Evaluation of a Modified Gross Flows Estimator for The Current Population Survey

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Outline

Monthly Labor Force Estimates from BLS

- The Bureau of Labor Statistics (BLS) publishes monthly estimates for individuals aged 16+ in the Civilian Non institutional Population (CNP)
  - Total for those Employed
  - Total for those Unemployed
  - Total for those Not in the Labor Force
- Month-to-month transitions between those labor force states which are called ”Gross Flows”
- There are some individuals who transition in or out of the CNP each month which we call Flows (either inflows or outflows)

Monthly Gross Flows Labor Force Estimation

Table: Typical Monthly Table (in thousands).

		April 2024				
		E	U	N	F	T
March 2024	E	155,916	1,361	4,053	26	161,356
	U	1,793	3,176	1,633	2	6,604
	N	3,760	1,347	94,609	209	99,924
	F	121	10	288	–	418
	T	161,590	5,894	100,582	237	–

E = Employed
U = Unemployed
N = Not-in-Labor-Force
F = Flow (In-flow or Out-flow)
T = Total

Theoretical Monthly Gross Flows Table

Table: Population Gross Flows Table.

		Current Month				
		E	U	N	F	T
Previous Month	E	T_{EE}	T_{EU}	T_{EN}	T_{EF}	T_{ET}
	U	T_{UE}	T_{UU}	T_{UN}	T_{UF}	T_{UT}
	N	T_{NE}	T_{NU}	T_{NN}	T_{NF}	T_{NT}
	F	T_{FE}	T_{FU}	T_{FN}	$-$	T_{FT}
	T	T_{TE}	T_{TU}	T_{TN}	T_{TF}	$-$

E = Employed
U = Unemployed
N = Not-in-Labor-Force
F = Flow (In-flow or Out-flow)
T = Total

Motivation for Our Research

- The current raking method of Gross Flows Estimation used by BLS was described in Frazis, Robison, Evans and Duff (2005)
- The purpose of our research is to evaluate an alternative estimation method which builds off a model proposed by Stasny and Fienberg (1985)
  - Does not use external death data from the NCHS
  - Explicitly models differences in Month-in-sample pairs from the Current Population Survey (CPS)

Outline

Current Population Survey

- Household survey conducted each month, with particular emphasis on the month unemployment rate
- Survey of approximately 42,000 households each month
- Basic weighting reflects: Probability of selection, various nonresponse adjustments, and Post-stratification to known population control totals each month
- 4-8-4 Rotation Design.

The CPS 4-8-4 Rotation Design

- In the CPS a household is in sample for 4 consecutive months, then exits the sample for 8 months, then reenters the sample for a final 4 consecutive months.
- MIS1, MIS2, . . ., MIS8 refers the number of months a sample household has been in Sample.
- Each month there are 8 month-in-sample groups.

The CPS 4-8-4 Rotation Design

Table: Month in Sample Pairs

	Month		
MIS	Previous	Current	Pair
1	$\searrow$	R	
2	$\searrow$	$\longrightarrow$	(1,2)
3	$\searrow$	$\longrightarrow$	(2,3)
4	R	$\longrightarrow$	(3,4)
5	$\searrow$	R	
6	$\searrow$	$\longrightarrow$	(5,6)
7	$\searrow$	$\longrightarrow$	(6,7)
8	R	$\longrightarrow$	(7,8)

- R = unpaired due to sample rotation

Outline

Definition of Rotation and Missing

- Each month some units were eligible to be sampled but were not collected. We refer to these as Missing.
- Each month some sample units are not available because they have been rotated out of the sample. We refer to this unavailability as Rotation.
- Note: both Rotation and Missing are distinct from Flows

Partial Flow Table A Using Previous Month's Weights

Table: Sample A Table

		Current Month						
		E	U	N	F	M	R	T
Previous Month	E	A_{EE}	A_{EU}	A_{EN}	A_{EF}	A_{EM}	A_{ER}	A_{ET}
	U	A_{UE}	A_{UU}	A_{UN}	A_{UF}	A_{UM}	A_{UR}	A_{UT}
	N	A_{NE}	A_{NU}	A_{NN}	A_{NF}	A_{NM}	A_{NR}	A_{NT}

