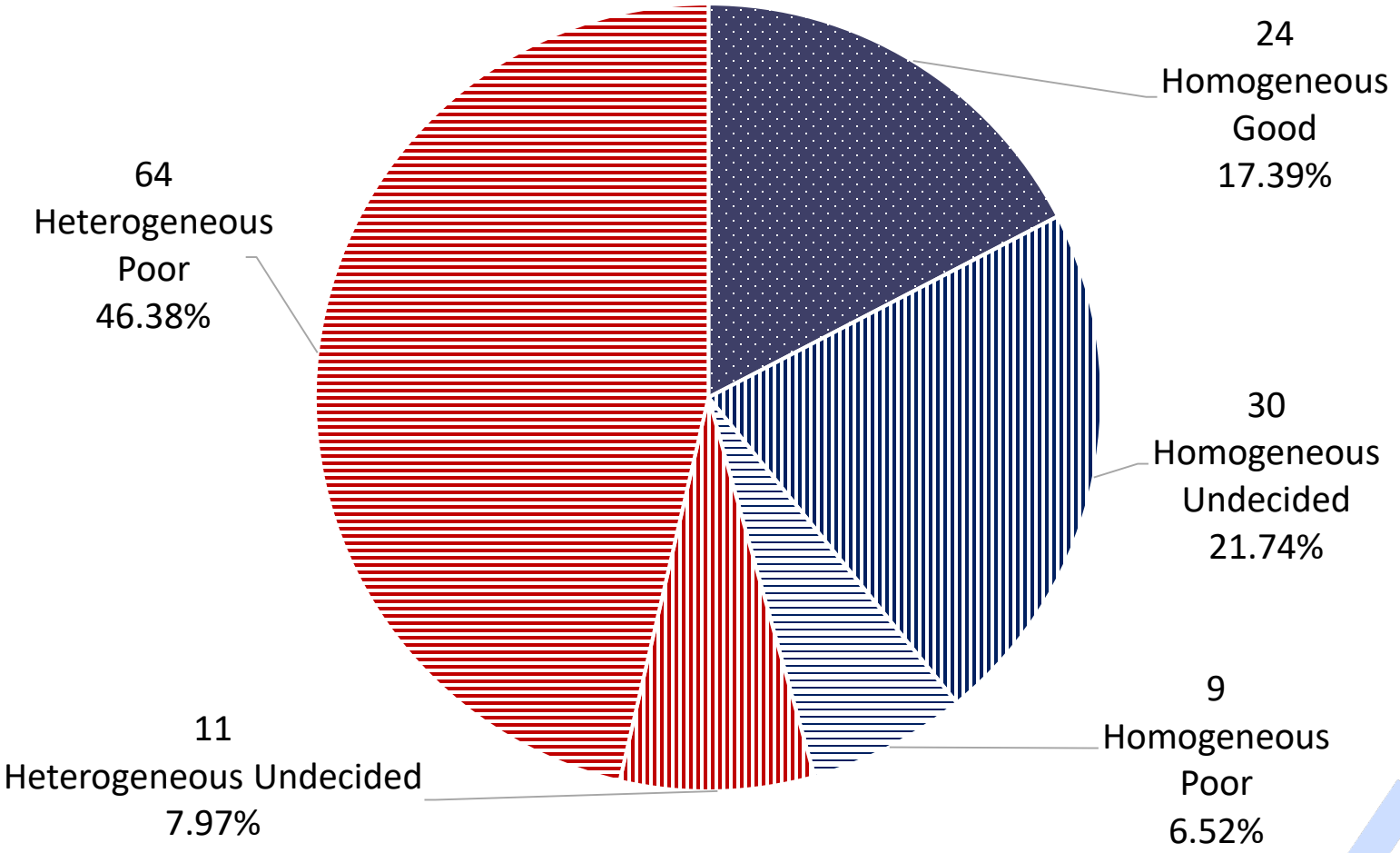
N=28

5-digit Export UV Indexes by Quality

Homogeneous/ Heterogeneous	Index Quality	Number of 5-digit BEA End Use U.V. Indexes	Trade Dollar Value, 2015 In millions	Percent Trade Weight
Homogeneous	**Good**	**24**	**$328,869**	**22.5**
Homogeneous	Undecided	19	$150,099	10.3
Heterogeneous	Undecided	11	$136,100	9.3
Homogeneous	Poor	9	$68,781	4.7
Heterogeneous	Poor	64	$777,116	53.2
ALL INDEXES		127	$1,460,964	100.0

