Continuing to Explore the Relation of Economic and Political Conditions with Government Survey Refusal Rates

Luke J. Larsen, Joanna Fane Lineback, and Benjamin Reist
U.S. Census Bureau

May 12-15, 2016
2016 AAPOR Conference and Proceedings in Austin, TX

This presentation is released to inform interested parties of ongoing research and to encourage discussion of work in progress. The views expressed are those of the authors and not necessarily those of the U.S. Census Bureau.

Outline

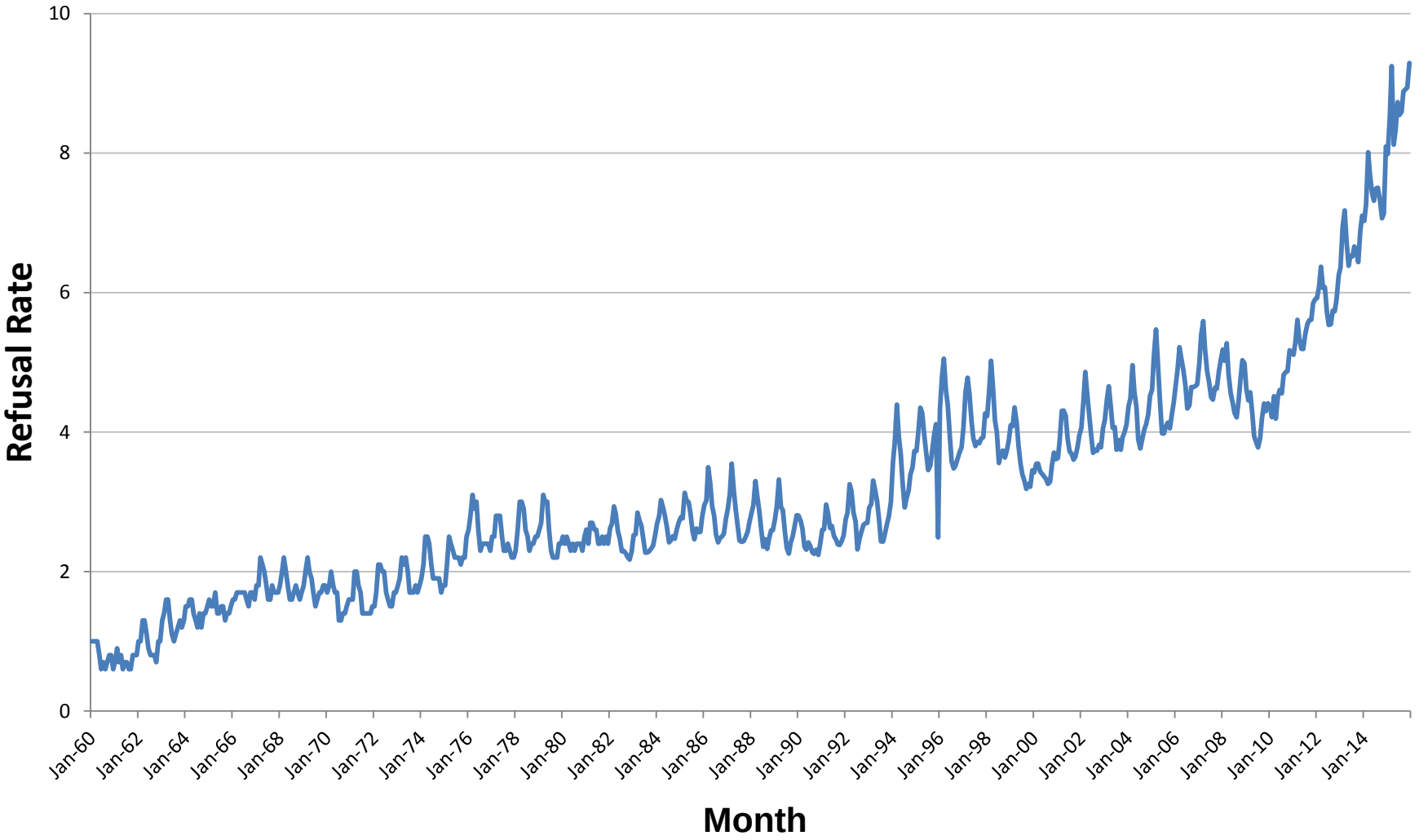
1. Motivation
2. Previous Research *(Harris-Kojetin & Tucker, 1999)*
3. Replicating Findings *(1960-1988)*
4. Extension *(1960-2015)*
5. Focus on Recent Years *(1989-2015)*
6. Discussion
7. Next Steps

