Improving Nowcasts for the U.S. Census Bureau Index of Economic Activity (IDEA)

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Presenter:
Elizabeth Marra Viehdorfer, U.S. Census Bureau

Authors:
Jose Asturias, William Bell, Rachel Butler, Rebecca Hutchinson,
Tucker McElroy, Valerie Pianin, Jenny Thompson, Rebecca Weaver,
all at the U.S. Census Bureau

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Disclaimer

Any opinions and conclusions expressed herein are those of the author(s) and do not reflect the views of the U.S. Census Bureau.

The Census Bureau has reviewed this data product to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data (Project No. P-7530992, Disclosure Review Board (DRB) approval number: CBDRB-FY24-ESMD010-001)

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What is the IDEA?

- U.S. Census Bureau Index of Economic Activity (IDEA) is an aggregation of 15 of Census Bureau's primary economic data series. These widely watched indicators are a large part of U.S. economic activity
- Provides a timely synthesis of activity in
  - Retail and wholesale trade
  - Manufacturing
  - Construction
  - International trade
  - Business formation
- We use Principal Component Analysis (PCA) to construct the index. One interpretation is that there is a latent variable that drives the co-movement of all the underlying series. PCA tries to estimate this latent variable to construct the index from growth rates of the input series
- Similar methodology is used to construct other indices:
  - Chicago Fed National Activity Index (CFNAI) issued by Federal Reserve Bank of Chicago
  - Weekly Economic Index (WEI) issued by Federal Reserve Bank of New York

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Data series used in Economic Index

Series	Source	Sector	PCA Weight*
Exports of Goods and Services	International Trade: Goods & Services	International Trade	0.365
Manufacturing Value of New Orders	Manufacturers' Goods	Manufacturing	0.363
Imports of Goods and Services	International Trade: Goods & Services	International Trade	0.345
Manufacturing Inventories	Manufacturers' Goods	Manufacturing	0.330
Wholesale Trade Inventories	Advance Economic Indicator Report	Wholesale	0.305
Retail Inventories	Advance Economic Indicator Report	Retail	0.283
New Orders for Durable Goods	Advance Report Durable Goods	Manufacturing	0.265
Retail Trade and Food Services Sales	Advance Monthly Retail Trade	Retail	0.258
Total Construction Spending	Construction Spending	Construction	0.231
Housing Units Authorized in Permit-Issuing Places	New Residential Construction	Construction	0.225
Housing Units Started	New Residential Construction	Construction	0.216
New Single-Family Houses for Sale	New Residential Sales	Construction	0.197
Housing Units Completed	New Residential Construction	Construction	0.072
New Single-Family Houses Sold	New Residential Sales	Construction	0.046
Business Applications	Business Formation Statistics	Business Formations	0.019

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*Weights as of 08/14/2024

Source: Index of Economic Activity

Methodology

- For each seasonally adjusted component series, we calculate the month-to-month growth rates and standardize them to have a mean 0, and variance 1

$$\text{Growth Rates: } X_t = \log Y_t - \log Y_{t-1}$$

- We apply Principal Component Analysis (PCA) to the 15 rescaled series and use the first principal component as weights

- Example: If we have variables X1 and X2 then we find weights w1 and w2 to calculate index, w1*X1 + w2*X2 (first principal component)

- This is a monthly index; however, weights are updated once, annually. This helps to avoid noise being introduced into the index by changing weights

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Principal Component Analysis

- PCA computes the eigenvalues and eigenvectors of the correlation matrix for the 15 rescaled economic data series

- The elements of the eigenvector corresponding to the largest eigenvalue define the weights for the index

- This weighted linear combination of the variables has maximum variance over all linear combinations whose squared weights sum to 1
  - Since the weights don’t sum to 1, we standardize the index using the mean and standard deviation calculated over the time span August 2004 to May 2024, excluding March 2020 to August 2020, so that the final index has mean 0 and standard deviation 1

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Application to Census Data

- We apply this methodology to the monthly “headline” principal federal economic indicators (PFEIs) issued by Census
  - PFEIs are widely watched and are a large piece of the U.S. economy