All Export Indexes by Category

n=127



Quality Groups of the 5-Digit BEA Research Indexes

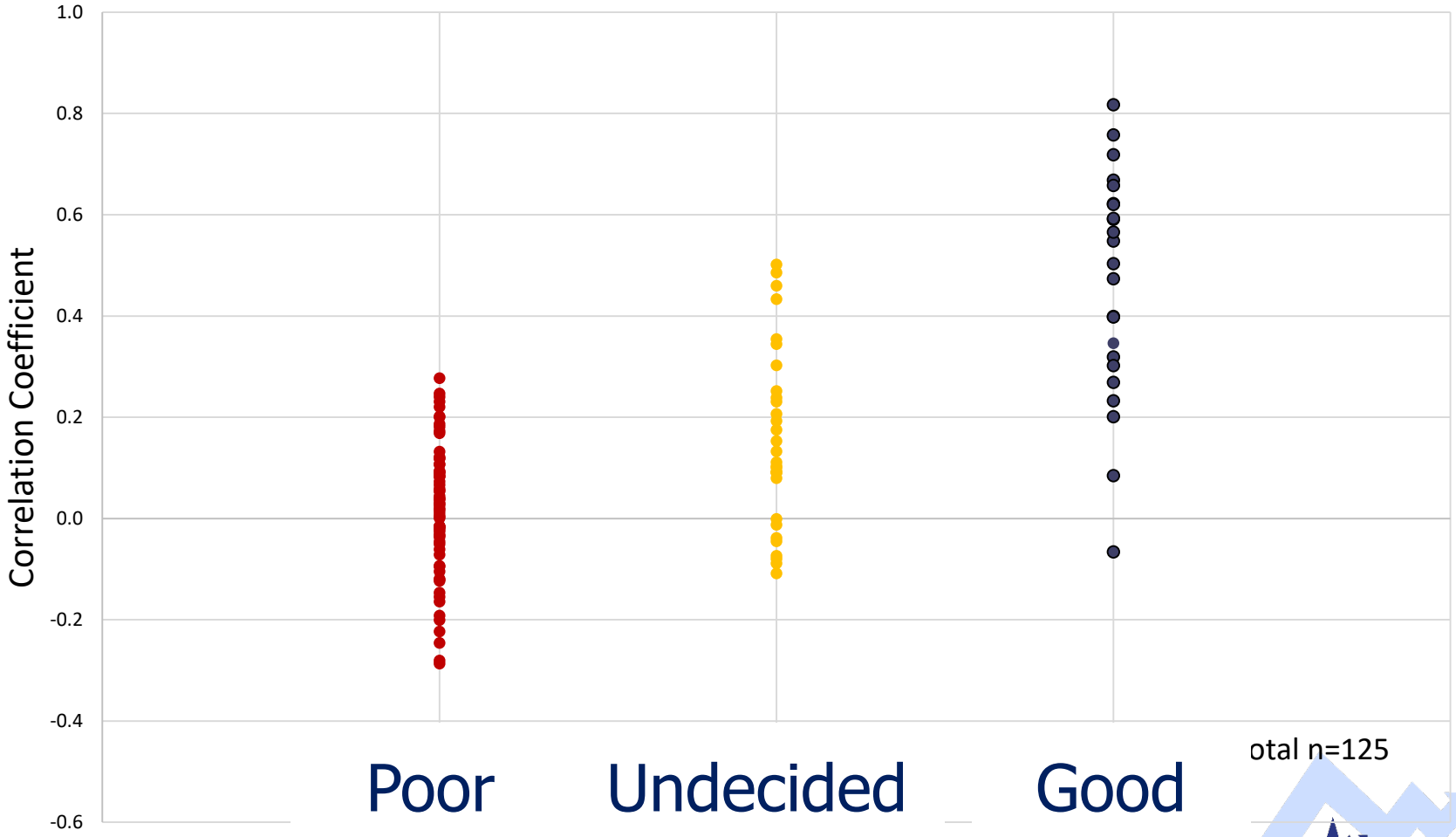
- Good - Homogeneous products that pass all mean and SD tests, and at least one of the three statistical tests.
- Undecided - HM and HT products that demonstrate potential bias, but with changes in methods may produce a quality index.
- Poor – There is not enough detail in the item characteristics to validate it is a homogenous item.

