Effect of Parameters in a Two Country Trade Model

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Research Question

- What are the effects of exogenous shocks to sectoral productivity in a trade model? How do these effects vary with model parameters?
  - Based on *Trade and the Global Recession* by Eaton, Kortum, Neiman, and Romalis (2016)
    - This model uses weak calibration for its parameters
    - How do the estimates from this model change if the parameters are estimated using strong calibration?

The EKNR Model

- Eaton, et al. formulates a dynamic multi-country, multi-sector general equilibrium trade model
  - Shock exogenous variables and observe behavior of endogenous variables such as capital, bilateral trade shares, sectoral price indices, and investment spending
- This project uses simple two-country two-sector model version, hereafter EKNR
  - Durables output used for investment, traded
  - Services output used for consumption, non-traded
  - Cobb-Douglas Production with CRS

The EKNR Model

- Formulate Lagrangian, use FOC's to back out shadow values of consumption and investment, and to generate EE
- Two central equations which rely on parameters I have chosen to estimate are:

$$Y_{n,t} = A^D_{n,t} L_n^{\beta_L} K_n^{\beta_K} \tag{1}$$

$$K_{n,t+1} = \chi_{n,t} \left(\frac{X^D_{n,t}}{p^D_{n,t}} \right)^{\alpha} (K_{n,t})^{1-\alpha} + (1-\delta) K_{n,t} \tag{2}$$

- The only parameter embedded in (1) or (2) that I will not be estimating is θ, which p^D in (2) depends on

Parameters and Motivation

	Description	EKNR Value	Bounds	Source
β_L	Labor Output Elasticity	0.66	[0,1]	Unclear
β_K	Capital Output Elasticity	0.33	[0,1]	Unclear
α	Adjustment Costs	0.55	[0,1]	Uncited literature
δ	Capital Depreciation	0.1	[0,1]	Greenwood, Hercowitz & Krusell (1997)

Table 1: Summary of EKNR parameters of interest

- Use two separate GMM procedures
- Conduct certain counterfactuals and compare outcomes using my estimates of the parameters to those of the weakly calibrated values
- What is the effect of a depression in productivity in China, on the US?
  - Negative shock to productivity in durables, A^D, to simulate a consequence of COVID-19

Estimating Output Parameters

- Ordinary OLS does not work
- $y_t = \beta_0 + \beta_L l_t + \beta_K k_t + \beta_M m_t + \omega_t + \epsilon_t$
  - ω_t: productivity, function of k_t and m_t
  - Assume that labor is chosen one period prior to other inputs
- Estimate coefficients the following moments, where η is an i.i.d. shock in production

$$\hat{\eta}_t(\beta_L, \beta_K) \times \begin{pmatrix} l_{t-1} \\ k_t \end{pmatrix} = 0$$

- Two moments, perfectly identified

Estimating K LOM Parameters - Theory

- p^D from K LOM defined as:

$$p^D_{n,t} = \left(\sum_{i=1,2} \left(\frac{b_{i,t} d_{ni,t}}{A^D_{i,t}} \right)^{-\theta} \right)^{-1/\theta}$$

- Relation to bilateral trade shares: the percentage of spending in durables that comes from imports

$$\pi_{ni,t} = \left(\frac{b_{i,t} d_{ni,t}}{p^D_{n,t} A^D_{i,t}} \right)^{-\theta}$$

- Bundle of factors depends on real data and other parameters

$$b_{i,t} = (w_{i,t})^{\beta_L} (r_{i,t})^{\beta_K} = \frac{Y_{i,t}}{L^{\beta_L}_{i,t} K^{\beta_K}_{i,t}}$$

Estimation of α and δ depends on estimation of β_L and β_K

Estimating K LOM Parameters - Theory

$$\hat{b}_{i,t} = \left(\frac{\hat{Y}_{i,t}}{\hat{L}_{i,t}}\right)^{\beta_L} \left(\frac{\hat{Y}_{i,t}}{\hat{K}_{i,t}}\right)^{\beta_K}$$