- We use a timespan starting from August 2004 through the most recent May, excluding the data values from March 2020 through August 2020 to account for the effects of COVID-19

- We use the publicly available Census API* to download data series and run our methodology using R

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*Source: Economic Indicator data available in the Census API

Census.gov

- IDEA serves as a complement to the Economic Indicators dashboard
- IDEA is located above the Briefing Room cards

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Source: [Census Bureau Economic Indicator Briefing Room]

Census.gov

Last updated 11:30 AM August 29, 2024

- Process Control chart that characterizes whether economic activity is within a normal range, represented by the darker blue bands*
- Great Recession and COVID-19 pandemic clearly reflected in index

*Index graph as of 8/29/2024

Source: [Census Bureau Economic Indicator Briefing Room]

Challenges

1. Data revisions
   - historic data revisions
   - seasonal adjustment
   - benchmarking
   - advance vs. preliminary vs. revised estimates
2. The index is updated each business day as new values of any of its input data sources are released to the public, however;
   - Indicators are published at different dates during the month
   - These release dates can change from month to month, including the order in which these series are released

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Nowcasting Framework

For any given day in a month, between 1 and 15 indicators have been published. The missing indicators can be imputed via nowcasting:

- Projection based on past time series data and present cross-sectional data
- Use a fitted order 1 Vector AutoRegression (VAR1) to nowcast the not yet released indicators for that month
- Fitted over the model span of the 15 economic data series using the Yule-Walker equations
- PCA weights are applied to observed and nowcasted values throughout the month

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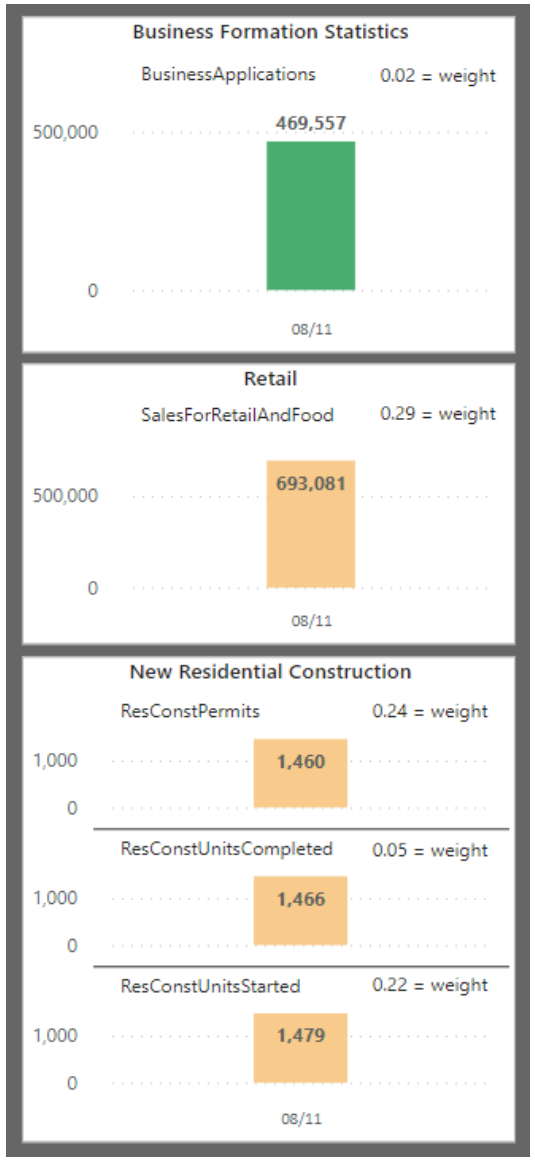
Nowcasts in Action