Average Index Value Variability by Quality Groups

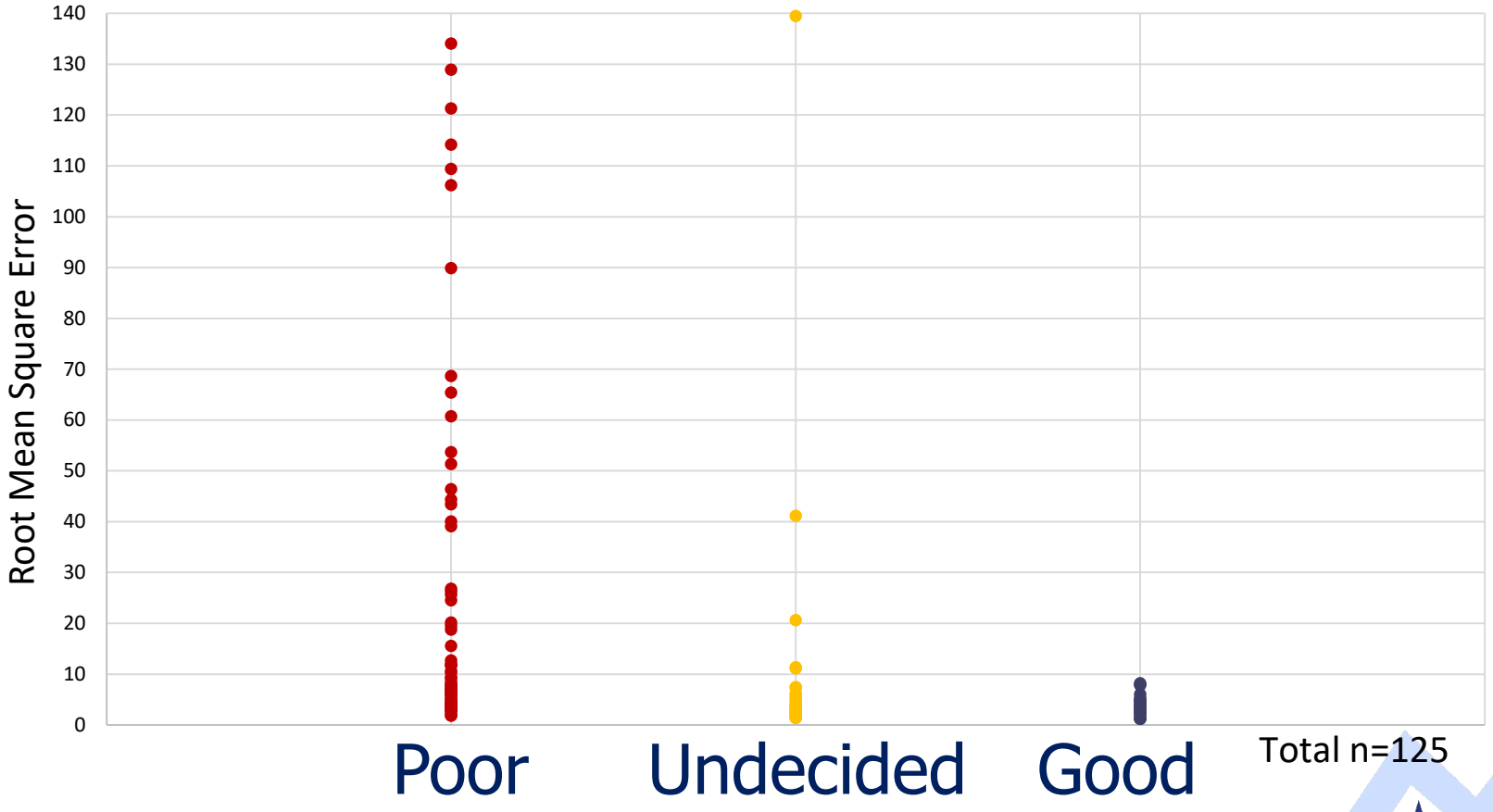
(January 2012-December 2017)
Jan. 2012 = 100

	Mean Official XPI Values	Mean Unit Value XPI	Std. Dev. Official XPI	Std. Dev. Unit Value XPI
Good	89.6	90.9	13.4	11.2
Undecided	98.2	106.0	8.6	13.9
Poor	100.7	220.6	4.4	158.9

