Free Trade and Domestic Institutions or Water Quality, redux
Testing for and Modeling Non-Linear and/or Interaction Relationships

1. Run your model, and test for omitted variables (involving non-linear relationships or interactions) using the Ramsey test (estat ovtest). Report your results.

a. For the purpose this assignment, I use my final model from assignment three.

Table 1: State's Level of Trade's Dependency

	(3) State Level of Trade (SLT)
Left-Leaning Parties Cabinet Seats (LLPCS)	-0.129*
	(0.0324)
Population	-0.000332*
	(0.0000314)
Presidential System	2.475+
	(1.423)
Federal System	0.830
	(1.983)
Bicameralism Strength	-3.291*
	(1.552)
GDP	2.481*
	(0.410)
Openness in Capital Account Transactions	-6.763
	(5.212)
Unemployment Program	4.916*
	(1.356)
Year	2.242*
	(0.163)
Elderly (over 65 % of population)	-1.945*
	(0.578)
_cons	-4359.5*
	(321.1)
N	955
adj. R^2	0.405

Standard errors in parentheses
+ $p < 0.10$, * $p < 0.05$

The Ramsey test shows that the model could be biased due to omitted variables. The null hypothesis of no omitted variable is rejected here.

Ramsey RESET test for omitted variables

Omitted: Powers of fitted values of openc

H0: Model has no omitted variables

F(3, 941) = 31.62

Prob > F = 0.0000

2. Theorize about at least one interaction or non-linear relationship that might be present in this data.
    a. Looking at the model to find potential omitted variables, I assumed that the relation of Real GDP Growth (realgdpgr) with state's level of trade might not be linear. My assumption is as countries have better growth in their GDP comparing to previous year, their state level of trade should increase many times. Hence, I think there might be quadratic relation between GDP growth and state level of trade.

       Also, looking at model, the negative relation of openness in capital account transactions (kaopen) on the state level of trade is questionable for me. I think their relation might be inverse.

3. Re-specify the regression model so that it can model the relationship you theorized about in part 2.

    a. I modified the model based on my assumptions by squaring GDP growth and replacing openness in capital account transactions with its inverse.

Table 2: State's Level of Trade's Dependency Modified

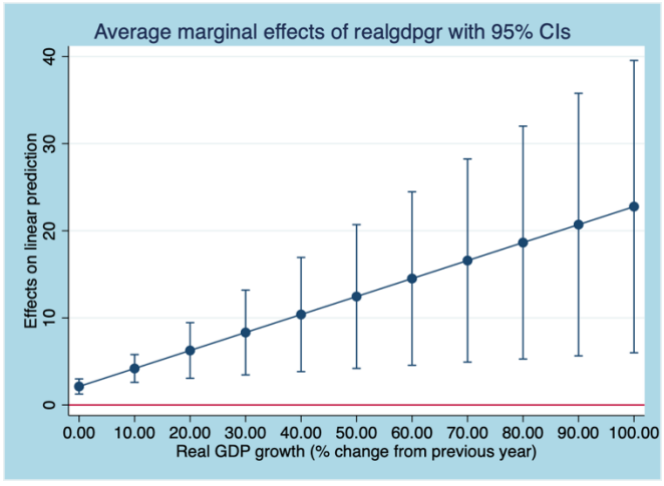
	(3) State Level of Trade (SLT)
Left-Leaning Parties Cabinet Seats (LLPCS)	-0.127*
	(0.0323)
Population	-0.000331*
	(0.0000310)
Presidential System	2.493+
	(1.412)
Federal System	0.681
	(1.973)
Bicameralism Strength	-2.595+
	(1.566)
Real GDP Growth	2.127*
	(0.442)
Real GDP Growth Squared	0.103*
	(0.0435)
Openness in Capital Account Transactions	2.565*
	(1.059)
Unemployment Program	5.332*
	(1.359)
Year	2.218*
	(0.159)
Elderly (over 65 % of population)	-1.798*
	(0.580)
_cons	-4324.9*
	(314.4)
N	955
adj. R^2	0.405

4. Use the margins command to investigate whether there is support for your theory. Produce a relevant graphic.
    a. As shown in Table 3 and Figure 1 below, there seem to be a non-linear effect of real GDP growth on state level of trade.

Table 3: Real GDP Growth Margins Command Table

	Delta-method					
	dy/dx	std. err.	t	P>t	[95% conf.	interval]
Real GDP Growth						
_at						
1	2.12689	.4422072	4.81	0.000	1.25906	2.99472
2	4.191581	.8142048	5.15	0.000	2.593707	5.789455
3	6.256273	1.626745	3.85	0.000	3.063792	9.448753
4	8.320964	2.479043	3.36	0.001	3.455851	13.18608
5	10.38566	3.340808	3.11	0.002	3.829333	16.94198
6	12.45035	4.206225	2.96	0.003	4.195647	20.70505
7	14.51504	5.073425	2.86	0.004	4.558461	24.47162
8	16.57973	5.941628	2.79	0.005	4.919307	28.24015
9	18.64442	6.81045	2.74	0.006	5.278938	32.0099
10	20.70911	7.679682	2.70	0.007	5.637766	35.78046
11	22.7738	8.549197	2.66	0.008	5.996037	39.55157

Figure 1: Real GDP Marginal Effect



5. Discuss your results: do you have evidence of an interaction or non-linear relationship here? Is it consistent with your theoretical expectations from part 2?

    a. There is no significant change in overall explanatory power of the modified model in Table 3. However, the 0.1 coefficient for the squared GDP growth indicates weak causality quadratic relation. Also, unlike the original model, the inverse causal relation between openness in capital account transactions and state level of trade is supported by the new model.