Estimating key macroeconomic relationships at the undergraduate level: Taylor rule and Okun's Law examples

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Paper/data/handouts available on web site:
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Goals for students

- Estimate key relationships as undergraduates
- Develop spreadsheet skills
- Reinforce “big ideas”
- Use as gateway to discuss key issues
- Develop good research practice
  - ➔ What form may be estimated?
  - ➔ What are appropriate hypothesis tests?

Examples

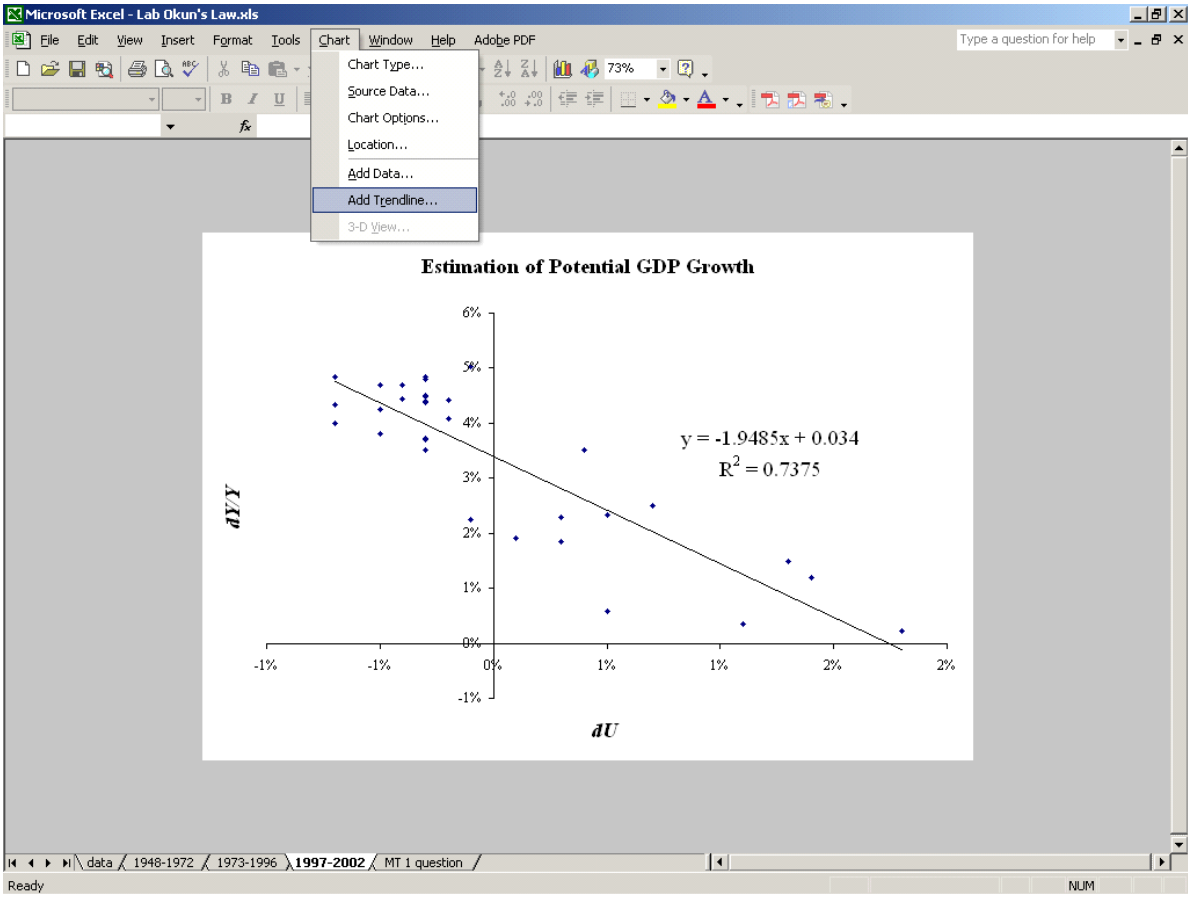
- Okun’s Law: relationship between unemployment rate and GDP gap
  - ➔ estimate key parameter values in Excel
- Taylor Rule: simple model of monetary policy reaction function
  - ➔ replicate (and improve) seminal paper
  - ➔ estimate key parameter values using Excel