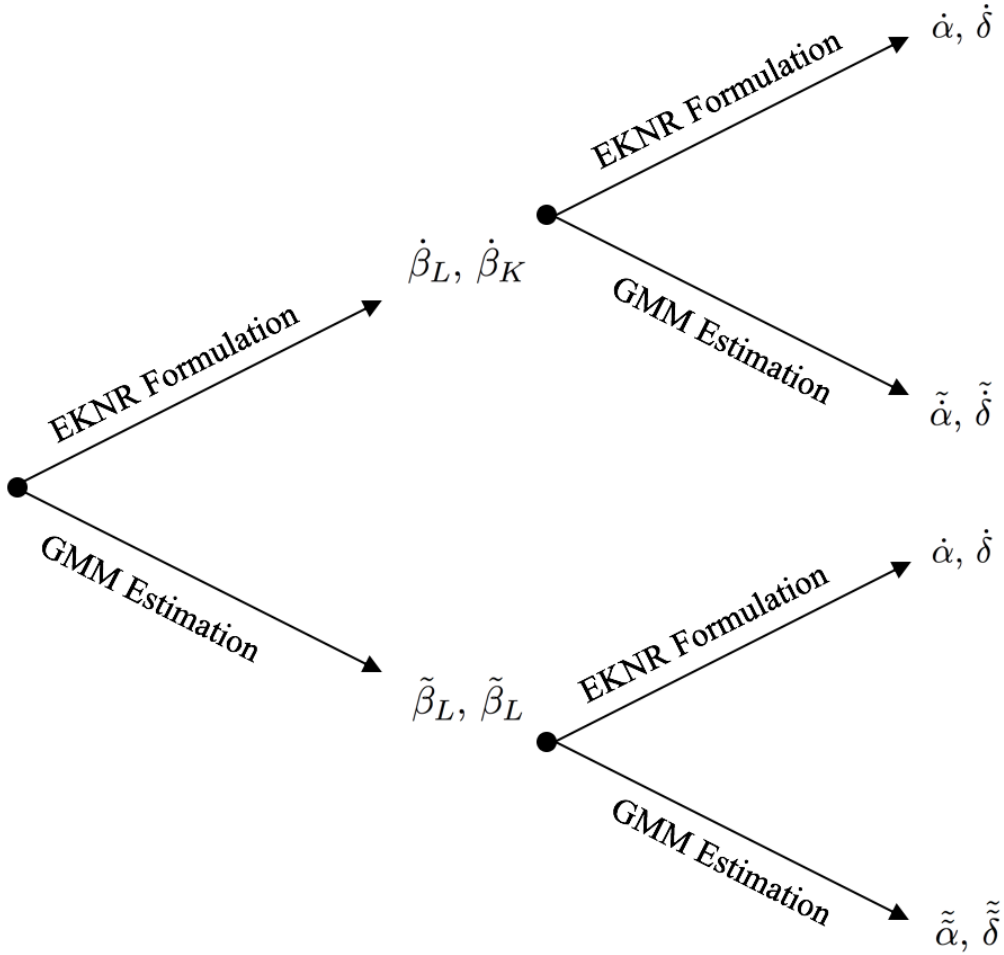
$$\hat{p}^D_{n,t+1} = \left(\sum_{i=1,2} \pi_{ni,t} \left(\frac{\hat{b}_{i,t+1}\hat{d}_{ni,t+1}}{\hat{A}^D_{i,t+1}}\right)^{-\theta}\right)^{-1/\theta}$$

$$\hat{K}_{n,t+2} = \hat{\chi}_{n,t+1} \left(\frac{\hat{X}^D_{n,t+1}}{\hat{p}^D_{n,t+1}\hat{K}_{n,t+1}}\right)^{\alpha} \left[\hat{K}_{n,t+1} - (1-\delta)\right] + (1-\delta)$$

- Given shocks $\hat{\chi}$, $\hat{b}$, $\hat{d}$, $\hat{A}^D$, parameters θ, β_L, β_K, and data to compute π, $\hat{X}$, $\hat{Y}$, $\hat{L}$, we can back out path of $\hat{K}$
- Moments, ignoring recession period (2001 - 2007, 2013 - 2018)
  1. Average of $\hat{K}$
  2. Average of $\hat{K}/\hat{Y}$
  3. Corr$(\hat{K}_{t+1}, \hat{K}_t)$