E = Employed, U = Unemployed, N = Not-in-Labor Force
F = Flow (In-flow or Out-flow)
M = Missing, R = Rotation, T = Total

Partial Flow Table B Using Current Month's Weights

Table: Sample B Table

		Current Month		
		E	U	N
Previous Month	E	B_{EE}	B_{EU}	B_{EN}
	U	B_{UE}	B_{UU}	B_{UN}
	N	B_{NE}	B_{NU}	B_{NN}
	F	B_{FE}	B_{FU}	B_{FN}
	M	B_{ME}	B_{MU}	B_{MN}
	R	B_{RE}	B_{RU}	B_{RN}
	T	B_{TE}	B_{TU}	B_{TN}

E = Employed, U = Unemployed, N = Not-in-Labor Force
F = Flow (In-flow or Out-flow)
M = Missing, R = Rotation, T = Total

Schematic Representation of Our Estimation Method

Table: Reallocation of Those due to Missing and Rotation

		Current Month						
		E	U	N	F	M	R	T
Previous Month	E	$\hat{T}_{EE}$	$\hat{T}_{EU}$	$\hat{T}_{EN}$	$\hat{T}_{EF}$	$\Longleftarrow$	$\Longleftarrow$	$\hat{T}_{ET}$
	U	$\hat{T}_{UE}$	$\hat{T}_{UU}$	$\hat{T}_{UN}$	$\hat{T}_{UF}$	$\Longleftarrow$	$\Longleftarrow$	$\hat{T}_{UT}$
	N	$\hat{T}_{NE}$	$\hat{T}_{NU}$	$\hat{T}_{NN}$	$\hat{T}_{NF}$	$\Longleftarrow$	$\Longleftarrow$	$\hat{T}_{NT}$
	F	$\hat{T}_{FE}$	$\hat{T}_{FU}$	$\hat{T}_{FN}$				
	M	$\Uparrow$	$\Uparrow$	$\Uparrow$				
	R	$\Uparrow$	$\Uparrow$	$\Uparrow$				
	T	$\hat{T}_{TE}$	$\hat{T}_{TU}$	$\hat{T}_{TN}$				

E = Employed, U = Unemployed, N = Not-in-Labor Force

F = Flow (In-flow or Out-flow)

M = Missing, R = Rotation, T = Total

Example of Modeling for the A Table

Row E month-in-sample i = 1,2,3,5,6,7

$$
\begin{aligned}
E\{A_{EE}^{(i)}\} &= \theta_{AEi}(1 - P_{AEi})T_{EE} \\
E\{A_{EU}^{(i)}\} &= \theta_{AEi}(1 - P_{AEi})T_{EU} \\
E\{A_{EN}^{(i)}\} &= \theta_{AEi}(1 - P_{AEi})T_{EN} \\
E\{A_{EF}^{(i)}\} &= \theta_{AEi}(1 - P_{AEi})T_{EF} \\
E\{A_{EM}^{(i)}\} &= \theta_{AEi}P_{AEi}T_{ET}
\end{aligned}
$$

Row E month-in-sample i = 4,8

$$
E\{A_{ER}^{(i)}\} = \theta_{AEi}T_{ET}
$$

Example of Modeling for the B Table

Column E month-in-sample i = 2,3,4,6,7,8

$$
\begin{aligned}
E\{B_{EE}^{(i)}\} &= \theta_{BEi}(1 - P_{BEi})T_{EE} \\
E\{B_{UE}^{(i)}\} &= \theta_{BEi}(1 - P_{BEi})T_{UE} \\
E\{B_{NE}^{(i)}\} &= \theta_{BEi}(1 - P_{BEi})T_{NE} \\
E\{B_{FE}^{(i)}\} &= \theta_{BEi}(1 - P_{BEi})T_{FE} \\
E\{B_{ME}^{(i)}\} &= \theta_{BEi}P_{BEi}T_{TE}
\end{aligned}
$$

Column E month-in-sample i = 1,5

$$
E\{B_{RE}^{(i)}\} = \theta_{BEi}T_{TE}
$$

Interpretation of the Parameters

- The P parameters indicate the $\%$ missing rate
  - These are computed for E, U, N
  - Also computed for each A and B table
  - And computed for each MIS pair (1,2), (2,3), (3,4), (5,6), (6,7), (7,8)
- The θ indicate the month-in-sample effects and are computed monthly
- These parameters model the differences between MIS pairs and are a unique contribution of our research

