LEARNING THROUGH JOB SEARCH

Insights on Belief Updating Rules from Survey Data

Sebastian Brown, Kenneth Chan

Research Question

- **How do wage expectations change in response to individual wage signals in the job market?**
- **How should we model this behavior?**

Contributions

- We use survey data from a representative dataset to study wage belief updating in the labor market.
- Prior empirical literature on this subject has been limited due to a lack of data.
- We apply a recently-developed test from Augenblick and Rabin (2021) and conduct analyses that rely on fewer assumptions and relate more specifically to popular models of updating than the existing literature does.
- We are able to rule out several updating rules as explanations for average updating behavior.

Data

- We use the labor supplement of the Survey of Consumer Expectations, a nationally representative survey conducted by the New York Federal Reserve.
- The labor supplement is administered every four months, in March, July, and November.
- Observations in our sample consist of before-after pairs, where an individual appears in two consecutive surveys.
- The composition of our final dataset is given in the table below.

Description	Count	
	At least one reported offer	No reported offers
Total observations	978	3,890
Unique individuals	847	2,883
Unemployed	59	131
Employed	804	3,151
Not in labor force	104	562
Missing employment status	11	46
Data Range	3/2015-3/2020	

Updating Rules

- We examine the following four common updating rules.

1. Bayesian Updating

$$g^{bayes}_{t+1}(\theta|x) = \frac{g_t(\theta)p(x_{t+1}|\theta)}{\int_{\theta'\in\Theta} g_t(\theta')p(x_{t+1}|\theta')}$$

2. Epstein, Noor and Sandroni (2010)

$$g^{bias}_{t+1}(\theta|x) = (1-\lambda)g_t(\theta) + \lambda g^{bayes}_{t+1}(\theta|x)$$

3. Grether (1980) ?

$$g^{bias}_{t+1}(\theta|x) = \frac{g_t(\theta)^a p(x_{t+1}|\theta)^b}{\int_{\theta'\in\Theta} g_t(\theta')^a p(x_{t+1}|\theta')^b}$$

4. Multiple prior models (e.g. Ortoleva (2012))

Martingale Test

- We first compute the following statistics for our main analysis.

- **Belief Movement:**

$$m_{1,2} \equiv \sum_{i=1}^{6} (\pi^i_2 - \pi^i_1)^2$$

- **Uncertainty Reduction:**

$$r_{1,2} \equiv \sum_{i=1}^{6} \pi^i_1(1-\pi^i_1) - \pi^i_2(1-\pi^i_2)$$

- We then test for Bayesian updating with the following t test, adapted from Augenblick and Rabin (2021).

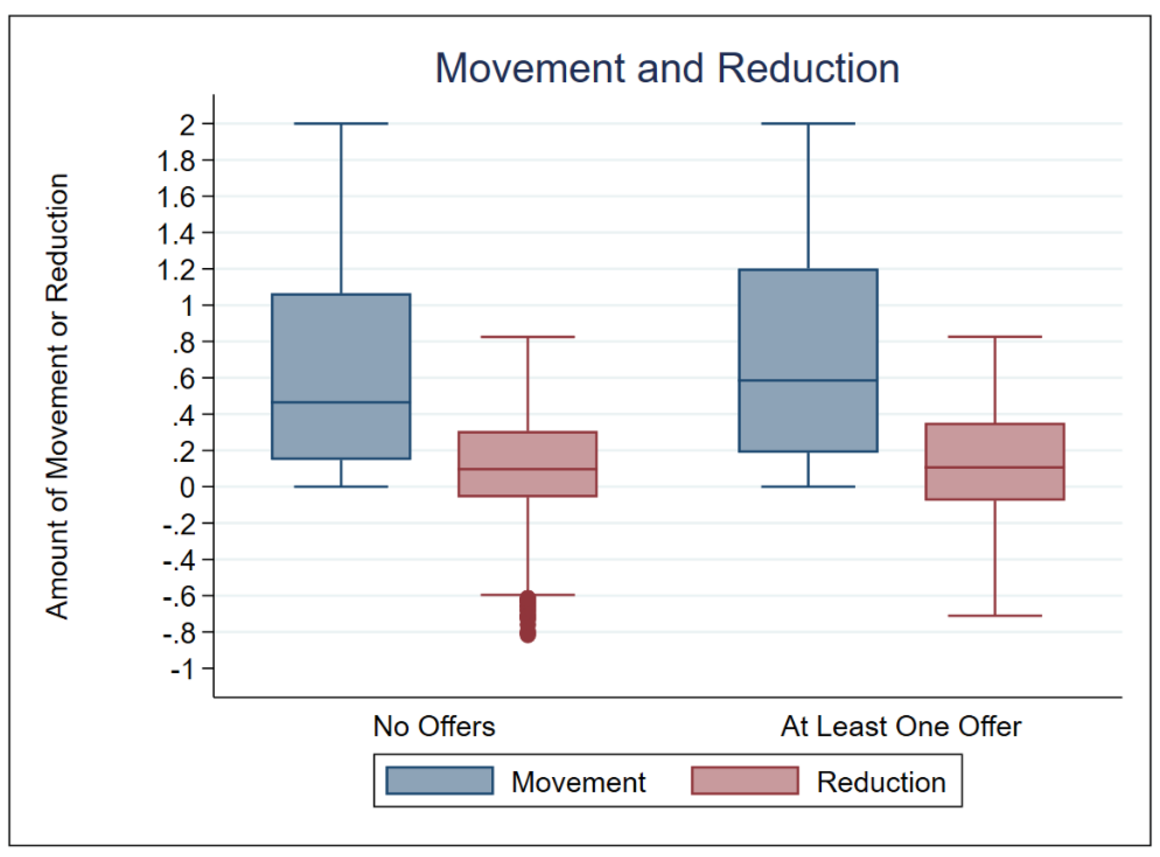
- H_0 : People are Bayesian (satisfy Martingale Property)

$$X \equiv \mathbb{E}M_{t_1,t_2} - \mathbb{E}R_{t_1,t_2} = 0$$

- H_1 : People are not Bayesian (does not satisfy Martingale Property)

$$X \equiv \mathbb{E}M_{t_1,t_2} - \mathbb{E}R_{t_1,t_2} \neq 0$$

- The box plot below shows clear visual differences in the spread of the two variables in the sample.