Data and Scenarios

- BEA NIPA, WIOD, IMF NFA, OECD, and CEPII BACI for years 2000 - 2018

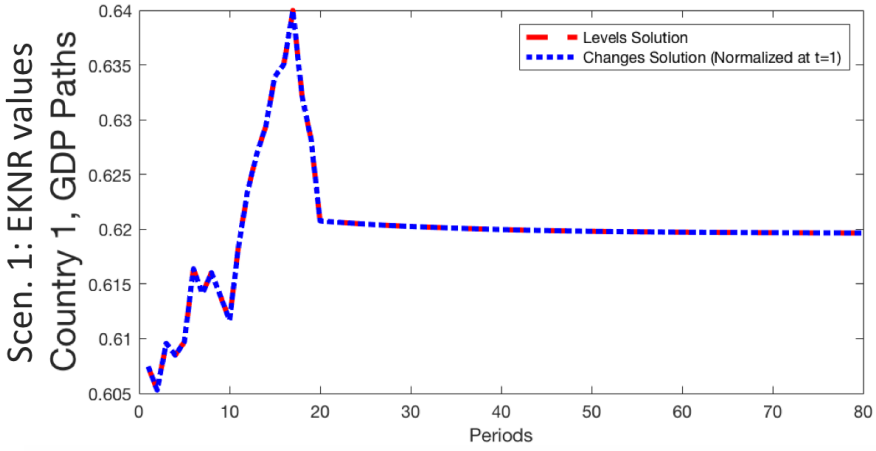


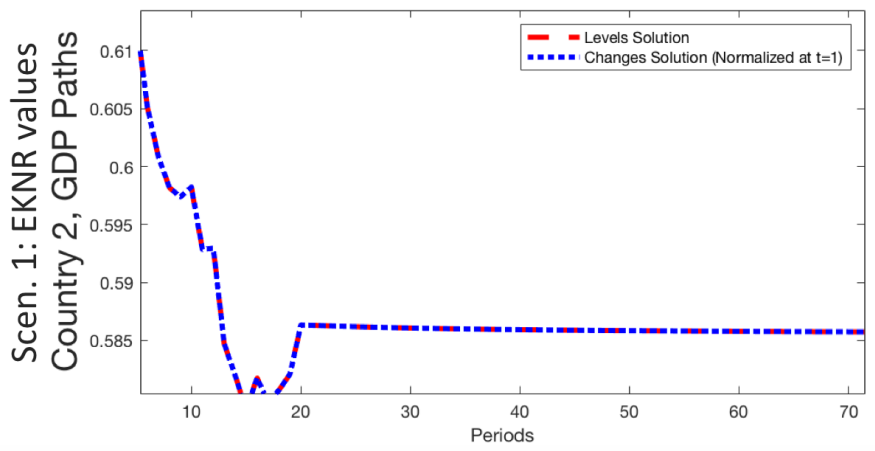
Findings

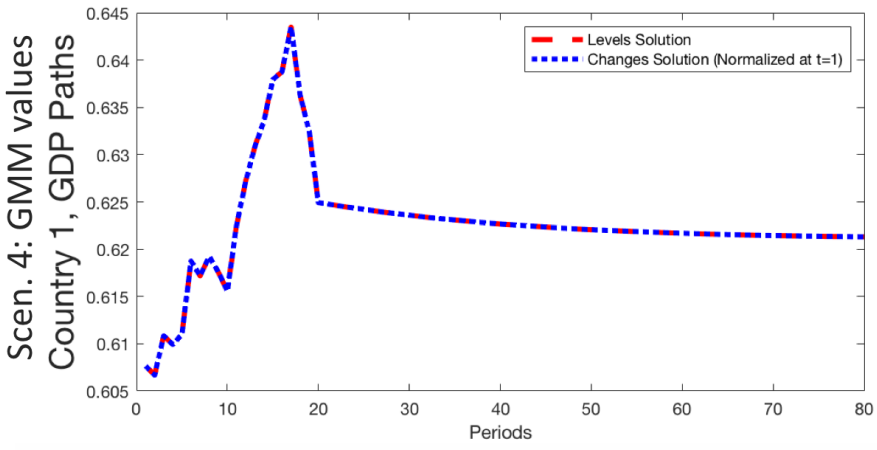
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
β_L	0.66	0.66	0.672	0.672
β_K	0.33	0.33	0.328	0.328
α	0.55	0.4754	0.55	0.4747
δ	0.1	0.1225	0.1	0.1221