July 2023 Input Values as of 8/11



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Index = 0.11

Key

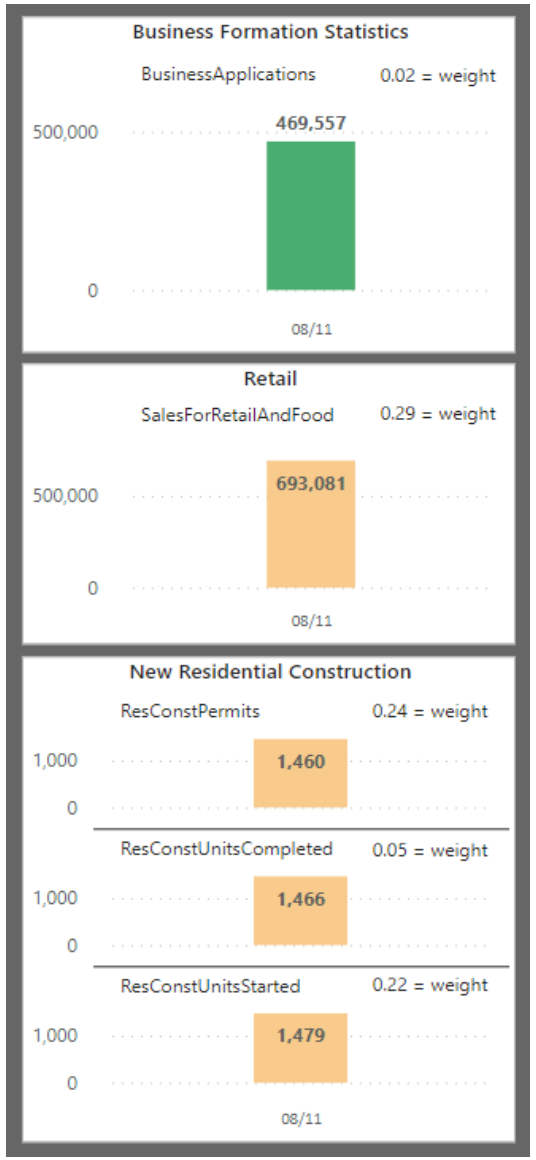
Green – Actual Values

Yellow – Nowcast Values

Source: Index of Economic Activity

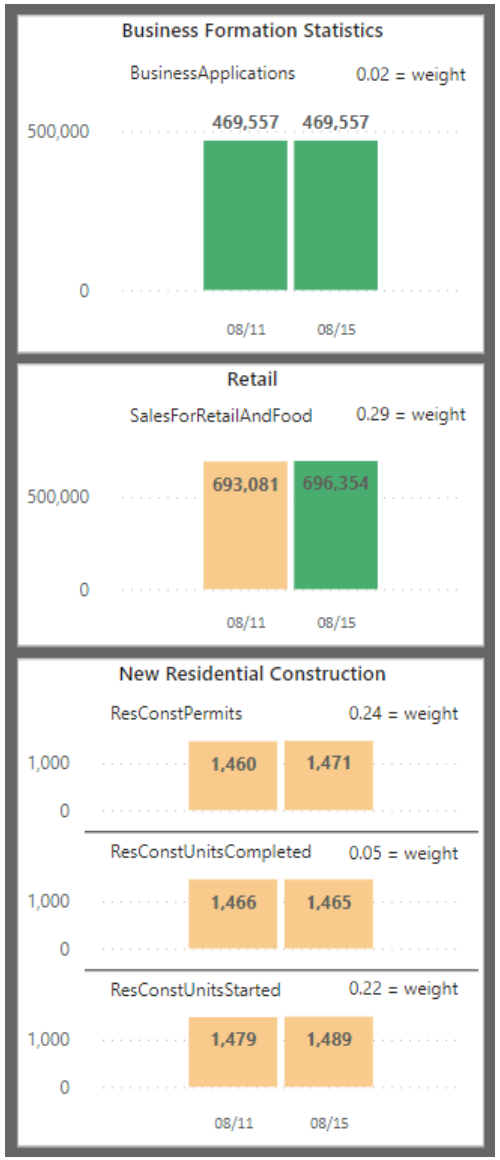
Nowcasts in Action

July Input Values as of



Index = 0.11

July Input Values as of 8/15



Index = 0.20

Key

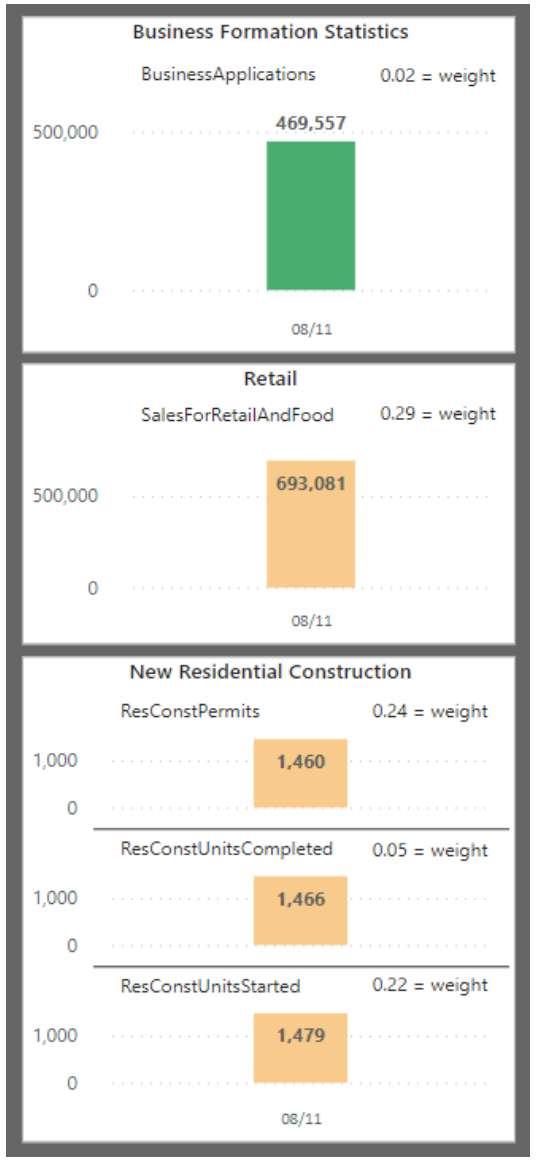
Green – Actual Values

Yellow – Nowcast Values

Source: Index of Economic Activity

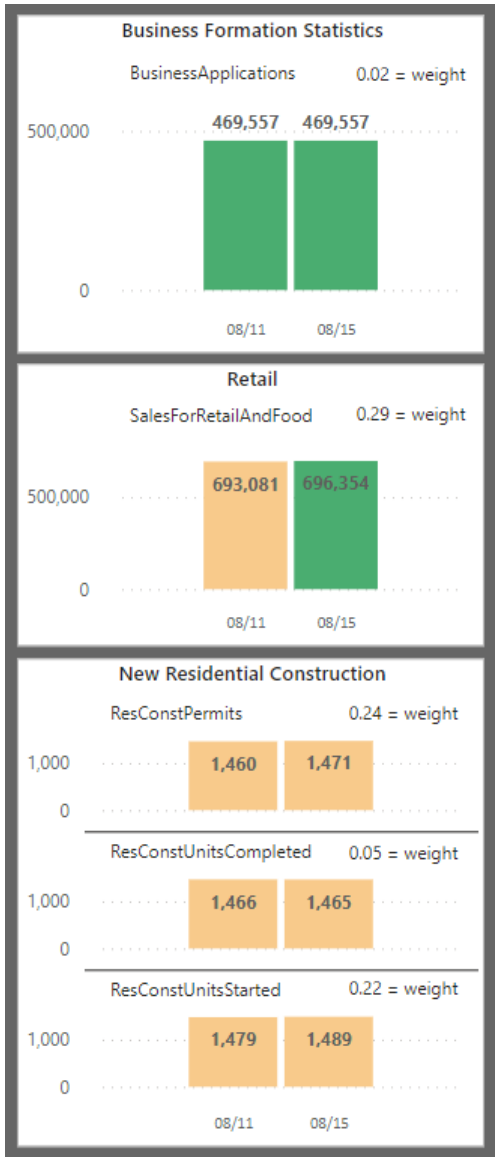
Nowcasts in Action

July Input Values as of



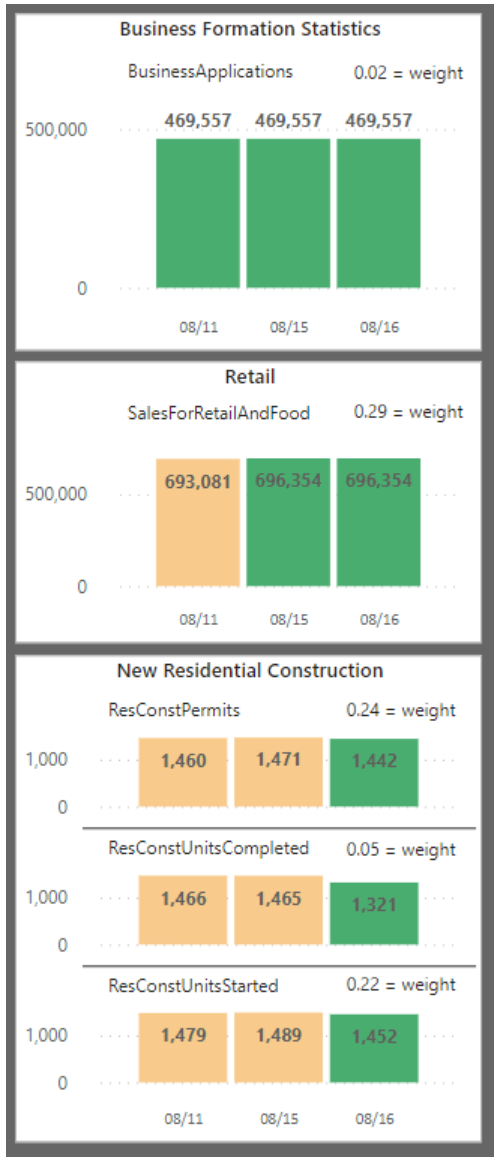
Index = 0.11

July Input Values as of 8/15



Index = 0.20

July Input Values as of 8/16



Index = 0.14

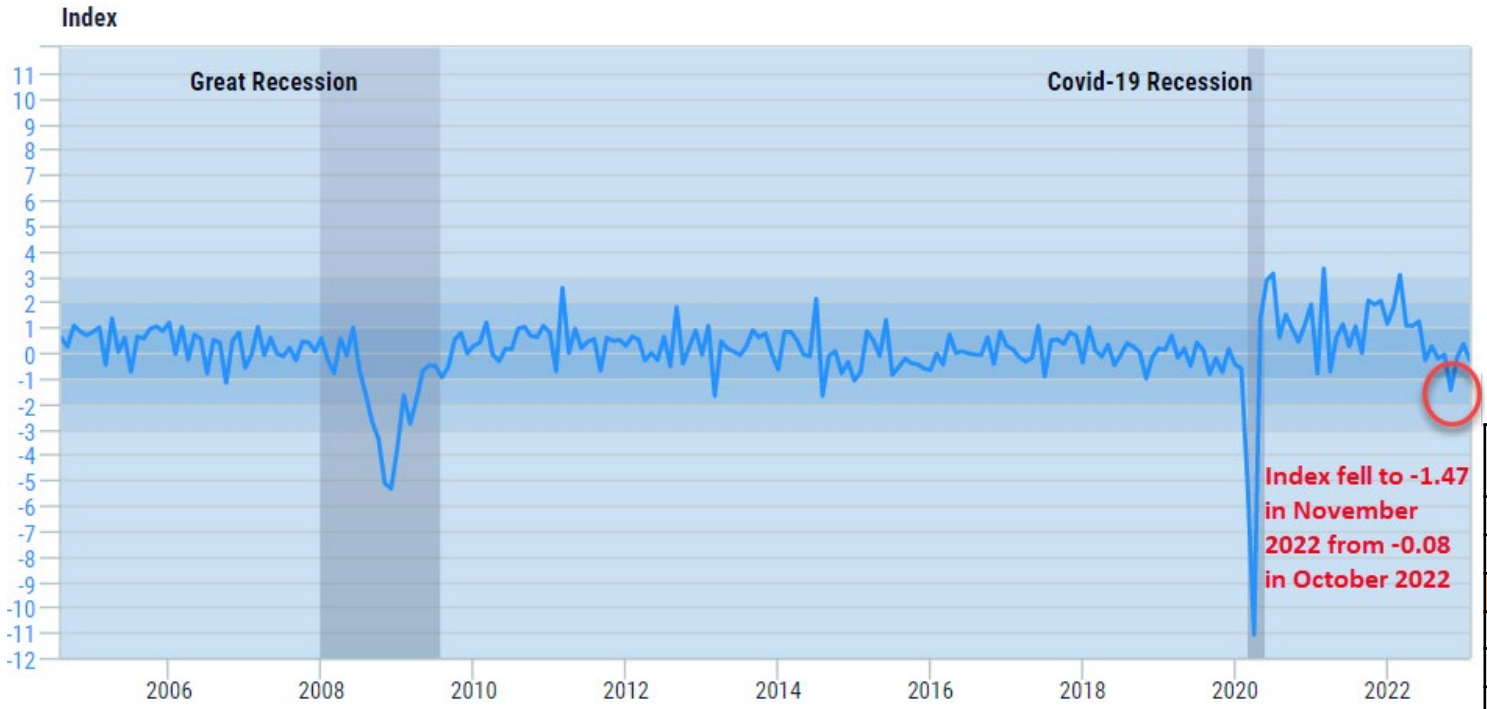