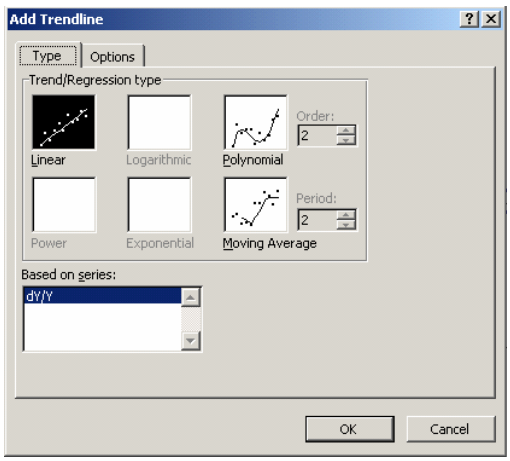
Okun's Law

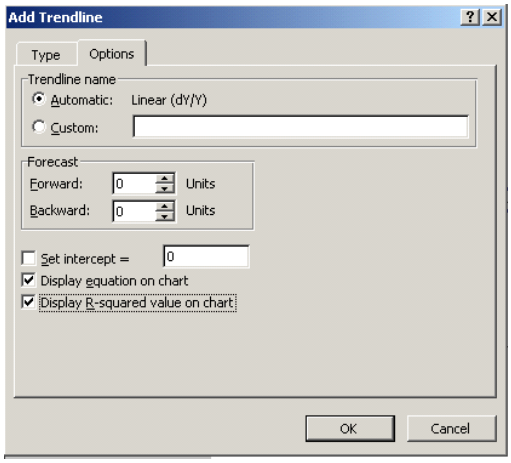
"Original" version: $\omega(U^* - U) = (Y - Y^*)/Y^*$

Growth rate version: $dY/Y = -\omega dU + dY^*/Y^*$

- plot as "scatter plot"
- insert "trendline" (regression line)







Results

Version:	growth rate		original	
Time period	ω	dY^*/Y^*	ω	U^*
1949-1972	2.2	4.09%	2.5	5.2%
1973-1996	1.8	3.01%	1.9	6.1%
1997-2004	1.9	3.40%	3	4.9%

Benefits to students

- Able to make key estimates themselves
- Requires modification of original equation
- Requires careful interpretation
- (May) require data manipulation

Gateways for discussions

- Changing GDP growth
  ➔ slowdown/new economy
- Changing natural rate
- Meaning of “laws” in economics
- Foundation for later short run models

Taylor Rule

$$i_t^T = r^* + \pi_t + \alpha_1\left(\pi_t - \pi^*\right) + \alpha_2\left(Y_t - Y_t^*\right)/Y_t^*$$