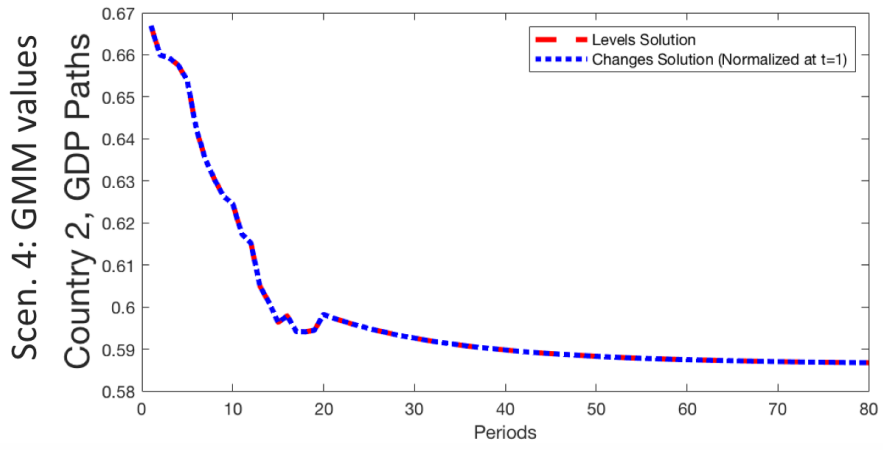
- The value estimated for adjustment cost α is about 14% different than that weakly calibrated in EKNR
- Note that identity matrix used for GMM