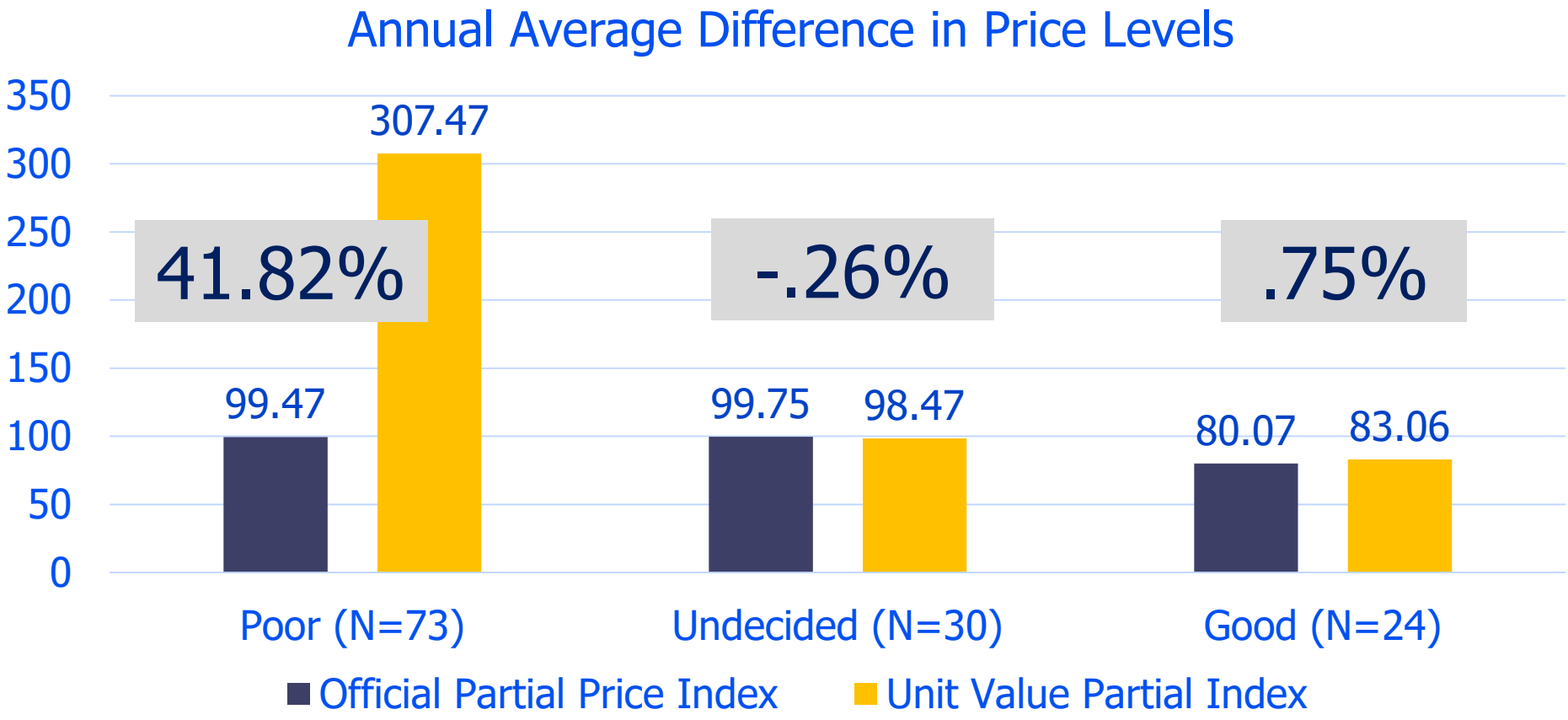
Distribution of Correlation Coefficients by Quality Groups



