

**Problem Set #2: Endogenous Growth, Poverty Traps and Convergence** (*sections in italics optional*). Please type your answers (you can add Figures or equations by hand) copy the text of each section 1b) etc. and put it in italics at the beginning of each answer. Start each new question at the top of a page, if possible.

**2.1 Asian Growth Miracle:** a) Briefly summarize Paul Krugman's and [Alyn Young's](#) "myth of the East Asian Miracle" argument. Does evidence provided by [Bosworth and Collins \(2003\)](#) and [Bosworth and Collins \(2008\)](#) support the Krugman/Young argument regarding a lack of TFP growth in Asia? See also [IMF-Nicholas Crafts \(1999\)](#). Briefly sketch two explanations of the Asian growth miracle, one consistent with endogenous growth models (AK or HD) and one consistent with exogenous Solow-Swan models (see the [WB-Team report page 68](#) available core readings/empirical evidence/EastAsianGrowthDebate). Discuss the implications of these explanations for long-run growth in Asia. *What alternative explanation does Lucas (1993) offer in [Making a Miracle?](#)*  
b) Following the method of Jones Chapter Exercise #1 page 75 (see posted): pick 3-4 Asian countries and 3-4 other countries and compute their steady states (using "A" estimates from the TFP worksheet). What do the steady state computations of Jones suggest about future Asian growth (at least China)? What implications do these alternate explanations of East Asian high growth have for future growth rates in the Asian countries you chose? d) *In an [appendix to Chapter 5](#) the TEAM report argues that growth Granger causes investment, but not vice versa. Discuss how this observation could be consistent with the low savings poverty trap as discussed in Sachs et. al. (2004) or Ros (1999) page 59-60 or Robelo page 27 eq 44. Briefly discuss the two steady states in this framework. Might a technology based poverty trap model also account for this result– growth determining investment? (See chapter 5 of Ros).*

**2.2 Demand-side poverty traps:** a) Briefly discuss two versions the "big push" or market demand poverty trap due to Rosenstien-Rodan and formalized by [Murphy, Schliefer and Vishny \(1989\)](#) or [BSIM Chapter 1 page 75](#) or the handout Krugman's "[Fall and Rise of Development Economics](#)" or [Ros, 1999, Chapter 5](#). What can the government do to encourage growth of the more efficient modern sector? Can exports always overcome a demand side poverty trap? (b) What is the tradeoff between opening to trade and protection in these models? Illustrate this last point using the monopolistic competition-free trade example used in class. Why does firm size tend to increase in the open economy shoe industry? Might this lead to political opposition to opening trade? What will happen to employment and wages in the local garment industry after the economy opens up to trade? Outline the pros and cons of liberalization in this case.

**2.3 Empirical Evidence:** The basic growth equation used by [Levine and Renelt \(1992\)](#) to test the robustness of Barro's 1989 cross section growth estimates,

$$\gamma = -.83 - .35*RGDP60 - .38*GPOP + 3.2*SEC + 17.5*INV \quad R^2 = .46$$

(.85)    (.14)                    (.22)                    (1.3)                    (2.7)

where the per capita growth rate  $\gamma$  depends on per capital income in 1960 (RGDP0), population growth (GPOP), secondary enrollment (SEC) and investment share of GDP (INV). (a) Briefly compare the RHS variables above with those in [Bosworth and Collins \(2003\)](#) Table 10, [Barro 1997 Table 1](#) and in [BSIM Chapter 12 Table 12.3](#). Which variables are added, which are dropped, broadly speaking? (b) Discuss the extent to which the above results are consistent with the predictions of endogenous (HD or AK) and exogenous growth models such as the augmented Solow model? (c) *Briefly outline the stepwise method Levine and Renelt advocate to determine the robustness of cross section regression RHS variables.*

**2.4 Hybrid endogenous and exogenous growth models:** (a) Briefly outline and illustrate if possible the "Sobelo" and "Learning by Doing" model of Villanueva in which long term growth depends on the savings rate. Illustrate both models using the diagram with growth rate on the vertical axis. Which properties associated with endogenous and exogenous growth models do these hybrid models share? *Formulate a definition of endogenous vs. exogenous growth models, which can distinguish between both of these hybrid models.* (b) In his [15 years of growth theory](#) Sala-i-Martin's argues "...research shows that the conditional convergence hypothesis is one of the strongest and

most robust empirical regularities found in the data. Hence, by taking the theory seriously, researchers arrived at the exact opposite empirical conclusion: the neoclassical model is not rejected by the data, whereas the AK model is.” Discuss this statement in light of the convergence properties of the Sobelo model discussed above. *What sort of evidence could be used to distinguish between these two classes of models?* (see also [McGratten’s “In Defense of AK models”](#)). *What evidence does Jones use to argue against endogenous growth in chapter 8?*