Counterfactuals - Original Shocks



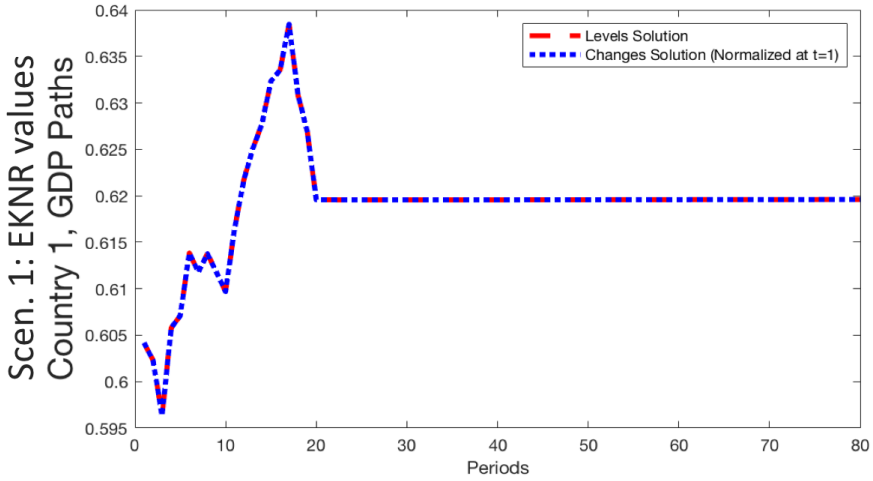


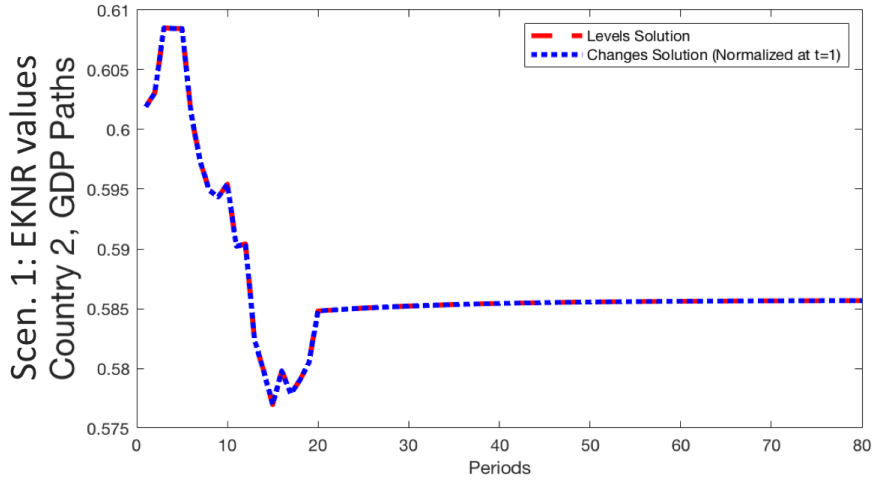


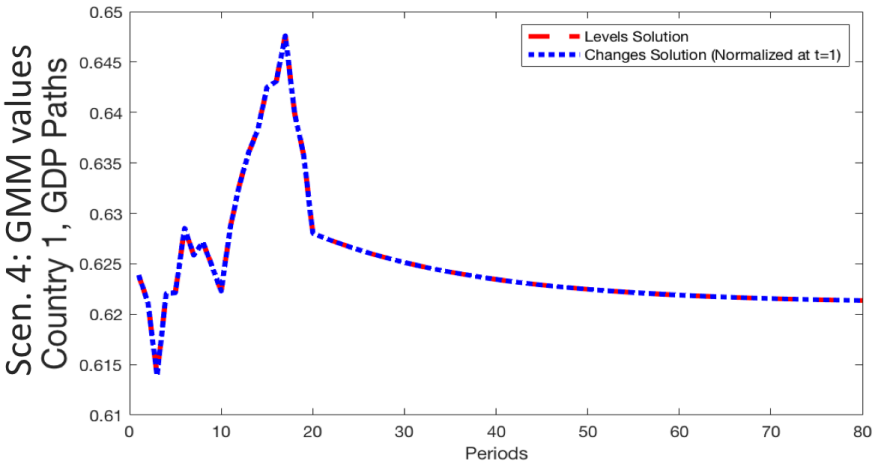


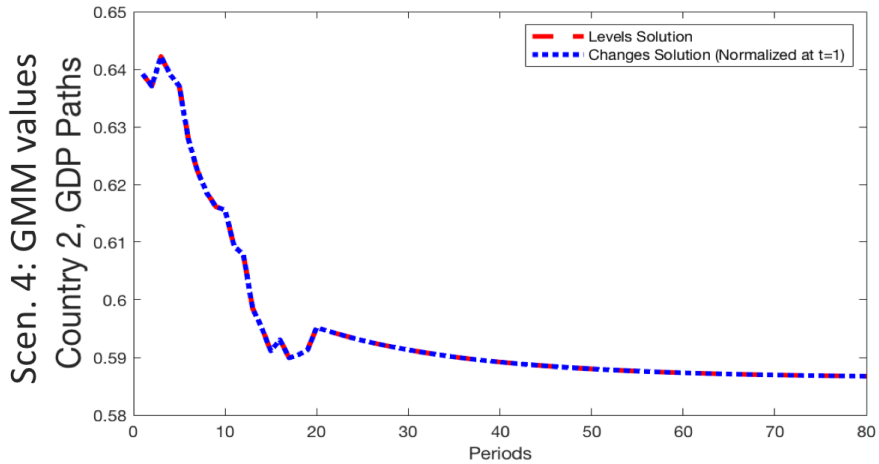
Counterfactuals - Negative Shock to A^D

Introduce a 10% negative shock to A^D in China (Country 1)