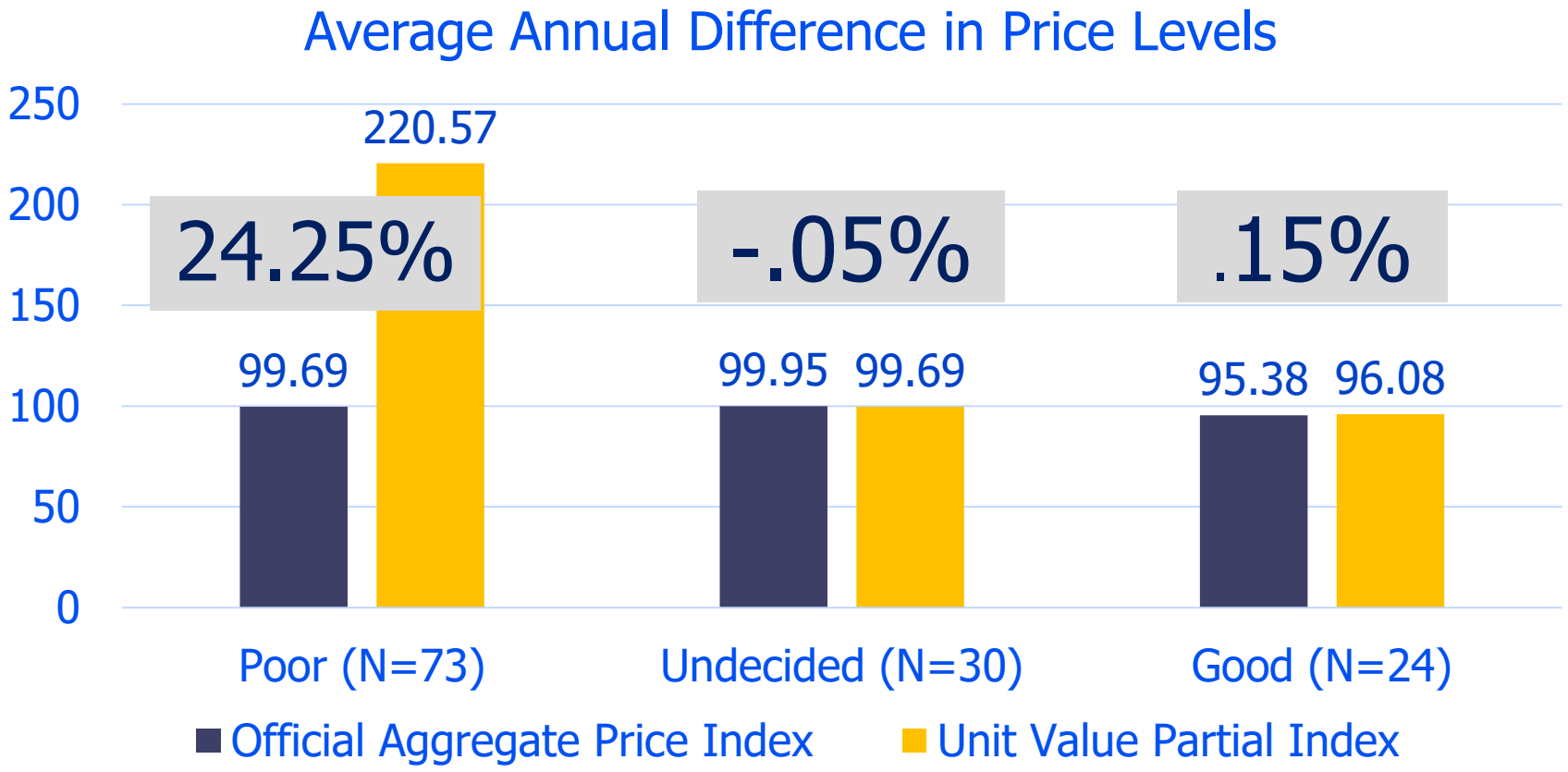
Distribution of Root Mean Square Errors by Quality Groups



Partial 5-digit BEA XPI, Dec 2017
(Jan 2012=100)