1. Motivation

- Rapid decrease in survey participation for important demographic government surveys
- Current research into phenomenon focuses on micro-level influences, e.g., interviewer effects
- Interested in examining macro-level influences on survey refusal rates

$$\text{(Refusal Rate} = \frac{\#\ \text{Refusals}}{\#\ \text{Completes} + \ \#\ \text{Eligible Nonresponses ("Type A")}} \times 100)$$

Monthly Current Population Survey Refusal Rates: 1960-2015



Source: U.S. Census Bureau, Current Population Survey, January 1960 – December 2015 (unweighted)

Some Factors Possibly Associated with Survey Refusal

Macro-level Factors

- GDP/recession
- Consumer Price Index
- Presidential approval
- Congressional make-up
- Unemployment rate
- Privacy concerns (climate)
- Trust in government (climate)

Micro-level Factors

- Gate-keeping
- On Do Not Call registry
- Time constraints
- Respondent hostility
- Unemployment status
- Privacy concerns (personal)
- Trust in government (personal)

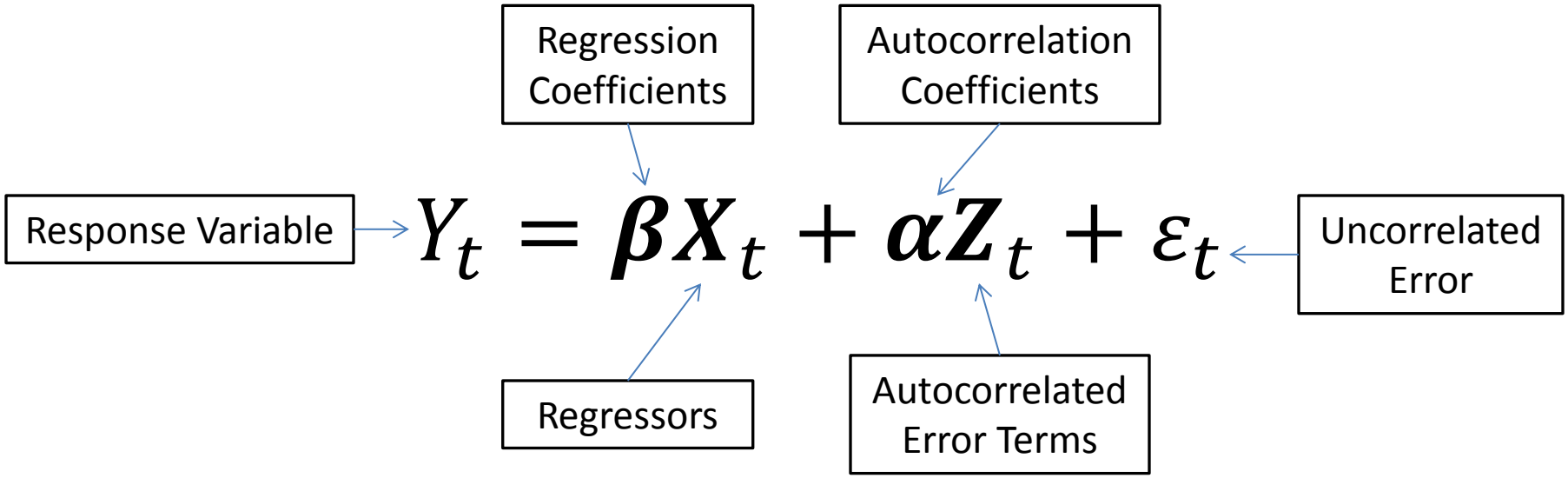
2. Previous Research

- Harris-Kojetin and Tucker (1999) explored effect of national economic conditions and political attitudes on refusal rates for the monthly Current Population Survey (CPS) over the period 1960-1988
- Used time-series regression analysis to fit selected regressors and autocorrelated error terms to the refusal rate series
- Found that external factors were linked to one's decision to refuse to participate in the CPS