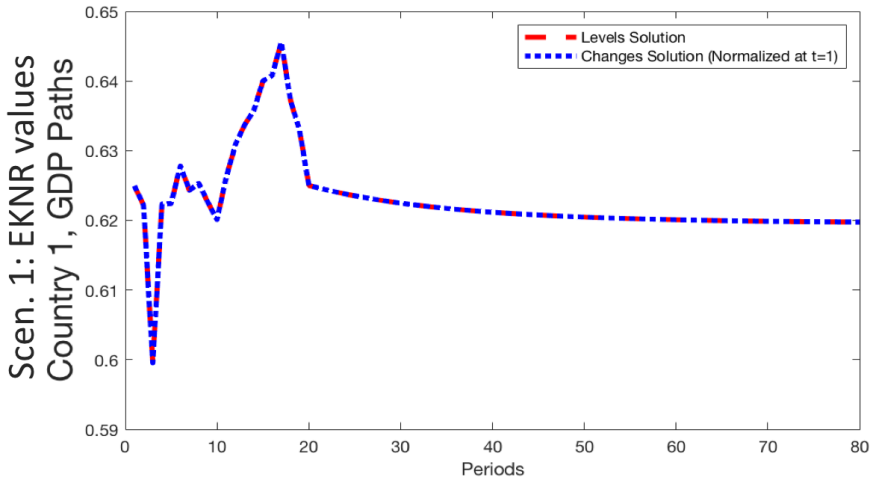


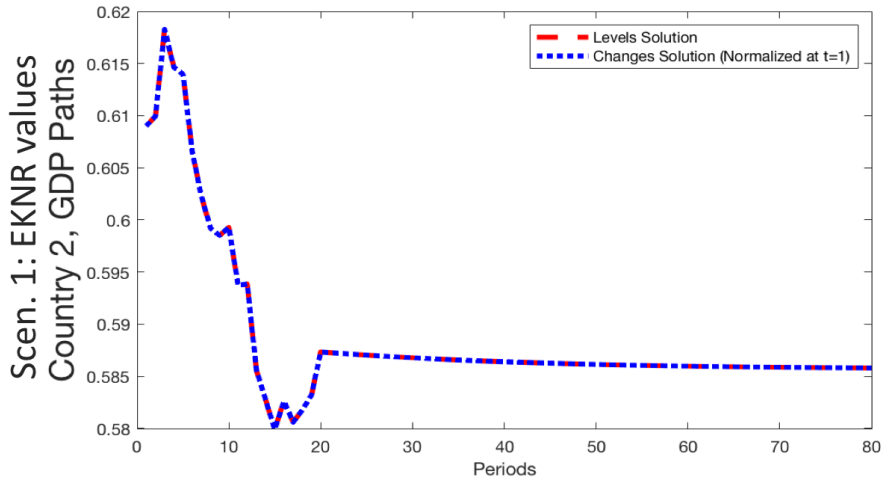


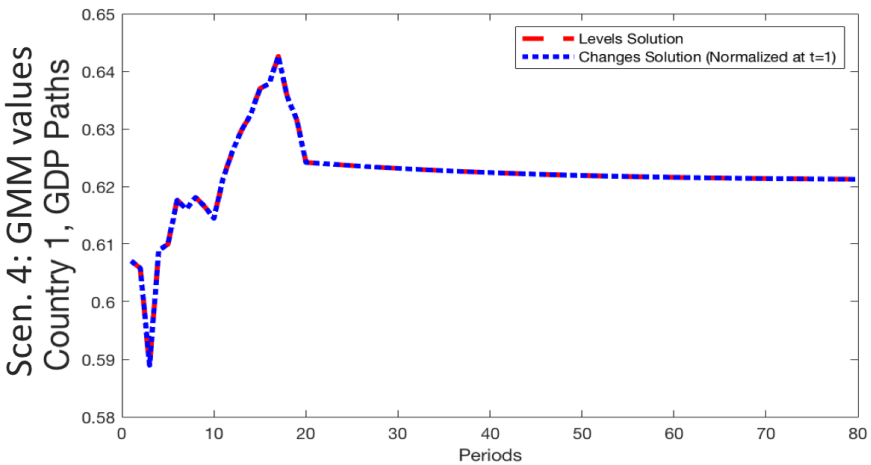


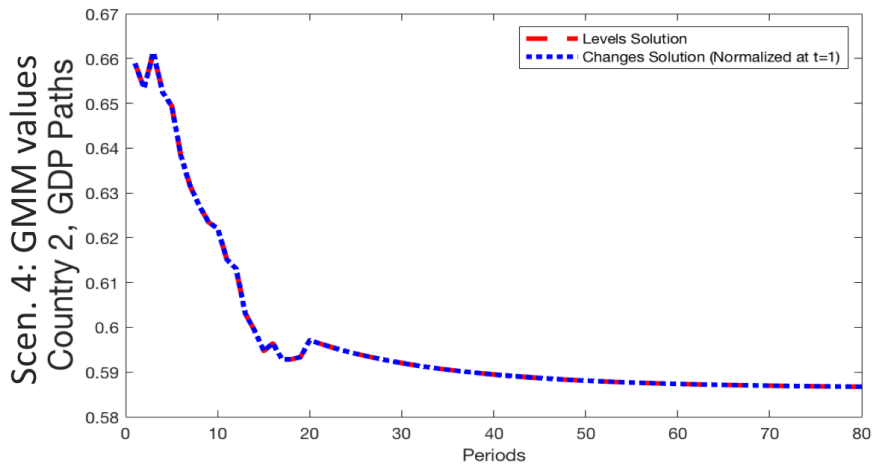
Counterfactuals - Bigger Negative Shock to A^D

Introduce a 20% negative shock to A^D in China (Country 1)









Conclusion

- Most significant finding is difference in adjustment cost parameter
- Effect of negative shocks to productivity in China
  - Model with EKNR parameters predicts that GDP in China is lower in 7 year period following shock
  - Model with GMM parameters predicts similar pattern, although transition is less smooth
  - Effect of negative shocks to productivity in U.S.
    - Overall smoother transition path
- Shortcomings
  - Due to complexity of production function estimation, perhaps neither value for β_L, β_K is actually appropriate

Appendix - Shock Values

	t = 1	t = 2	t = 3	t = 4	t = 5	t = 6	t = 7	t = 8	t = 9	t = 10	t = 11	t = 12	t = 13	t = 14	t = 15	t = 16	t = 17	t = 18	t = 19	t = 20
Productivity in Durables Shocks																				