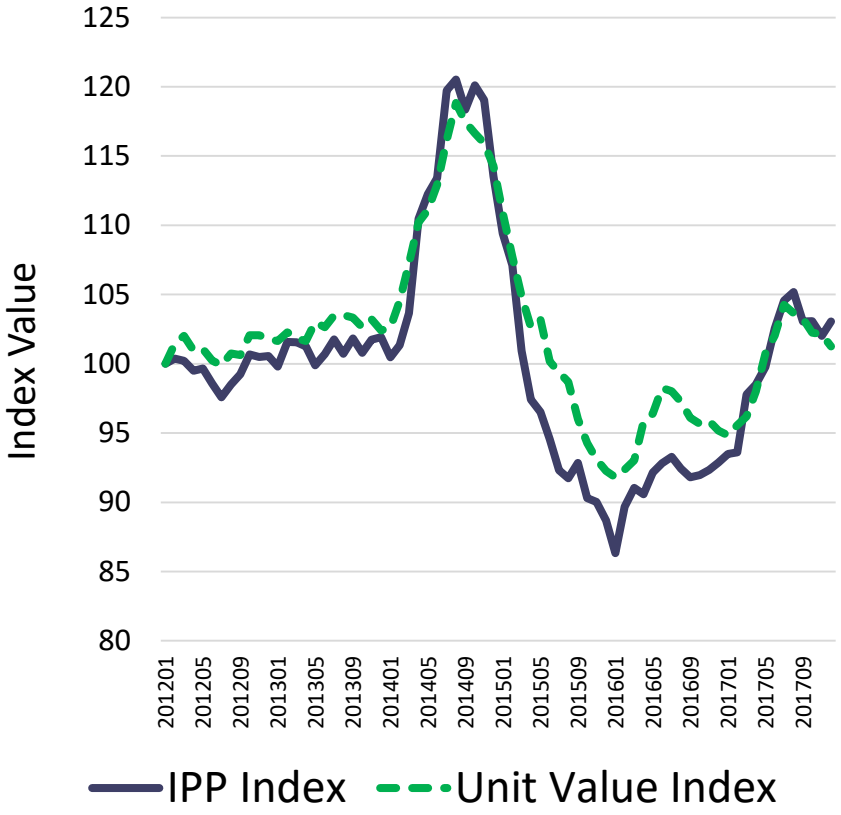


Top Level XPI, Dec 2017
(Jan 2012=100)