- These visual differences are supported by the test results, which find a significant difference in group averages.

Statistic	(1) All Individuals	(2) Without Offers	(3) With Offers Only
X	.5314	.5161	.5924
t	58.4621	51.4491	27.8964
X_{norm}	5.2194	5.1611	5.4344
Observations	4,866	3,888	978

Excess Movement Statistics. Excess movement, X, refers to the difference between movement and reduction. Normalized excess movement, X_{norm}, refers to the ratio of movement to reduction.

- The results of this test suggest that updating rules that have the Martingale Property, such as Bayesian updating and the model for non-Bayesian updating proposed in Epstein, Noor and Sandroni (2010), may not be useful for modeling learning in the labor market.

Measurement Error Calibration

- The results of the Martingale Test show much more normalized excess movement than was found in Augenblick and Rabin's original paper.
- We prove that for multiple states with measurement error, the excess movement statistic will be twice the sum of each state's prior measurement error variance.
- We run a Monte Carlo analysis with 10,000 simulations and find the following:

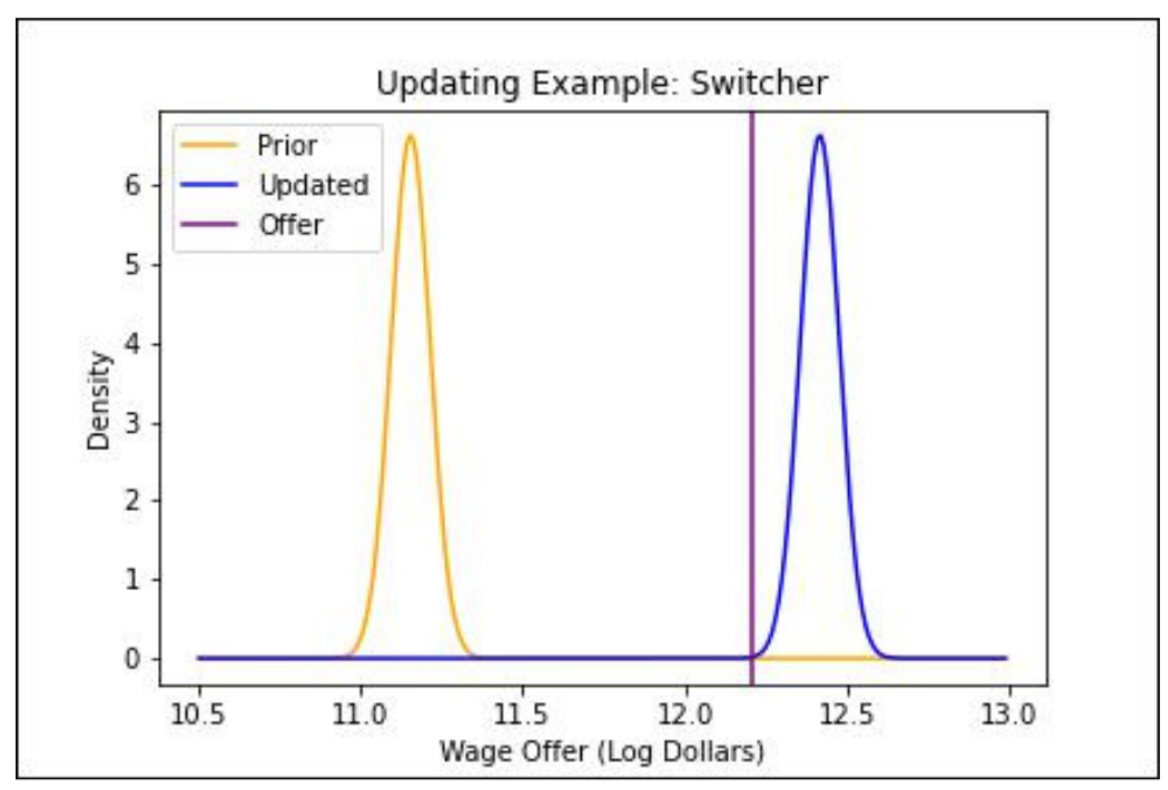
Statistic	Uniform Prior with Matched Belief Movement
X	0.5275 [0.5158, 0.5388]
X_{norm}	5.2349 [5.0219, 5.4579]
Δ	0.9831 [0.9765, 0.9899]

where $\Delta = \sum_{i=1}^{6} |\hat{\pi}^i_1 - \pi^i_{prior}|$ is the error.

- These results suggest the observed excess movement is not due to measurement error.

Prior Switching

- While the Martingale test rejects Bayesian updating and the Epstein, Noor and Sandrioni's (2010) model, it does not address the Grether (1980) model or multiple prior models updating rules.
- The graph below shows an example of "prior switching," wherein parts of the prior distribution with zero probability weight are updated to have positive weight, and vice-versa.



- This pattern violates Grether's model, but is consistent with a model of multiple priors.
- When fitting reported binned beliefs to log normal distributions, roughly 20% of our sample updates to a distribution with no shared mass with their initial prior for at least 5 of the 6 probability bins.
- The remaining bin generally contains very little of the remaining probability mass.

Economics Department
UC Santa Baraba
sebastiannbrown.github.io