Written Exam for the M.Sc. in Economics winter 2013-14

Advanced Development Economics – Macro aspects

SOLUTION GUIDE

A.1.

This question draws on Feyrer (2009). The key thing to observe is that the closing (and later re-opening) of the Suez canal creates an exogenous change in sea distance (from the point of view of most nations, save from those involved in the Six days war), and therefore in trade costs, between nations who's trade previously was transported via the canal. To the extent that this change in sea distance instigates changes in actual trade, we can use the former as an instrument for the latter.

Specifically, as a first step one would examine bilateral trade between any two country pairs. That is, invoke a so-called Gravity Equation. One key determinant of bilateral trade is the bilateral sea distance between countries; due to the Suez "natural experiment" this distance is time varying. As a result, we can now estimate a panel data version of the gravity equation, which allows us to include country pair fixed effects (and time dummies) that "mops up" all time invariant determinants of bilateral trade. With estimates in hand for the impact of sea distance on bilateral trade, we can aggregate across county pairs to obtain "fitted" total trade for each country (formally: for each country *i* we sum the predicted trade levels from the regression for all $j \neq i$). In the end, the fitted trade variable will change at two points in time (for each country): when the canal is opened, and when it is closed. One can however think about adding lags of sea distance in the gravity equation, so as to examine how the closing of the canal influenced trade gradually. This would provide a smoother series for fitted trade.

In a second step we can estimate a model of the form

$$\Delta \log Y_{it} = a + b \Delta \log T_{it} + \varepsilon_{it}$$

Where DlogY is growth in GDP between t and t+1, whereas DlogT is growth in total trade (imports plus exports) over the same period. This equation can be viewed as a first differenced version of a levels equation, which would also involve country fixed effects. Common time fixed effects can also be added. The parameter of interest is b.

The idea is then to instrument DlogT by changes in "fitted trade" that is based on the gravity equation discussed above, thereby obtaining 2SLS estimates of the impact of trade on growth. This is done in Feyrer. The key result is that a change in (total) trade of one percent increases the level of GDP by 0.2 percent.

The identifying assumption is that the instrument is uncorrelated with other country specific factors (beyond trade) that impacts on growth. The assumption seems plausible.

A.2.

This draws on Acemoglu and Johnson (2007), Aghion et al (2009), Bloom et al (2013) and Cervalleti and Sunde (2011).

The origin of the debate is the contribution of A-J. The authors takes a Solow model, modified so as to allow land to enter the production function, as theoretical basis for an empirical test of the impact of changes in longevity on growth. Assuming countries are around steady state when observed, they derive an estimation equation, which in first differences reads

$$\Delta \log y_{it} = a + b\Delta \log X_{it} + \varepsilon_{it}$$

Implicitly, therefore, country fixed effects have been differenced out.

In order to identify the impact of X, life expectancy, on growth, the authors exploit the so-called epidemiological transition, which occurs in the aftermath of a set of major health innovation that take place around 1940. Chief among them, the discovery of penicillin. The timing of these innovations, can be viewed as exogenous from the point of view of the individual nation. A-J provides a careful discussion of how e.g. penicillin found its way to the poorest countries on the planet. In order to exploit this event, they construct a variable which captures the ex ante mortality rates from diseases that subsequently became fully curable (e.g. TB.). Assuming the ex post mortality rate from these diseases is zero (alternatively, declines with the time varying global frontier level), they construct a variable which is labeled "predicted mortality change", given by the difference between ex post and ex ante mortality from these diseases. They subsequently use the predicted mortality change variable as an instrument for actual overall mortality for a cross-section of countries for which data is available. The exclusion restriction is that predicted mortality (for practical purposes: ex ante mortality within a set of diseases) has no impact on growth above and beyond its impact via changes in longevity. Their main finding is that increasing longevity has *not* stimulated growth in income per *capita*. If anything the estimate for longevity is negative. Longevity has, however, increased population growth and to a lesser extent total GDP. They interpret this result along Malthusian lines: greater population growth, in the presence of a fixed factor of production, has worked to lower average income.

Concerns have been raised, however, with regards to this study. The first issue concerns the exclusion restriction. If the level of mortality, in addition to the change in mortality, influences growth the exclusion restriction is violated, and the results thus suspect.