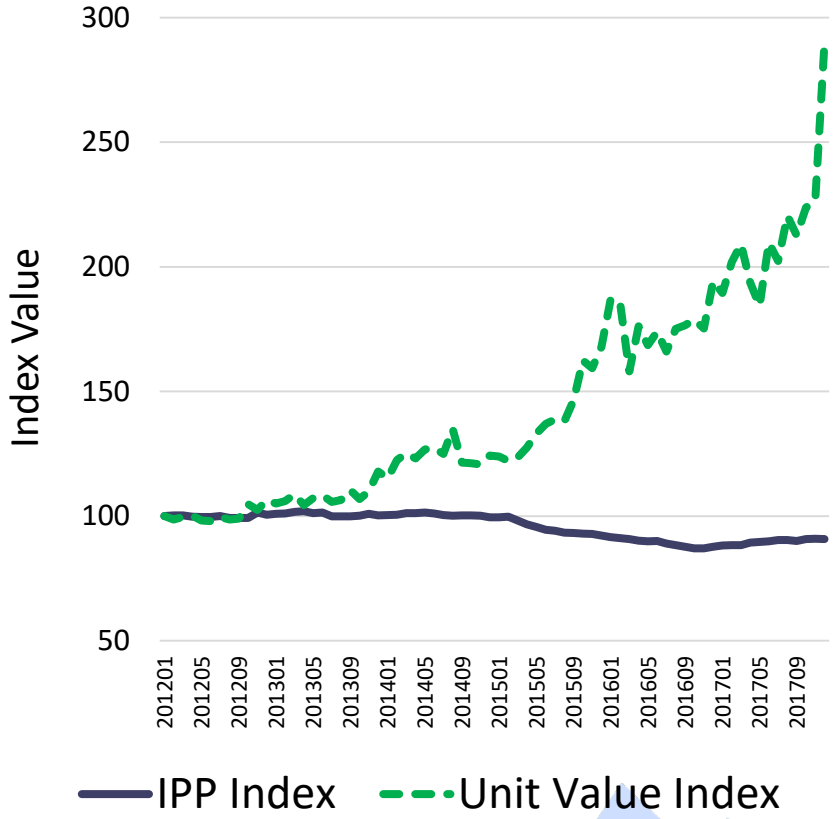


Official and Unit Value Price Indexes Homogeneous and Heterogeneous

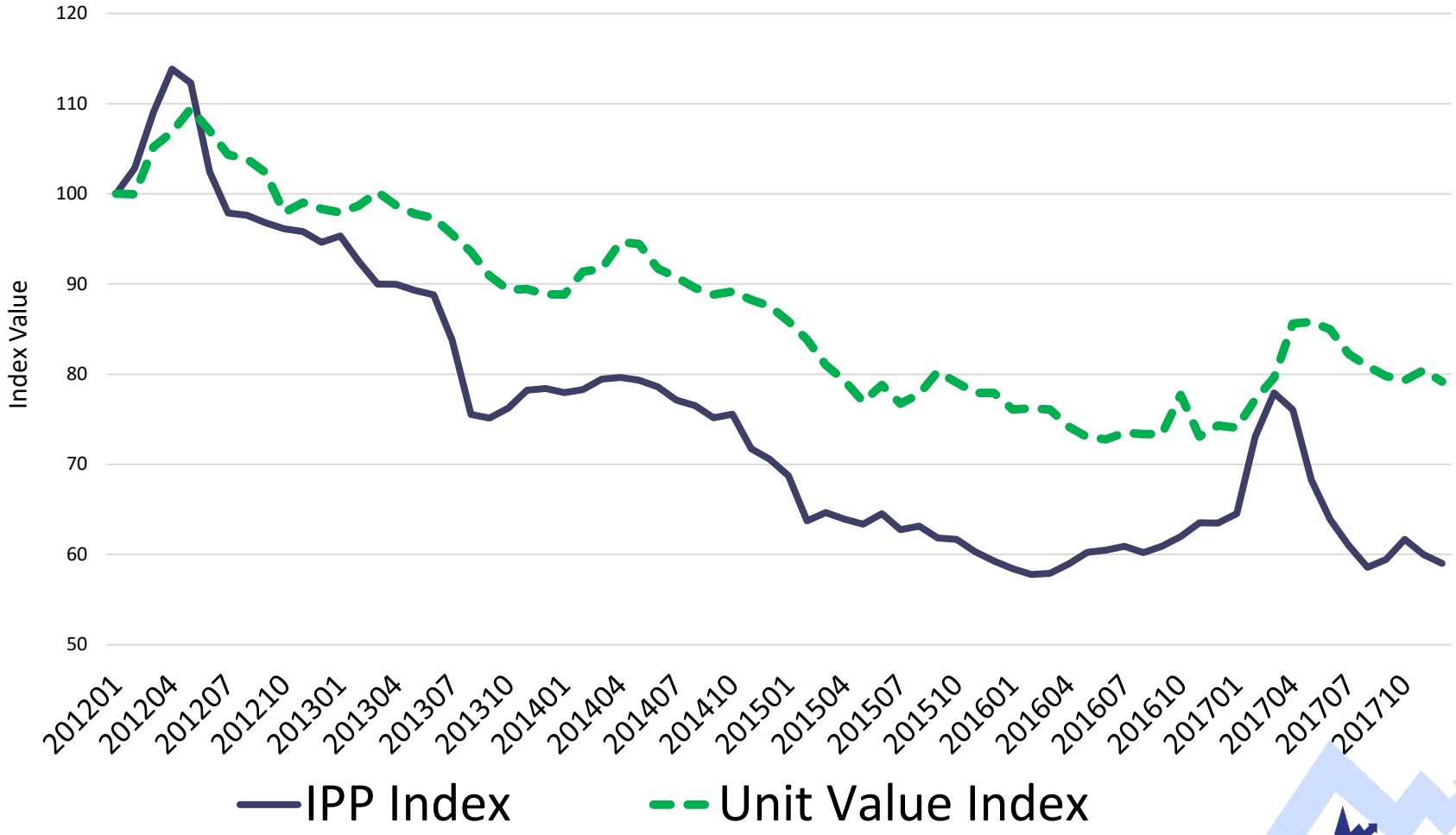
HM-Meat&Poultry



HT-Computer Parts



Official and Unit Value Index Comparison – Synthetic Rubber-Primary



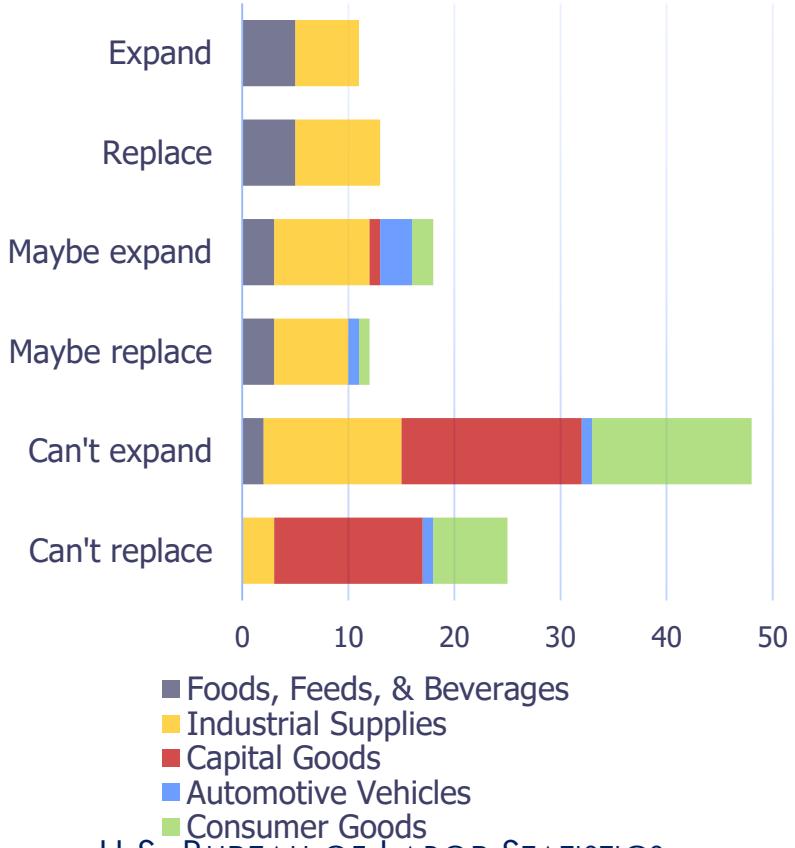
Tornquist Index Formula Bias?