Key

Green – Actual Values

Yellow – Nowcast Values

Source: Index of Economic Activity

What is causing movement in the index?



November 2022

Series	Month-to-Month % Change	PCA Weight
Manufacturing Value of New Orders	-1.93	0.37
Exports of Goods and Services	-1.82	0.36
Imports of Goods and Services	-6.34	0.34
Manufacturing Durable Goods Inventories	0.03	0.34
Retail Inventories	-0.04	0.30
Retail Trade and Food Services Sales	-1.07	0.28
New Orders for Durable Goods	-1.80	0.28
Wholesale Trade Inventories	0.82	0.28
Housing Units Authorized in Permit-Issuing Places	-10.65	0.24
Housing Units Started	-0.49	0.22
Total Construction Spending	1.77	0.19
New Single-Family Houses for Sale	-2.15	0.17
New Single-Family Houses Sold	-1.19	0.07
Housing Units Completed	13.41	0.05
Business Applications	-3.12	0.02

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Source: Index of Economic Activity

International Trade Imports and Exports

- Often at Census we produce advance estimates of our monthly economic indicators
  - Example: Advance Retail Sales and Retail Sales*
- For the Index calculation we use these advance estimates until the full estimates are produced.
- The International trade program produces advance estimates of imports and exports; however, they differ from the full trade numbers in a few ways (see next slide)

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*Source: Advance Monthly Retail Trade Report and Monthly Retail Trade Report

International Trade Imports and Exports

Advance Imports and Exports

- Includes only Goods
- Census Basis

Full Imports and Exports

- Includes Goods and Services
- Balance of Payments Basis

Balance of Payments (BOP) vs. Census Basis: Goods on a Census basis are adjusted by the U.S. Bureau of Economic Analysis to goods on a BOP basis. Broadly, the adjustments include changes in ownership that occur without goods passing into or out of the customs territory of the United States.

Description of the International Trade Statistical Program (census.gov)

*Sources: Advance Economic Indicators Report and International Trade in Goods and Service Report

Typically we do not use the word "Full" to represent the preliminary estimates published after the advance estimates; however, for this presentation we use "Full Imports and Exports" for clarity.