Estimation

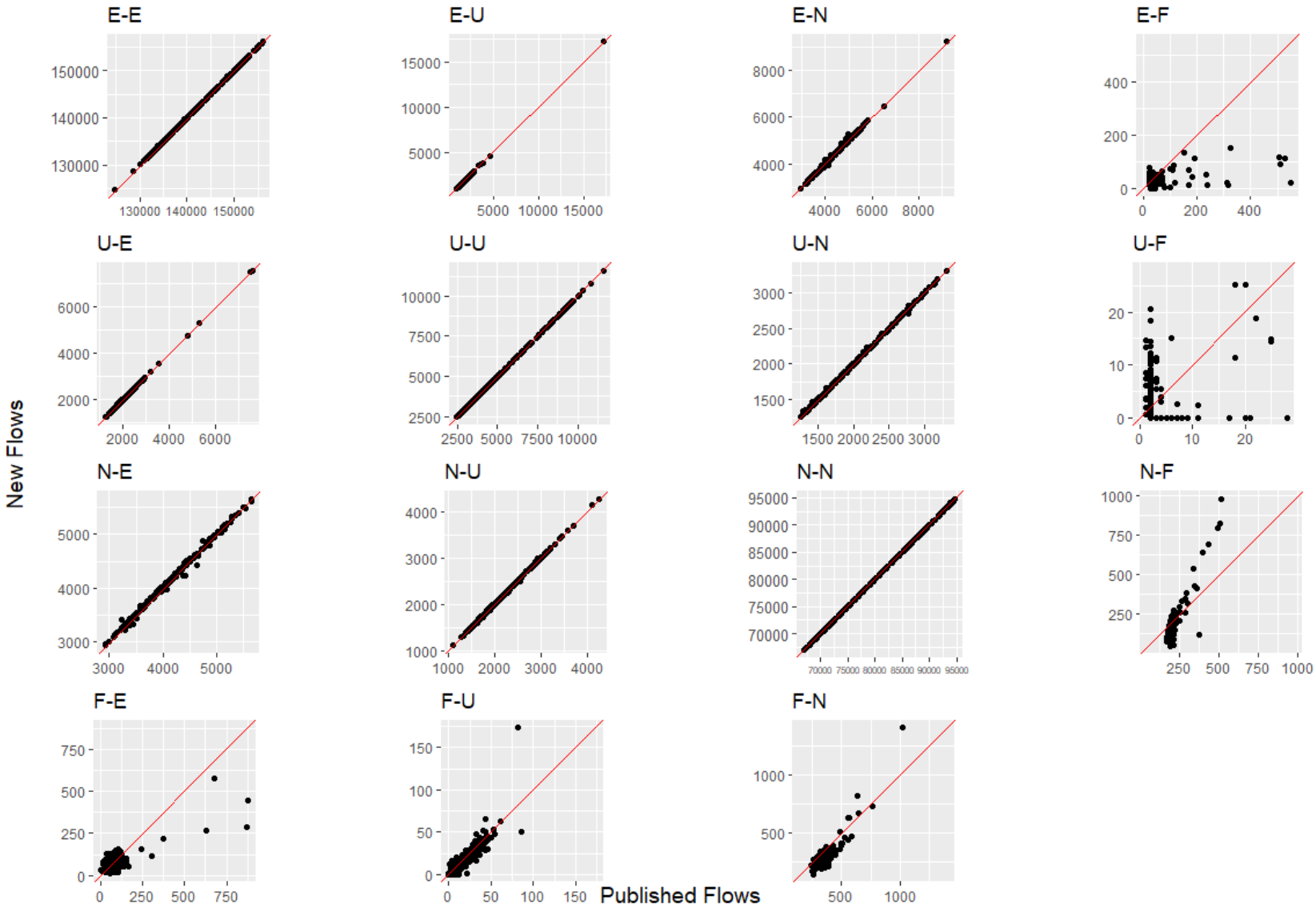
- We use a pseudo likelihood method based on a multinomial likelihood.
- We estimate the parameters by nonlinear optimization while constraining the row and column totals of the the Gross Flows Table for E, U and N to match the official monthly estimates (6 constraints). The 6 constraints correspond to 6 Lagrange multipliers which we compute each month.