**2.5 Trade and Growth:** Does trade increase economic growth, or *vis versa*? It has been surprisingly difficult to prove a causal link between trade and growth or specifically between trade policy and growth. **a) MA-IPED** students briefly describe *while PhD students write down equations for two growth models which higher tariffs raise or reduce growth* (see [Rodriguez & Rodrik 2000 \(R&R\)](#) or [Sachs and Gallup, 1999](#) or the [Basu and McLeod, 1992](#) handout.) **(b)** Why is it difficult to determine whether trade causes growth? Discuss some of the techniques (tricks) economists have use to find a relationship between trade and growth starting with [Levine and Renelt \(1992\)](#) and Sala-i-Martin (1997, [I just ran 2 million regressions...](#)) through [Rodriguez and Rodrik \(2000\)](#). Then pick one “second round” paper (post R&R 2000) and discuss how they respond to R&R’s replication and criticism of their results (for example, [Warner \(2003\)](#), [Wacziarg and Welch \(2008\)](#) or [Dollar and Kraay \(2004\)](#) and [Estevadeordal and Taylor, 2008](#). The paper you use should explicitly references the R&R paper (you can use google scholar to find other papers if you want to). Briefly summarize this 2<sup>nd</sup> round evidence in response to [Rodriguez and Rodrik \(2000\)](#) argument that trade does not increase growth. **(d) Case study question:** *Is your country “open” or closed to trade (provide a Figure or Table with trade to GDP ratios)? Is your country open or closed to capital inflows (Table or figures for CA over GDP)? Mention free trade agreements, currency areas, etc. Does your country have policy levers to manage its real exchange rate? Is data on a real exchange rate measure available? (PPP or WDI or [USDA ERS Macro database](#)).*

**2.6 Evidence for conditional convergence and poverty traps:** Answer question 1 page 75 of Jones but then also choose 3-4 other countries that have data on the [TFP worksheet of this spreadsheet](#) (similar to DR and Haiti) (PhD students—optional for Masters) Import the [Jones Table C.1 Excel file](#) [Jones file for Appendix C](#) and put the data into [Eviews Workfile](#) some other multivariate regression program (even excel will to this, just not very quickly). **(a)** Carefully regress growth rates 1960-97 or  $g(60-97)$  on the level of income per capita in 1960 ( $Y_{60}$ ). What does this regression tell you about absolute convergence among this group of countries? **(b)** Now add years of schooling ( $u$ ) or the savings rate provided ( $S_K$ ) or population growth to this regression. What happens to the coefficient on 1960s per capita income? Which of these regressions demonstrate conditional convergence? Explain. Pick three pairs of countries with similar levels of schooling—put them in a table showing schooling years, initial 1960 income and the growth rate for 1960-97 (all taken directly from Table C.2). Does the evidence in your table support conditional convergence? Explain why, why it doesn’t. **(c)** Regress the level of GDP per capita in 1997 ( $Y_{97}$ ) on the  $S_K$ ,  $n$  and  $y(60)$  then do a second regression adding  $u$  (years of schooling). Compare the  $R^2$  for this regression. What does this say about explanatory power of the Solow-Swan and Mankiw-Romer-Weil version of the neoclassical (Solow) growth model? **(d)** (optional) How does Jones proceed to explain savings/investment rates in Chapter 7—does this exercise overcome the endogeneity problem associated with savings and schooling? Explain. **(e)** optional for everyone: What can be done to validate obtained from the regressions such as those in #1 above which may suffer from simultaneous equation bias? **(e)** Use the coefficient computed above to draw some conclusions regard the speed of convergence using Table 11.1 assuming a capital share  $\alpha$  of .4.

**2.7 Endogenous growth with Government:** **(a)** Show how Barro's growth model with government investment is a special case of the "AK" model where in Barro's notation  $y = k^{(1-\alpha)}g^\alpha$  and  $g = \tau y$  (see the Government and growth handouts [the long version](#), there is also a one page version). **(b)** Describe the private sector's maximization problem. Why might growth be sub optimal if investment decisions are left to the private sector? Describe the solution to the social planner's problem. What is the optimal tax rate? Relate this to optimal savings rate discussed in problem set #1. **(c)** What are the empirical implications of this model for the relationship between growth and public sector spending shares? Suppose taxes are unpopular in democracies, but that large public sector are appealing to authoritarian governments: use the optimal tax diagram to show the tax rate these two countries are likely to choose. Will democracies grow faster? (optional: Compare with the predictions of this model with [Barro 1997 Tables 1-3](#) results for democracy and growth. Further)

## EXERCISES

1. *Where are these economies headed?* Consider the following data:

	$\hat{y}_{97}$	$s_K$	$u$	$n$	$\hat{A}_{90}$
U.S.A.	1.000	0.204	11.9	0.010	1.000
Canada	0.864	0.246	11.4	0.012	0.972
Argentina	0.453	0.144	8.5	0.014	0.517
Thailand	0.233	0.213	6.1	0.015	0.468
Cameroon	0.048	0.102	3.4	0.028	0.234

Assume that  $g + d = .075$ ,  $\alpha = 1/3$ , and  $\psi = .10$  for all countries. Using equation (3.9), estimate the steady-state incomes of these economies, relative to the United States. Consider two extreme cases: (a) the 1990 TFP ratios are maintained, and (b) the TFP levels converge completely. For each case, which economy will grow fastest in the next decade and which slowest? Why?

**Figure LS-1 Dominican Republic Labor Share Compensation**