Solution

- Add the Advance Trade data to the fitting of the nowcast model
  - Our research showed that Advance Trade growth rates are strongly related to the Full Trade grown rates

- Use this model to nowcast Full Trade as well as the other 13 indicators. The nowcast model would contain 17 series, but the index calculation would still contain 15 indicators
  - Including Advance Trade in the VAR nowcast model greatly improves nowcasts of Full Trade.

- Gives us a better estimate of the index about a week earlier than if we hadn't used the Advance Trade data

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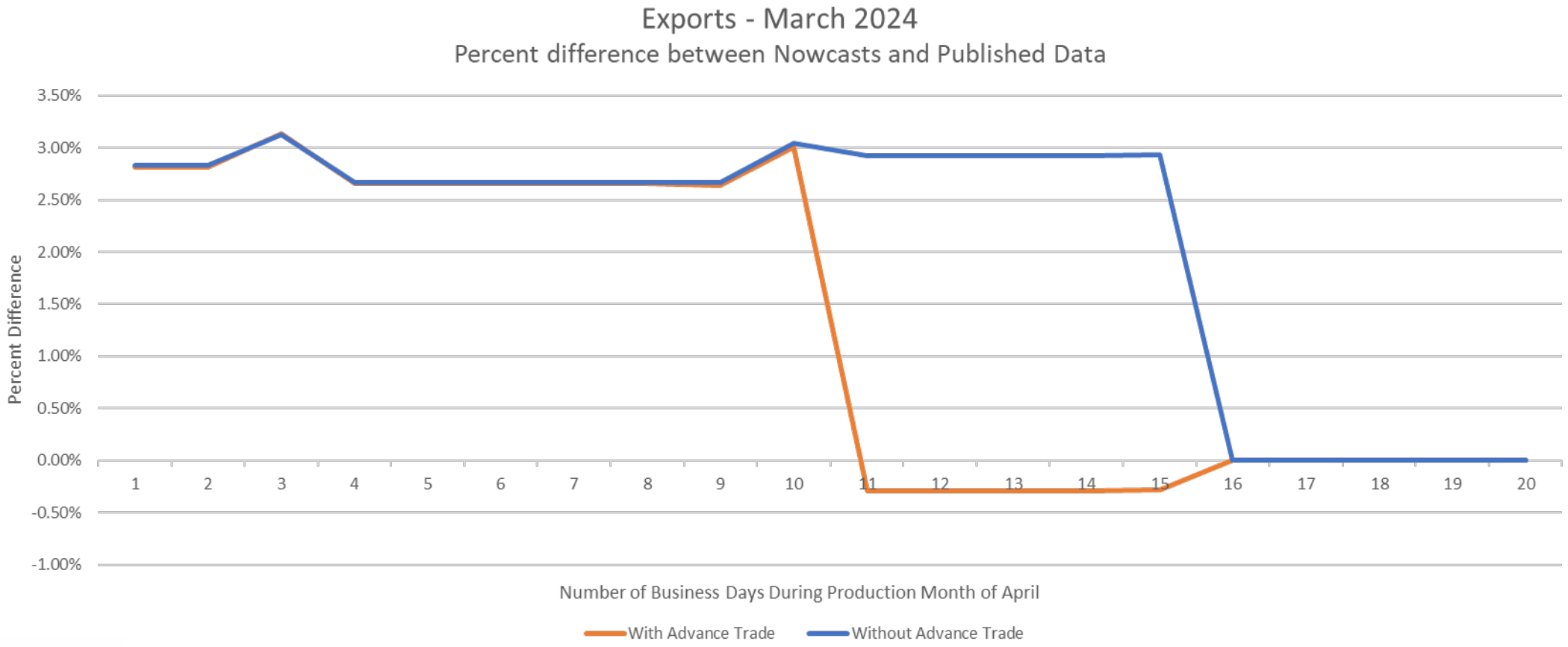
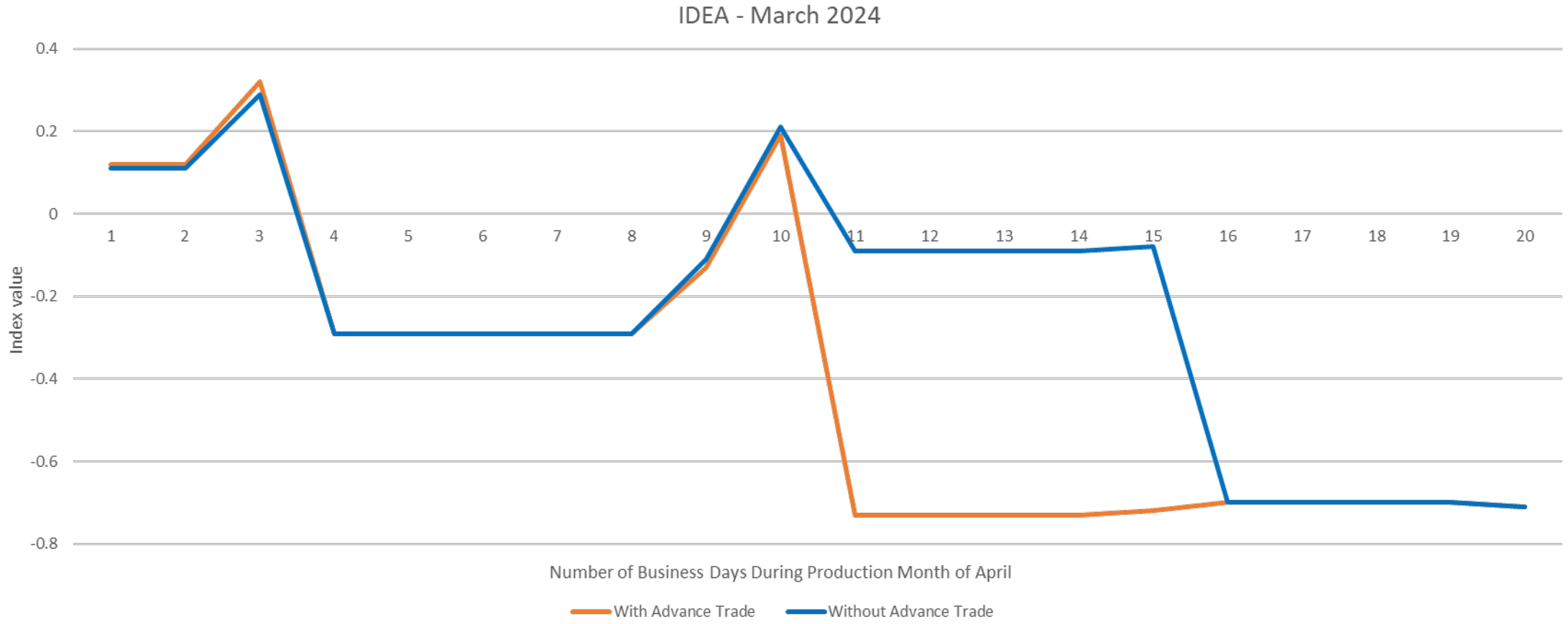
Comparing Nowcasts with and without Advance Trade in the nowcast modeling



Source: Economic Indicator data available in the [Census API]

Comparing Index with and without Advance Trade in the nowcast modeling



Source: Economic Indicator data available in the Census API

Thank you to my co-authors

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All at the U.S. Census Bureau

Future Research

1. Are there other economic indicators we should be including in the calculation of the Index?
2. Other potential improvements to nowcast models?
3. What other indices could we produce? Quarterly? Annual?

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Thank you!

Questions about this presentation?

Elizabeth Marra Viehdorfer: Elizabeth.M.Viehdorfer@census.gov

Questions about the IDEA in general?

IDEA team: EID.Economic.Index@census.gov

Index of Economic Activity: https://www.census.gov/economic-indicators/

Census API: https://www.census.gov/data/developers/data-sets/economic-indicators.html

Retail Trade Report: https://www.census.gov/retail/sales.html

Advance Economic Indicators: https://www.census.gov/econ/indicators/index.html

International Trade in Goods and Services: https://www.census.gov/foreign-trade/index.html

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