Outline

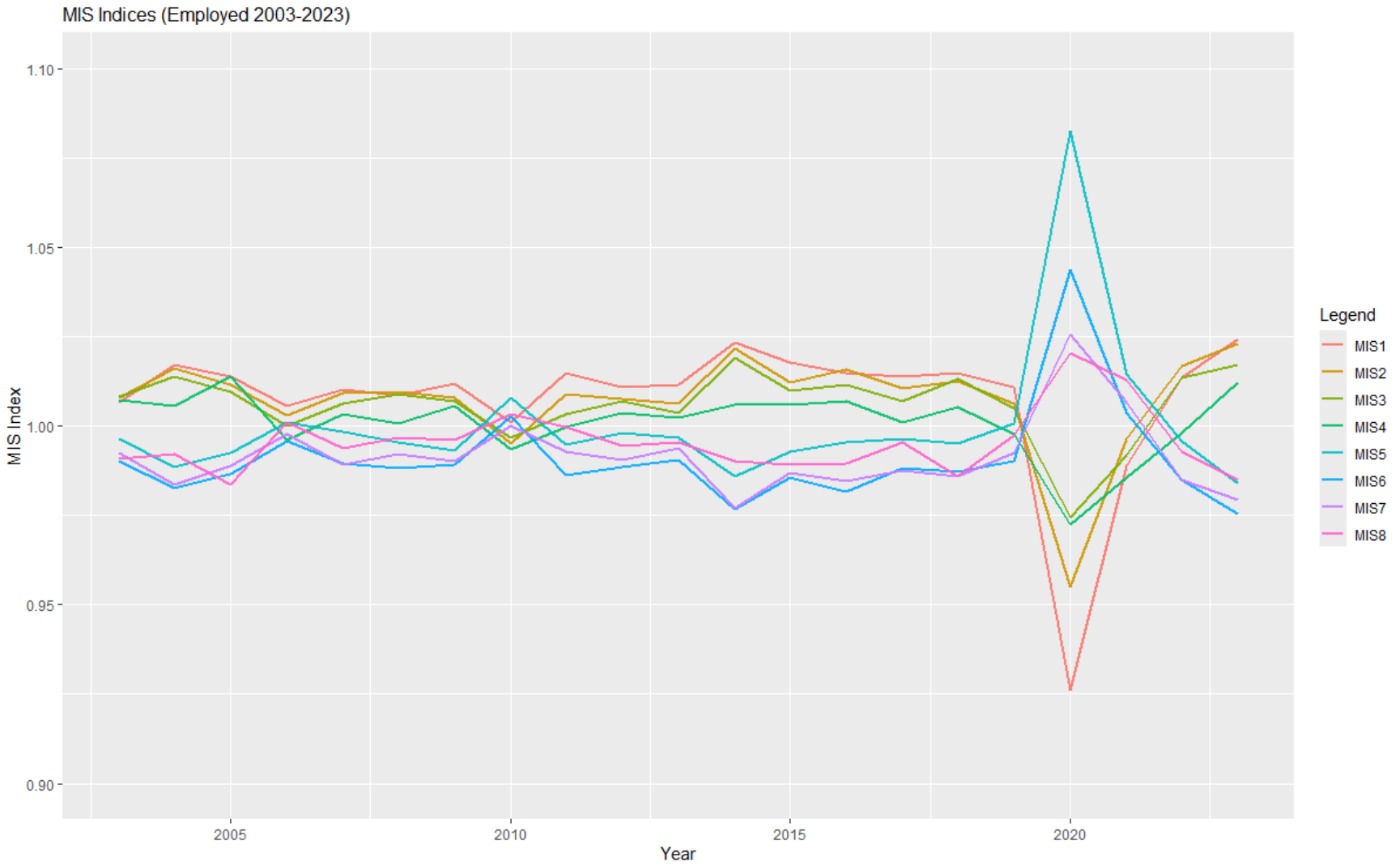
Data Analyzed

- Monthly estimates from December 2002 to December 2023 were used.
- Gross Flows Tables were calculated by Total and Total split by Sex, but only Total are presented here.