Regressors from Original Model

Regressor	Data Source
Presidential approval rating	Gallup Poll
Annual percent change in inflation index	CPI-U (1982 basis), Bureau of Labor Statistics
Unemployment rate	CPS, Bureau of Labor Statistics
Index of Consumer Sentiment	Survey of Consumers, University of Michigan
Decennial Census year indicator	-
CPS March Supplement indicator	-

Time Series Regression Model



Autocorrelated error structure (Seasonal ARIMA)

$$(\boldsymbol{p}, \boldsymbol{d}, \boldsymbol{q}) \times (\boldsymbol{P}, \boldsymbol{D}, \boldsymbol{Q})_{\{12\}}$$

Remaining error should be

$$\boldsymbol{\varepsilon_t} \sim \boldsymbol{Normal}\left(\mathbf{0}, \boldsymbol{\sigma^2}\right);$$
$$\boldsymbol{Cov}\left(\boldsymbol{\varepsilon_i}, \boldsymbol{\varepsilon_{j \neq i}}\right) = \mathbf{0}$$
$$\forall\, \boldsymbol{i}, \boldsymbol{j} \in [\mathbf{1}, \boldsymbol{t}]$$

Outcome from Original Model

Predictor	Estimate	Std. Error
Presidential approval (D)	-0.0026**	0.0011
Inflation rate	0.000	0.000
Unemployment rate (D)	-0.059**	0.018
Consumer sentiment (D)	0.0042**	0.0016
Census year	0.0084	0.0047
March supplement	0.012	0.0073

Source: Harris-Kojetin and Tucker (1999). All series are based on data from January 1960 to December 1988. Results shown are for differenced CPS refusal rates (first order and seasonal first order).
N=348. *(D)* indicates a differenced series. **p<0.05, **p<0.01.*

Significant factors:

- Presidential approval
- Unemployment rate
- Consumer sentiment

(Note: SARIMA error structure unknown)

3. Replicating 1960-1988 Results

Steps:

1. Obtain data from original sources
2. Time series regression modeling
3. Compare results

Data for Replicating Results

- Consumer sentiment, unemployment rate, and the inflation index were available back to January 1960
- Complete monthly CPS microdata for calculating refusals were unavailable for data years prior to 1982

  Solution:

  -Refusal rates for July 1970 – December 1981 were obtained from archival summary documents

  -Refusal rates for January 1960 – June 1970 were approximated from data plot in Harris-Kojetin and Tucker (1999)
- Monthly presidential approval ratings were not readily available from Gallup Poll

  Solution: Monthly ratings were approximated using individual poll results obtained via the Roper Center

Time Series Regression Modeling

- Time series regression analysis conducted in R via the sarima() wrapper, part of the “astsa” package
- Complex sample design of the CPS (“4-8-4” design) is key to SARIMA model selection
  - Ideal model would include AR(3) and SAR(1) to account for autocorrelation introduced by CPS sample design
  - During preliminary analysis, higher-order SARIMA terms led to instability and convergence failures
  - Systematic approach to produce up to 256 models by cycling AR(p), MA(q), SAR(P), SMA(Q) parameters between 0 and 3, with differences d and D fixed at 1.
  - Model selection based on AIC, residual analysis, and resulting regressor parameters

Compare Results

Original model: Error structure unknown

Predictor	Estimate	Std. Error
Presidential approval (D)	-0.0026**	0.0011
Inflation rate	0.000	0.000
Unemployment rate (D)	-0.059**	0.018
Consumer sentiment (D)	0.0042**	0.0016
Decennial year	0.0084	0.0047
Income supplement	0.012	0.0073

Replication model: $(3,1,1)x(2,1,1)_{12}$

Estimate	Std. Error
-0.0013	0.0012
-0.0004	0.0002
-0.0540**	0.0201
0.0043*	0.0020
0.0095	0.0196
0.0112*	0.0046

