The Good, The Bad, and The Ugly:

Measurement Error, Nonresponse and Administrative Mismatch in the CPS

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Research Questions

Focus on Earnings in Prior Year in U.S. Current Population Survey Annual Social and Economic Survey

1. Is there a relationship between item non-response and response error: Good Reporters, Bad Reporters?
2. Is measurement error all in the survey or are administrative records mismeasured too?
3. Is there mismatch in the CPS administrative record match?
4. What is the structure of the measurement error in earnings (common man)?

The March Current Population Survey (ASEC)

- Asks respondents about all earnings in prior calendar year.
- Longitudinal structure allows two observations (a year apart) on annual earnings.

Table 2: Earnings Item Response Rates

	Male	Female
Non-Respond Both Years	7.2	6.5
Respond Both Years	72.2	73.8
Respond Year 1 Only	10.8	10.3
Respond Year 2 Only	9.8	9.4
Switchers	20.6	19.8

Detailed Earnings Records

- Required earnings report from Employer to Social Security Administration (and IRS).
- Matched on name, address, and birthday.
- Approximately 90% match rate.
- Provides administrative record of annual earnings.

Empirical Models: Earnings

Mincer wage equation

$$Y_{it}^{*} = X_{it}\beta + u_{it},$$

Y^{*} is log earnings, $X's$ are "usual suspects": potential experience (quadratic), indicator education levels (12 dummies), race, metro-size, census division, and year dummies.

Usual assumption $E\left[u_{it}|X_{it}\right] = 0$ or at least that $u_{it} \perp X_{it}$ (uncorrelated).

DER Earnings Models

We also hypothesize a model for the log of administrative (DER) earnings:

$$Y_{it}^{D} = \begin{cases} Y_{it}^{*} + \varepsilon_{1it}^{D} & \text{with prob. } p \\ \mu_{Y} + \varepsilon_{2it}^{D} & \text{with prob. } 1-p. \end{cases}$$

Assume ε_{it}^{D} uncorrelated with Y^{*} and X_{it}.
Variations on this model include:

1. Administrative "Gold Standard" $p = 1$ and $\sigma_{D1}^{2} = 0$. $Y_{it}^{D} = Y_{it}^{*}$.
2. Classic measurement error in administrative records: $p = 1$.
3. Administrative mismatch: full model. unknown p estimated (FMM).

CPS Reported Earnings Models

$$Y_{it}^{C} = \begin{cases} \delta_1 + \rho_1 Y_{it}^{*} + \varepsilon_{1it}^{C} & \text{with prob. } q \\ \delta_2 + \rho_2 Y_{it}^{*} + \varepsilon_{2it}^{C} & \text{with prob. } 1-q. \end{cases}$$

We observe Y^C as the log of reported earnings. Assume all ε_{it}^{C} uncorrelated with Y^* and $X_{it.}$ and $\left(u_{it}, \varepsilon_{jit}^{D}, \varepsilon_{jit}^{C}\right)$ mutually uncorrelated.

1. Classical error: $q = 1, \rho_1 = 1$.
2. Common man error $q = 1$. $\rho_1 < 1$.
3. Good responder/bad responder: Good reporters: $\rho_1 \approx 1$,Bad reporters:$\rho_2 \neq 1$ (< 1)? Lower error variance for good reporters. $\sigma_{C1}^2 < \sigma_{C2}^2$.
   1. Use Non-response status in opposite year to determine which model.
   2. Use finite mixture models to determine which model.
      (test if response status improves FMM model)

Model of Response

$$R_{it} = \begin{cases} 1 & if \quad Z_{it}\gamma + h\left(\varepsilon_{it}^{C}\right) + v_{it} > 0 \\ 0 & otherwise. \end{cases} .$$

Where R is whether the individual provides earnings detail.
Measures of Measurement Error

1. Measurement error: ε_{it}^{C} from CPS on DER (quadratic).
2. Indicator from FMM CPS on DER (good reporter/bad reporter).
3. Probability from FMM CPS on DER (good reporter/bad reporter

Model Type 1: Assume DER is Correct

Table 5: Measurement Error Models by Response Status
Dependent Variable Ln CPS Earnings

Men

	Respond in Both		Switchers	
	Year 1	Year 2	Year 1	Year 2
Log DER	0.699*	0.700*	0.634*	0.602*
Residual Variance	0.208	0.166	0.394	0.349

Women

	Respond in Both		Switchers	
	Year 1	Year 2	Year 1	Year 2
Log DER	0.764*	0.760*	0.655*	0.681*
Residual Variance	0.130	0.127	0.329	0.172

$* = 1\%$, year indicators included.

Table 7: FMM Measurement Error Model with Response Status
LnCPS on LnDER, logistic model for component probabilities
Year One Responders

	Men		Women	
	Comp 1	Comp 2	Comp 1	Comp 2
Log DER Yr 1	0.950*	0.426*	0.962*	0.454*
Respondent Yr 2	0.747*		0.607*	
Residual Variance	0.120	0.884	0.112	0.761
Component Probabilities	0.768	0.232	0.796	0.204

$* = 1\%$, year indicators included.

Table 8: Probit Models of Response
Year 1 Response = 1

	Men			Women		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Residuals	-0.033			0.0325		
Residuals^2	-0.020*			-0.001		
FMM Prob.		0.329*			0.253*	
FMM Ind.			0.259*			0.200*

$* = 1\%$

Measurement error models estimated without indicator for response status, controls include proxy, DER earnings, experience, education, race, region, metro size, year.

Model Type 2: Allow Measurement Error in DER

Table 10: Using Predicted DER Earnings by Response Status
LnCPS on Predicted LnDER
Year 1 responders

	Men		Women	
	Both	Switcher	Both	Switchers
$\widehat{Ln(DER)}$	0.900*	0.948*	0.954*	0.992*
Residual Variance	0.347	0.540	0.255	0.445
Estimated Error Variance	0.127	0.258	0.069	0.213

$* = 1\%$, year indicators included

Table 11: FMM Measurement Error Model
LnCPS on Predicted LnDER, Logistic model of component
Year One Only

	Men		Women	
	Comp 1	Comp 2	Comp 1	Comp 2
$\widehat{Ln(DER)}$	0.897*	1.127*	0.949*	1.434*
Respondent Yr 2	0.780*		0.579*	
Residual Variance	0.218	4.951	0.180	3.706
Estimated Error Variance	0.04	2.951	0.025	1.612
Component Probabilities	0.969	0.031	0.974	0.026

$* = 1\%$, year indicators included.

Table 12: Probit Models of Response
Year 1 Response=1 (Sample is all responders in year 2)

	Men			Women		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Residuals	-0.034			0.0367		
Residuals^2	-0.017*			-0.0005		
FMM Prob.		0.233*			0.114	
FMM Ind.			0.156*			0.031

$* = 1\%$

Controls include proxy, DER earnings, potential experience, education, race, city size, region and year.

Measurement error variables from year two. Sample of year 2 responders.

Model Type 3: Allow Measurement and Force Mismatch Error in DER

- First stage finite mixture model of Y^D on X_{it}.
  - Force component two to have zero slopes.
  - That assumption rejected by data.
- Second stage IV Y^C on $\widehat{Y^D}$ (by status and via FMM).
- Probit model on residuals and FMM measures.
- Results very similar to Model Type 2: Not Presented Here for Brevity

Conclusions

1. There do appear to be two kinds of reporters in CPS, especially for men.
2. Measurement error is in CPS and in DER.
3. Less evidence for DER mismatch driving results.
4. Common man may be driven by errors in DER.