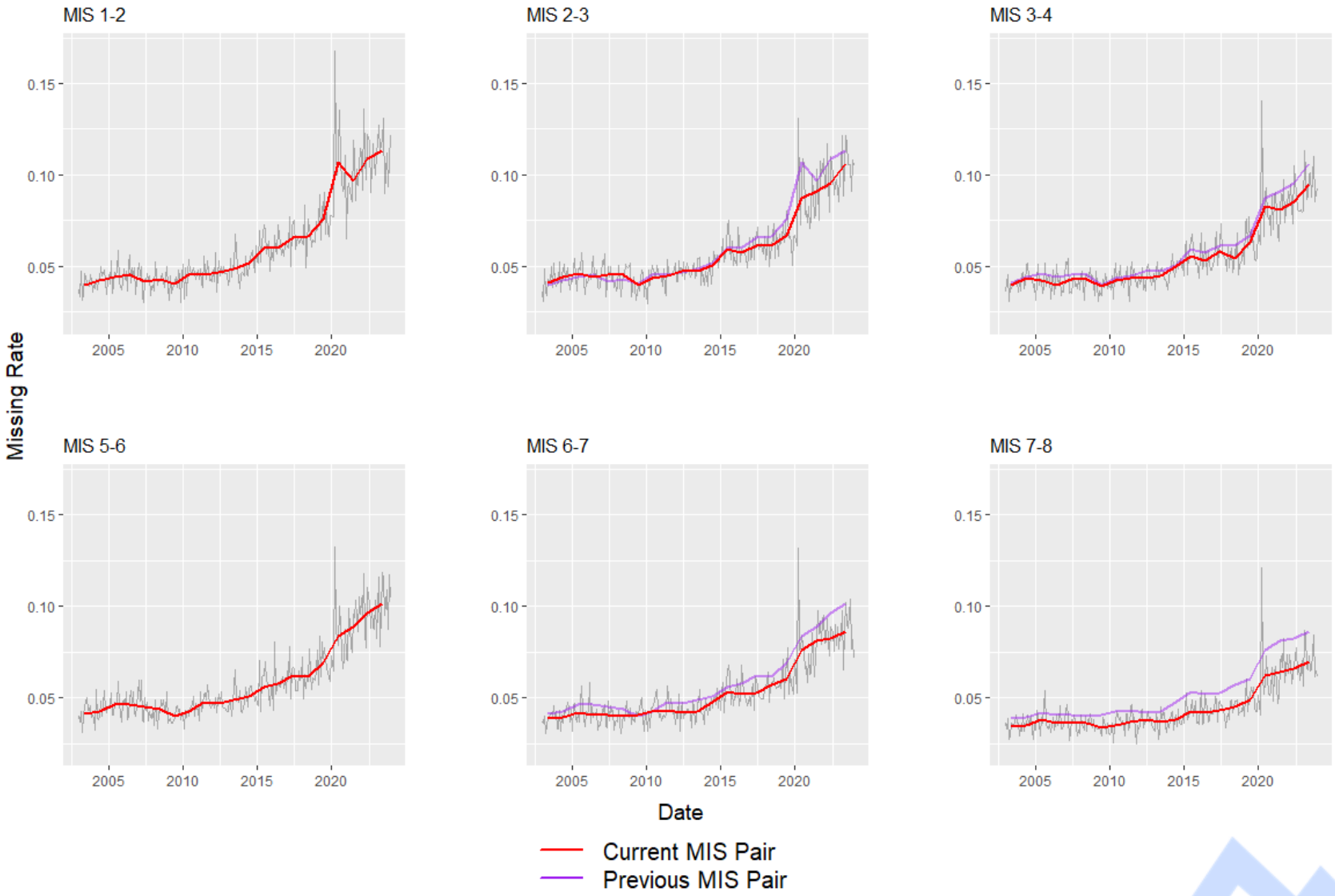
Gross Flow Estimate Comparison



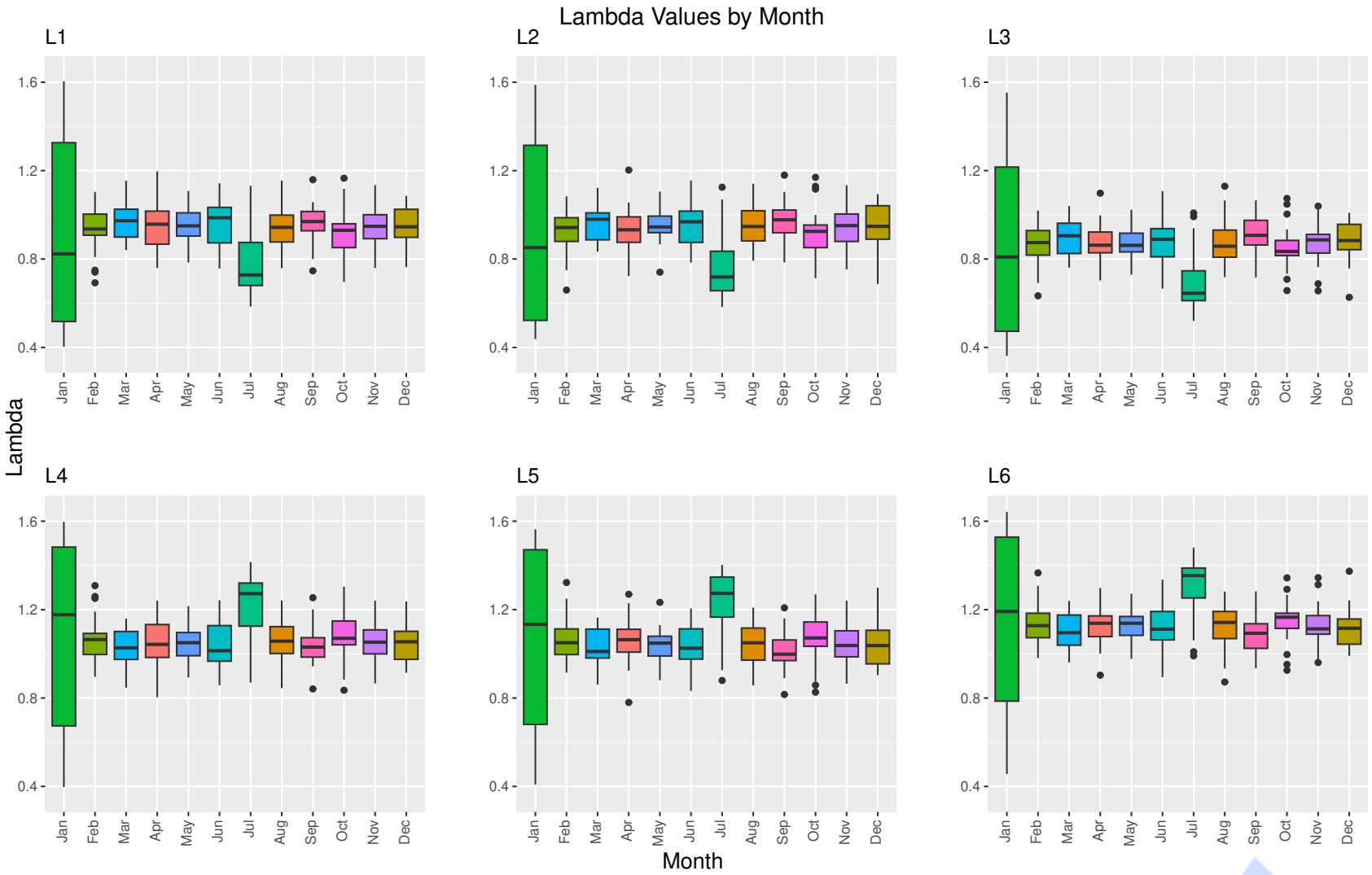
Month-in-Sample Effects (2003-2023)



Employed Missing Rates by MIS Pair (A Table)



Lagrange Constraints



Outline

- Our new estimates are very close to the reported estimates except for the in-flows and out-flows.
- Month-in-sample indexes reflect an unusual change around 2020.
- The Percent missing parameters are revealing about the dynamics of survey response.
- Lagrange multipliers reflect the impacts of annual population control changes in January,
- Future work will examine expanding the Gross Flow Table to expand Employed to include Part-time and Full-time, and expand Not-in-Labor-Force to include the Marginally Attached and the Non Marginally Attached.

CONTACT INFORMATION

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