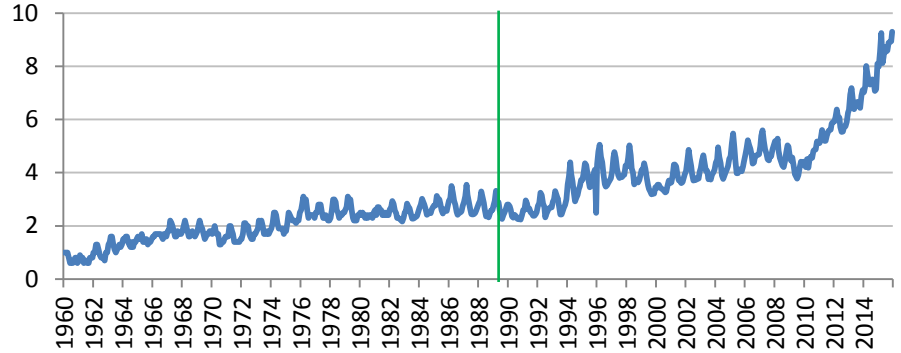
Source: Harris-Kojetin and Tucker (1999). All series are based on data from January 1960 to December 1988. Results shown are for differenced CPS refusal rates (first order and seasonal first order). *N*=348. *(D)* indicates a differenced series. **p*<0.05, ***p*<0.01. *AIC*=-525.99 for replication model. Red circle indicates a substantive change in direction and/or statistical significance of the estimate when comparing the replication attempt to the original output.

4. Extension, 1960-2015

Steps:

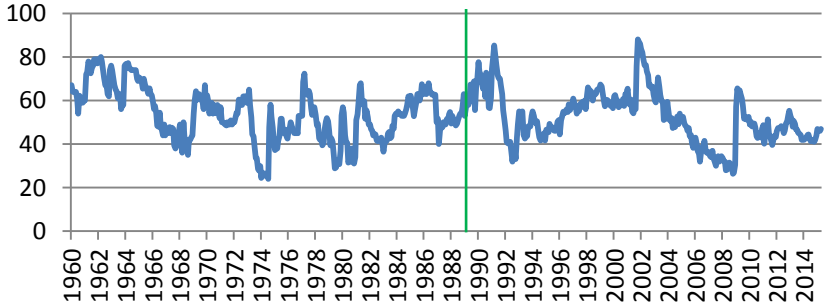
1. Plot the data over the extended period
2. Examine pairwise correlations
3. Re-run time series models
4. Compare results

Monthly CPS Participation Refusal Rates



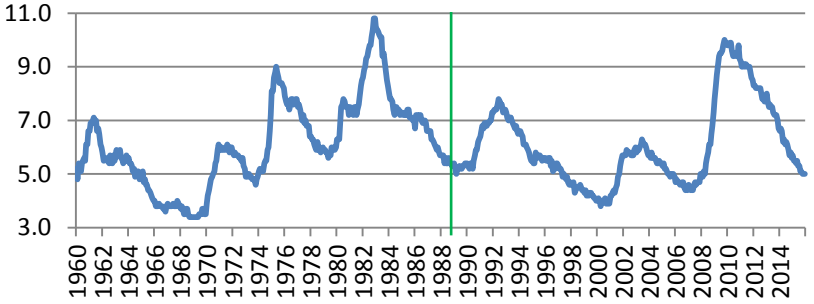
Source: U.S. Census Bureau, Current Population Survey, January 1960 – December 2015 (unweighted)

Monthly Presidential Approval Rates



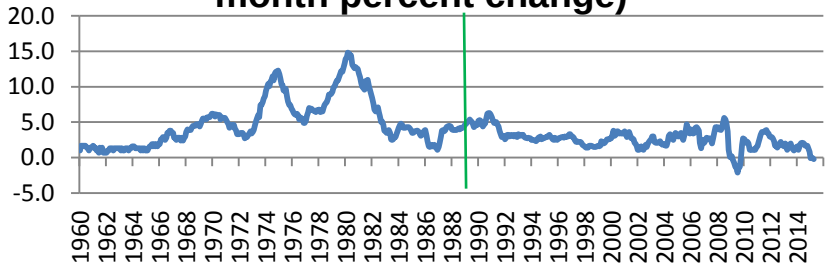
Source: Gallup Poll, January 1960 – December 2015