Aghion et al provide a theory of how this sort of a specification may arise. They assume health influences the level of GDP, as it is part of the human capital stock that enters the aggregate production function. This is analogous to the treatment of health in A-J. In addition, however, they hypothesize that the level of health also works to increase the speed of knowledge adoption, i.e. TFP growth. Combining these two views of how health influences the growth process they show that it implies that both the level and growth of health (mortality) should impact on growth.

Bloom et al takes this augmented model to the data, showing that the level indeed carries explanatory power (in addition to the change). They treat the initial level as exogenous, and proceed to show that A-Js instrument turns statistically weak (in fact, irrelevant).

Another perspective is offered by Cervalleti and Sunde. They argue A-Js model is misspecified as it assumes a constant parameter for the impact of longevity on growth for all countries. They proceed to argue that there might well be a differential effect of changes in mortality depending on whether countries are observed before or after the demographic transition. Specifically, the impact of changes in mortality could be "bad" in a pre-demographic transition setting, basically for the reasons A-J state, but hold a positive impact in countries that are in a post-demographic transition setting. They demonstrate that this indeed seems to be true in practice, using the A-J instrument.

A concern with the studies that have criticized A-J is that they strictly speaking are not estimating the correct econometric model. They all rely on a simple cross section, whereas the theory developed by Aghion et al would suggest that country fixed effects ought to be taken into account. Hence, overall the "jury seems to be out", awaiting more research.

B: Analytical questions

Rent-seeking

The exercise builds on Murphy et al (1989), Acemoglu et al (2001, 2002) and Albouy (2012)

B.1. One might think of β as reflecting the extent to which property rights are protected. That is, as property rights institutions. Low value of β suggests these rights are relatively well protected.

B.2. Market farmer. Since the probability of being approached is n in which case you loose β units of income, the expected income becomes α-βn. Hence, income is declining in n. It can never go below γ however, since the market farmer always can exit and become a subsistence farmer. Hence, there is a critical level of rent-seekers, n', such that $\alpha-\beta n' = \gamma$. So income is α-βn for $0<n<n'$ and γ for $n>n'$.

The pay-off from being a **rent-seeker** is β as long as $0<n<n'$. However, beyond this point they can no longer extract the maximum amount, as farmers otherwise exit. Hence for $n>n'$ the pay-off becomes $(\alpha - \gamma)/n<\beta$. Here rent-seekers are "crowding" each other out.

B.3. The rent-seekers are rational. They thereby understand that market farmers cannot be expropriated further than to the point where their income is γ (or epsilon above). Hence, in equilibrium no-one is a subsistence farmer since rent-seekers do not extract more than to the point where farmer income is at γ. Hence, the question comes down to the allocation of people between farming and rent-seeking. Following the hint, we can illustrate the pay-offs, and then look for the equilibrium n.

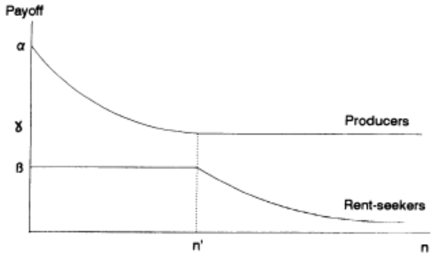

FIGURE 1. PAYOFFS TO PRODUCTION AND RENT-SEEKING, $\beta < \gamma$

Evidently the equilibrium is unique (n=0): for all levels of n it pays better to be a market producer. This case arises when the amount of funds that can be extracted is sufficiently modest. One way to interpret β is as capturing the quality of property rights institutions (as discussed above): the lower the level of β the better the institutions. Accordingly, with sufficiently good institutions everyone are participating in the market and per capita income is therefore α.

B.4.