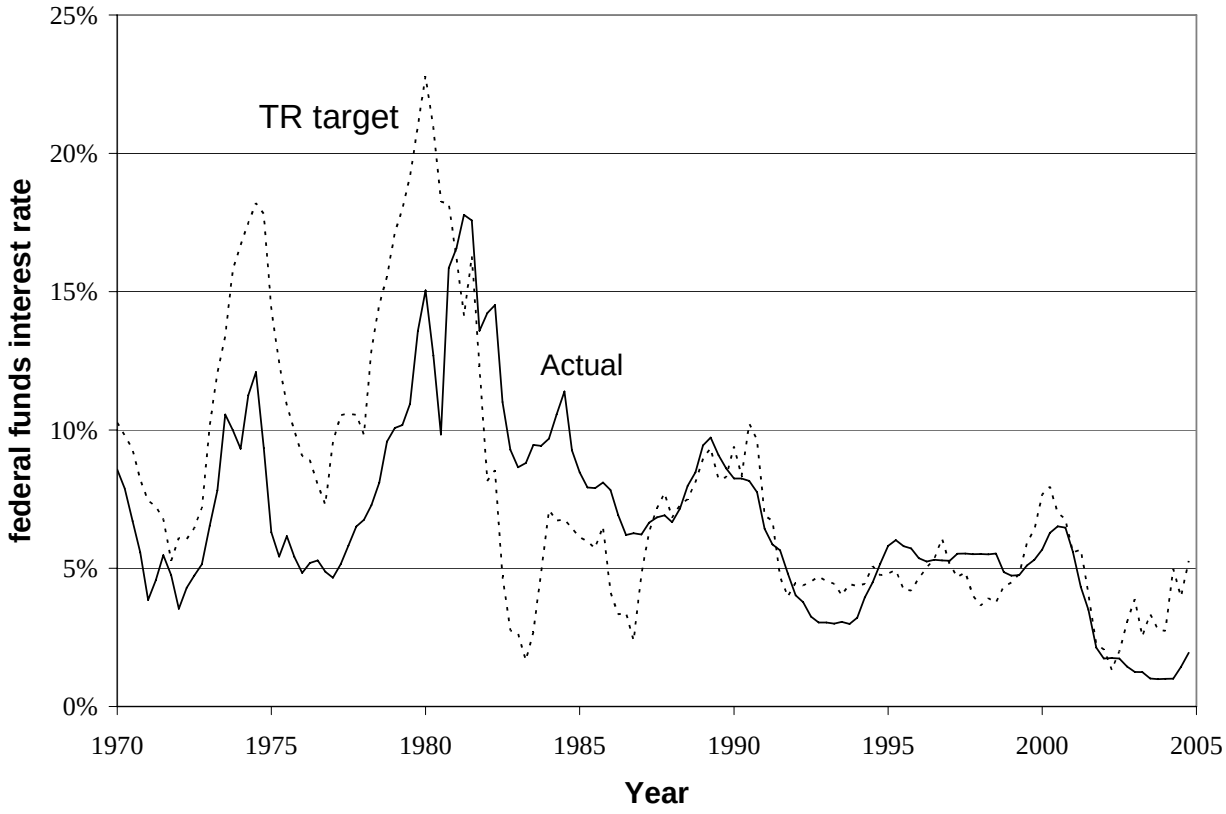
Lab 1: replicating/expanding Taylor (1993)

- Collect data in spreadsheet (1970-present)
  ➔ choose which series to use
- Convert to usable form
- Calculate rule target

	A	B	C	D	E
1				r*	0.02
2				pi*	0.02
3				alpha1	0.5
4				alpha2	0.5
5	Year	fed funds q	inflation rat	GDP gap	TR rule tar
6	1970	8.57%	6.09%	0.25%	
7	1970.25	7.88%	6.01%	-0.44%	
8	1970.5	6.70%	5.66%	-0.42%	
9	1970.75	5.57%	5.57%	-2.31%	
10	1971	3.86%	4.44%	-0.43%	
11	1971.25	4.56%	4.38%	-0.69%	
12	1971.5	5.47%	4.08%	-0.72%	
13	1971.75	4.75%	3.27%	-1.24%	
14	1972	3.54%	3.50%	-0.30%	
15	1972.25	4.30%	2.96%	1.22%	
16	1972.5	4.74%	3.19%	1.34%	
17	1972.75	5.14%	3.41%	2.13%	