Country n	1.000	1.007	**0.990**	0.986	1.003	1.011	0.991	0.988	0.985	0.993	0.997	1.017	1.034	1.018	1.023	1.017	1.039	1.022	1.010	0.996
Country i	1.000	0.980	1.003	1.024	1.047	1.030	1.047	1.041	1.048	1.031	1.016	1.040	1.027	1.015	1.017	1.021	1.002	1.017	1.025	1.046
Chi Shocks																				
Country n	1.000	0.982	1.004	1.019	1.027	1.040	1.028	1.052	1.035	1.024	1.048	1.048	1.030	1.052	1.044	1.058	1.060	1.034	1.017	1.014
Country i	1.000	1.021	1.045	1.026	1.003	0.997	0.975	0.953	0.952	0.961	0.953	0.963	0.951	0.944	0.960	0.972	0.986	0.978	0.983	0.962
Trade Cost Shocks																				
n - i	2.000	1.974	1.967	1.961	1.937	1.967	1.938	1.928	1.898	1.877	1.891	1.888	1.875	1.856	1.837	1.844	1.819	1.835	1.832	1.820
i - n	2.000	1.991	2.010	1.993	1.966	1.995	2.000	1.983	2.004	1.974	1.984	1.993	1.997	2.013	2.025	2.017	2.036	2.065	2.064	2.060
Intertemporal Preferences Shocks																				
Country n	1.000	0.996	1.003	1.001	0.999	1.011	1.017	1.016	1.016	1.009	1.018	1.024	1.034	1.036	1.047	1.047	1.048	1.045	1.044	1.033
Country i	1.000	1.004	0.997	0.999	1.001	0.989	0.983	0.984	0.984	0.991	0.982	0.976	0.966	0.964	0.953	0.953	0.952	0.955	0.956	0.967