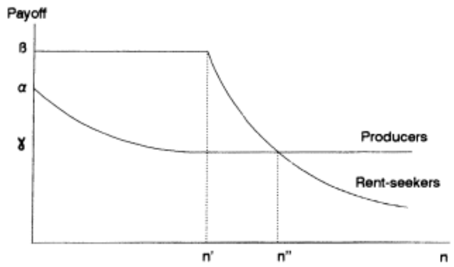

FIGURE 2. PAYOFFS TO PRODUCTION AND RENT-SEEKING, $\beta > \alpha$

Again we have a unique equilibrium at n’’, where n’’ fulfills: $(\alpha - \gamma)/n''=\gamma$. In equilibrium average income is γ; at subsistence. Hence, with poor property rights institutions average income drops way below market productivity. One should note the equilibrium is stable: if n differs from n’’ (either up or down”) one will expect n to adjust towards n’’. For instance, if $n<n''$ it clearly pays to be rent-seeker rather than a farmer for which reason one will expect entry until n= $(\alpha - \gamma)/\gamma=n''$.

B.5.

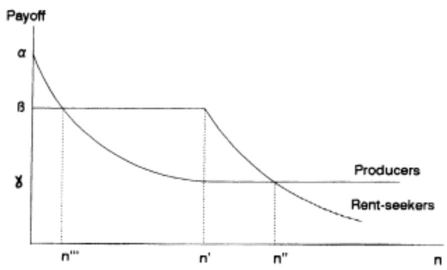

FIGURE 3. PAYOFFS TO PRODUCTION AND RENT-SEEKING, $\gamma < \beta < \alpha$

In this case the model allows for multiple stable equilibria: n= 0 and n=n''. Here, with "intermediate property rights" initial conditions" (i.e., initial n) determines whether income ends up at α or γ. A symmetrical argument to that made above makes clear both equilibria are locally stable.

B.6 A big implication of the model (given the interpretation of the extraction pay-off) is that institutions are critically important to long-run development. This proposition is in principle testable. Full points require some discussion of the empirical evidence on institutions and growth and the potential shortcomings in the approach taken. Hence, this part requires the student to draw on Acemoglu et al (2001, 2002) and Albouy (2012).

Optimal fertility and child mortality

The exercise is a slight extension, so as to include costs of non-surviving children, of the material discussed in Galor (2011).

B.7.
The problem is

$$\max_{c,n} U = \gamma \log(n) + (1-\gamma)\log(c)$$
$$s.t.$$
$$y \geq c + \lambda ny + pn/\sigma$$
$$\Rightarrow$$
$$\max_{n} U = \gamma \log(n) + (1-\gamma)\log(y - \lambda ny - pn/\sigma)$$
$$FOC$$
$$\gamma \frac{1}{n} - (1-\gamma)\frac{\lambda y + p/\sigma}{y - \lambda ny - pn/\sigma} = 0$$
$$\Leftrightarrow$$
$$\gamma y - \lambda\gamma ny - \gamma pn/\sigma = (\lambda yn + p/n\sigma) - \gamma\lambda yn - \gamma p/n\sigma$$
$$\Rightarrow$$
$$\gamma y = (\lambda yn + p/n\sigma)$$
$$\Rightarrow$$
$$n = \frac{\gamma y}{\lambda y + p/\sigma}$$

B.8. In this case we note that *n* becomes independent of *y*. Increasing income is in general associated with both an income and a substitution effect. In the present case, with log utility, these two exactly cancell out. Child mortality does not affect n either, though it does mechanically affect fertility, b=n/σ.

B.9. In the more general case, where costs exceed the time cost of child nurture (implicit in the cost term, λny), income works to *increase* fertility. The reason is that with rising income the "metabolic costs" of children, which has to be born irrespectively of whether the child survives or not and independently of income level, are declining: $(\lambda n + pn/y\sigma)y$, where obviously $\lim_{y\to\infty}(\lambda n + pn/y\sigma) = \lambda n$. Similarly, when survival increases this stimulates net fertility. The reason is that the cost of surviving children decline, when fewer die at birth.

B.10. One may observe that these results raise doubt that rising income and declining mortality are key drives behind the fertility transition. One can however discuss alternative frameworks that do potentially allow income and mortality to play role. In the case of income one needs to discuss models where the relative strength of the income and substitution effects may change with development. In the case of mortality uncertainty needs to be introduced, and the precautionary motive for having offspring. When the risk of mortality declines net fertility can come down. However, sequential fertility arguably makes the effect modest quantitatively. Alternative hypothesis (e.g., rising returns to skills in the presence of a quantity-quality trade-off) is relevant to mention.