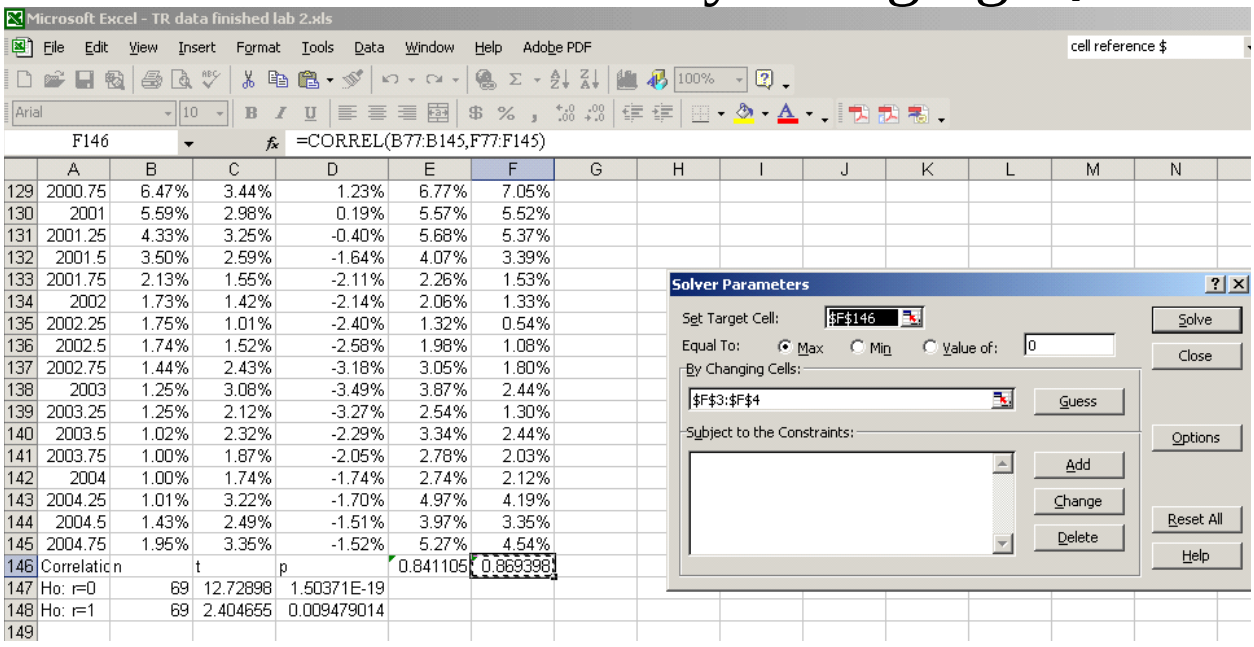
- Analysis
  ➔ time series (like Taylor)
  ➔ scatter plot (like Okun's Law lab)
  ➔ correlation, hypothesis tests

Plot



Use Solver to find better α_i

- Maximize correlation by changing α_i values



	A	B	C	D	E	F
129	2000.75	6.47%	3.44%	1.23%	6.77%	7.05%
130	2001	5.59%	2.98%	0.19%	5.57%	5.52%
131	2001.25	4.33%	3.25%	-0.40%	5.68%	5.37%
132	2001.5	3.50%	2.59%	-1.64%	4.07%	3.39%
133	2001.75	2.13%	1.55%	-2.11%	2.26%	1.53%
134	2002	1.73%	1.42%	-2.14%	2.06%	1.33%
135	2002.25	1.75%	1.01%	-2.40%	1.32%	0.54%
136	2002.5	1.74%	1.52%	-2.58%	1.98%	1.08%
137	2002.75	1.44%	2.43%	-3.18%	3.05%	1.80%
138	2003	1.25%	3.08%	-3.49%	3.87%	2.44%
139	2003.25	1.25%	2.12%	-3.27%	2.54%	1.30%
140	2003.5	1.02%	2.32%	-2.29%	3.34%	2.44%
141	2003.75	1.00%	1.87%	-2.05%	2.78%	2.03%
142	2004	1.00%	1.74%	-1.74%	2.74%	2.12%
143	2004.25	1.01%	3.22%	-1.70%	4.97%	4.19%
144	2004.5	1.43%	2.49%	-1.51%	3.97%	3.35%
145	2004.75	1.95%	3.35%	-1.52%	5.27%	4.54%
146	Correlation		t	p	0.841105	0.869398
147	Ho: r=0	69	12.72898	1.50371E-19		
148	Ho: r=1	69	2.404655	0.009479014		
149						