- By using Tornquist
  - Flattens index trends in both + and - directions
  - Changing weight values increase STR variability

Potential Impact on 5-digit BEA End Use Price Indexes

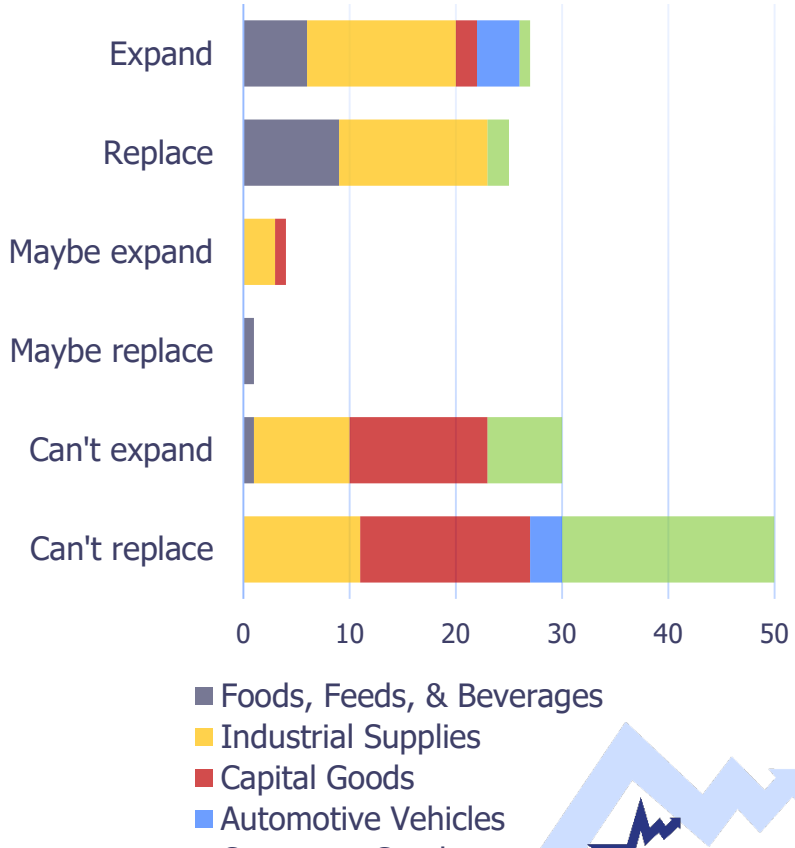
Export 5-digit N = 127

Expand + Replace = 24-54



Import 5-digit N = 137

Expand+ Replace = 52



Conclusion

- Homogeneous unit value indexes can be used in price indexes
  - Create items that approximate matched model
  - Intra-Item Substitutability bounds homogeneity
  - Homogeneity minimizes unit value bias
  - Need detailed and consistent item keys for homogeneity
  - The Coefficient of Variation Test performs well at identifying homogenous areas
  - Homogeneity is defined judgmentally

Conclusion

- Improvements
  - SOME Similar items are unique enough
  - Addressed all calculation problems except for timeliness of data availability
  - The Tornqvist index formula corrects for new goods/substitution/volatility of trade.

Conclusion

- Challenges
  - Variable monthly Q creates systemic flattening bias.
  - Greater variation of “Good” UV indexes than for “Undecided” UV indexes
  - Refining ‘Undecided’ UV index methods and definitions

Next Steps

Before finalizing an approach, we hope to:

- Use hedonic linear regressions to determine the ideal item key for 5-digit BEA indexes
- Explore the use of time-dummy hedonic models at the 10-digit based Harmonized level of classification
- Measure chain drift and investigate alternative aggregation methods

Next Steps

Critical path before deciding whether to operationalize:

- Research import unit value indexes
- Partial month data for preliminary measures

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Use of the export trade data are subject to Agreement No. 2067-2018-001, Memorandum of Understanding (MOU) between the U.S. Census Bureau and the Bureau of Labor Statistics (BLS). The BLS has received prior approval from the U.S. Census Bureau, which affirms that the research results do not present disclosure risks and approve the publication of the results.