Monthly Unemployment Rates



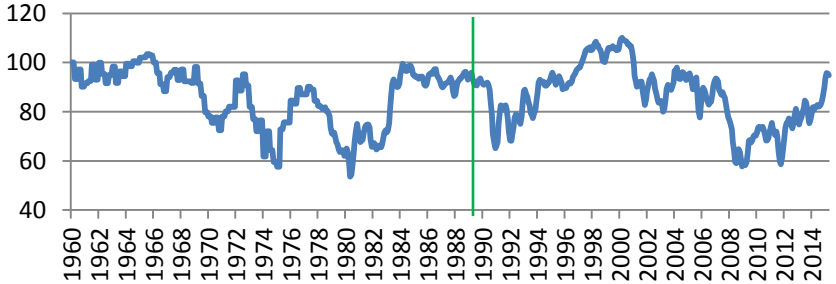
Source: U.S. Bureau of Labor Statistics, Current Population Survey, January 1960 – December 2015

Monthly Consumer Price Index (12-month percent change)



Source: U.S. Bureau of Labor Statistics, Consumer Price Index – Urban (1982 basis), January 1960 – December 2015

Monthly Index of Consumer Sentiment



Source: University of Michigan, Survey of Consumers, January 1960 – December 2015

Pairwise Correlations (1960-1988)

Predictor	CPS refusal rate	Inflation	Unemploy-ment	Consumer sentiment	Presidential approval	Decennial year
Inflation	0.46**	—				
Unemployment	0.44**	0.24**	—			
Consumer sentiment	-0.30**	-0.86**	-0.34**	—		
Presidential approval	-0.44**	-0.61**	-0.13*	-0.60**	—	
Decennial year	-0.33**	0.17**	0.06	0.13*	-0.25**	—
Income supplement	0.16**	0.00	0.00	0.03	0.00	0.00

Source: Harris-Kojetin and Tucker (1999). All series are based on data from January 1960 to December 1988. Results shown are for undifferenced CPS refusal rates and predictors. *N*=348. **p<0.05, **p<0.01.*

Pairwise Correlations (1960-2015)

Predictor	CPS refusal rate	Inflation	Unemploy-ment	Consumer sentiment	Presidential approval	Decennial year
Inflation	-0.30**	—				
Unemployment	0.13**	0.10*	—			
Consumer sentiment	-0.10**	-0.53**	-0.56**	—		
Presidential approval	-0.30**	-0.34**	-0.14**	0.48**	—	
Decennial year	-0.13**	0.16**	0.01	-0.09*	0.07	—
Income supplement	0.13**	-0.02	0.01	0.00	0.02	0.00

Sources: U.S. Census Bureau; U.S. Bureau of Labor Statistics; University of Michigan; Gallup. All series are based on data from January 1960 to December 2015. Results shown are for undifferenced CPS refusal rates and predictors. *N*=672. **p<0.05, **p<0.01.* Red circle indicates a substantive change in direction and/or statistical significance of the estimate when comparing the 1960-2015 data to the 1960-1988 data.

Modeling on 1960-2015

1960-1988 model: (3,1,1)x(2,1,1)$_{12}$, AIC = -525.99

Predictor	Estimate	Std. Error
Presidential approval (D)	-0.0013	0.0012
Inflation rate	-0.0004	0.0002
Unemployment rate (D)	-0.0540**	0.0201
Consumer sentiment (D)	0.0043*	0.0020
Decennial year	0.0095	0.0196
Income supplement	0.0112*	0.0046

1960-2015 model: (3,1,1)x(1,1,1)$_{12}$, AIC = -695.14

Estimate	Std. Error
-0.0024*	0.0012
-0.0007**	0.0002
-0.0714**	0.0222
0.0033	0.0020
0.0350**	0.0082
0.0051	0.0038

Sources: U.S. Census Bureau; U.S. Bureau of Labor Statistics; University of Michigan; Gallup. All series are based on data from January 1960 to December 2015. Results shown are for differenced CPS refusal rates . (D) indicates a differenced series (first order and seasonal first order). *N*=348 for 1960-1988. *N*=672 for 1960-2015. **p<0.05, **p<0.01.* Red circle indicates a substantive change in direction and/or statistical significance of the estimate when comparing the 1960-2015 data to the 1960-1988 data.