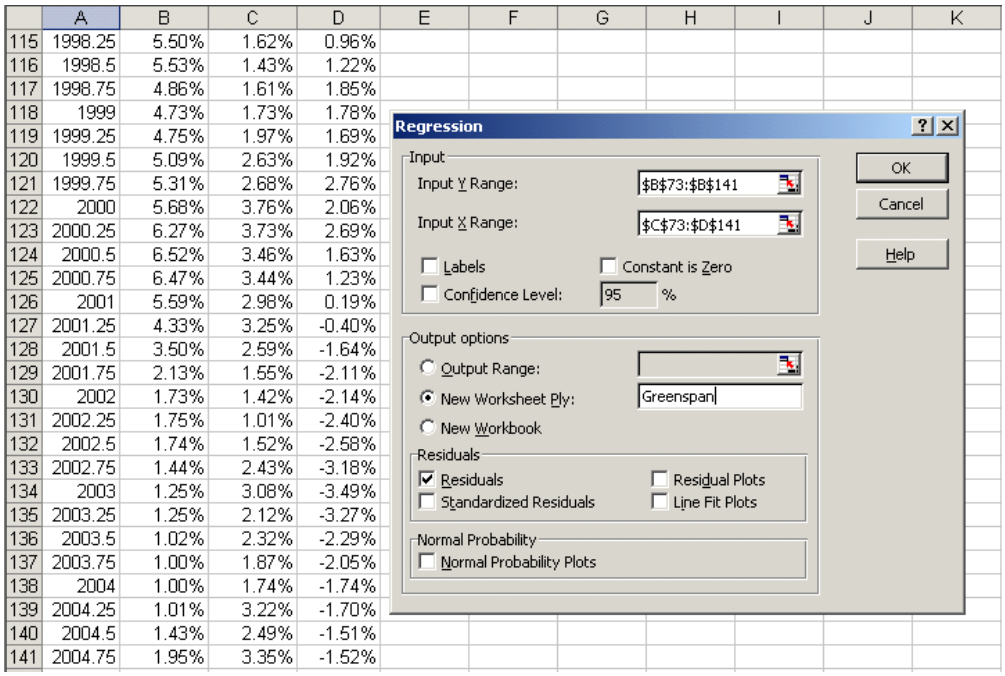
Lab 2: simplifying Judd and Rudebusch (1998)

- Obtain estimates of r^*, π^* α_1, α_2 for different Fed chairships
- Must modify TR to estimate

$$i_t^T = r^* + \pi_t + \alpha_1\left(\pi_t - \pi^*\right) + \alpha_2\left(Y_t - Y_t^*\right)/Y_t^*$$

$$i_i = \beta_0 + \beta_1\pi_t + \beta_2\left(Y_t - Y_t^*\right)/Y_t^* + \varepsilon_t$$

Regression in Excel:



	A	B	C	D
115	1998.25	5.50%	1.62%	0.96%
116	1998.5	5.53%	1.43%	1.22%
117	1998.75	4.86%	1.61%	1.85%
118	1999	4.73%	1.73%	1.78%
119	1999.25	4.75%	1.97%	1.69%
120	1999.5	5.09%	2.63%	1.92%
121	1999.75	5.31%	2.68%	2.76%
122	2000	5.68%	3.76%	2.06%
123	2000.25	6.27%	3.73%	2.69%
124	2000.5	6.52%	3.46%	1.63%
125	2000.75	6.47%	3.44%	1.23%
126	2001	5.59%	2.98%	0.19%
127	2001.25	4.33%	3.25%	-0.40%
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135	2003.25	1.25%	2.12%	-3.27%
136	2003.5	1.02%	2.32%	-2.29%
137	2003.75	1.00%	1.87%	-2.05%
138	2004	1.00%	1.74%	-1.74%
139	2004.25	1.01%	3.22%	-1.70%
140	2004.5	1.43%	2.49%	-1.51%
141	2004.75	1.95%	3.35%	-1.52%

Results

- OK for Greenspan, r^* overall
- α_i results for other periods problematic

Benefits for students

- Replicate / expand / simplify existing research
- Introduction to regression analysis
- Key research skills:
  ➔ find functional form that can be estimated
  ➔ find estimates of parameters of interest
  ➔ perform right hypothesis test
  (e.g. on α_1, not β_1)

Gateways for discussion

- Usefulness of monetary policy rules
- Monetary policy history
- Monetary policy reaction to special events

Conclusion

- Some key concepts in macro can be estimated by undergraduate students in lab class
- Allows for “discovery approach” of key issues
- Students learn important research skills
  ➔ manipulating equations for estimation
  ➔ gathering, cleaning data
  ➔ drawing appropriate conclusions
  ➔ replicating, extending, simplifying existing papers
- Students learn spreadsheet skills

<u>Other examples using same methods</u>

- Money demand
- Consumption function
- Engel’s Law