Interpreting 1960-2015 Model Fit

- Core model structure appears to fit the 1960-2015 period well, with few issues in residuals
- Substantial differences are present in results between the coefficients based on the original period and those based on the extended period
- Relative model fit is improved (AIC ≈ -695 vs -526) but not by much, given 27 more years of data, indicating possible issue with 1989-2015 period

5. Focus on Recent Years, 1989-2015

Steps:

1. Examine pairwise correlations
2. Re-run time series models
3. Compare results

Pairwise Correlations (1989-2015)

Predictor	CPS refusal rate	Inflation	Unemploy-ment	Consumer sentiment	Presidential approval	Decennial year
Inflation	-0.53**	—				
Unemployment	0.12*	-0.27**	—			
Consumer sentiment	-0.14*	0.00	-0.77**	—		
Presidential approval	-0.39**	-0.04	-0.15**	0.35**	—	
Decennial year	-0.21**	0.22**	0.08	0.04	0.17**	—
Income supplement	0.17**	-0.02	0.02	0.00	0.02	-0.01

Sources: U.S. Census Bureau; U.S. Bureau of Labor Statistics; University of Michigan; Gallup. All series are based on data from January 1989 to December 2015. Results shown are for undifferenced CPS refusal rates and predictors. *N*=324. **p<0.05, **p<0.01.* Red circle indicates a substantive change in direction and/or statistical significance of the estimate when comparing the correlations of the 1989-2015 data to those of the 1960-1988 data.

Modeling on 1989-2015

1960-1988 model: $(3,1,1)x(2,1,1)_{12}$ AIC = -525.99

Predictor	Estimate	Std. Error
Presidential approval (D)	-0.0013	0.0012
Inflation rate	-0.0004	0.0002
Unemployment rate (D)	-0.0540**	0.0201
Consumer sentiment (D)	0.0043*	0.0020
Decennial year	0.0095	0.0196
Income supplement	0.0112*	0.0046

1989-2015 model: $(2,1,2)x(3,1,3)_{12}$, AIC = -214.22

Estimate	Std. Error
-0.0060**	0.0022
-0.0009**	0.0006
-0.0014	0.0488
0.0104	0.0040
0.0256	0.0173
-0.0028	0.0062

Sources: U.S. Census Bureau; U.S. Bureau of Labor Statistics; University of Michigan; Gallup. All series are based on data from January 1960 to December 2015. Results shown are for differenced CPS refusal rates . (D) indicates a differenced series (first order and seasonal first order). *N*=348 for 1960-1988. *N*=324 for 1989-2015. **p<0.05, **p<0.01.* Red circle indicates a substantive change in direction and/or statistical significance of the estimate when comparing the 1989-2015 data to the 1960-1988 data.

Weakened Performance in 1989-2015

- Greater disparity among coefficient estimates and SE between the two eras
- Relative model fit is weaker for 1989-2015 compared with 1960-1988 (AIC ≈ -214 and -526, respectively)
- Fewer viable models to choose from in recent period (27 of 256 models for 1989-2015, vs 94 for 1960-1988 and 195 for the full period)
- Models based on recent period were more susceptible to issues with residuals

6. Discussion

- The original findings on the 1960-1988 are replicable, and, at first glance, this approach appears to work well for 1960-2015:
  - Over the extended period, increases in differenced presidential approval, inflation, and unemployment are associated with reductions in differenced CPS refusal rates
  - Meanwhile, interviewing during a Census year is associated with increases in differenced CPS refusal rates.

Discussion cont'd

- Further investigation shows this approach does not perform as well when considering only the 1989-2015 period
- While the original model may continue to work reasonably well over time, refinements to the model may be needed to make this approach relevant to the new era and beyond

7. Next Steps

- Investigate new covariates
- Test various transformations
- Explore interaction effects
- Devise alternative modeling strategies

Contact Information

Luke.J.Larsen@census.gov

Joanna.Fane.Lineback@census.gov

Benjamin.M.Reist@census.gov