ANSWERS TO:

Written Exam for the M.Sc. in Economics, Winter 2011/2012

Advanced Development Economics – Macro Aspects

Master's Course

2.1.2012
(3-hour, closed book exam)

A questions

Question A1a. The health of a worker should matter to productivity: Physiologically, workers with better health have more energy and are thus in a position to exert more effort on the job. Moreover, individual works power of concentration also improves in the absence of illness.

Question A1b. Shastry and Weil (SW) proceeds as follows. Micro studies("Mincer-style") have found a strong link between wages (presumably reflecting productivity) of individuals and health, measured by the height of the individuals. The logic is that, within populations, greater body size reflects better nutrition during childhood, which in turn should imply greater resistance against infection and disease. The "return" on health can then be taken as the parameter estimate linking individual height to individual wages; the empirical equation is log linear in height

$$\log(w) = \omega + \phi z,$$

Where w is the (hourly, say) wage and z is body size; ϕ empirically is somewhere between 0.04 to 0.08. That is, greater health as captured by 1 cm greater height increases wages by about four to eight percent. Naturally equations of this kind also include the usual suspects, such as schooling etc.

Now, with the production function stated in the text, we may write the representative firms inverse demand function as

$$w = A(K/Y)^{\alpha/(1-\alpha)} hv \Rightarrow \log(w) = \omega + \log v$$

Accordingly, to benefit from the micro estimates $\log(v) = \phi z$. This means $v = \exp(\phi z)$ is a possibly measure, where v is now, in the aggregate, average height in the population. A practical problem is that height is not commonly available in a cross-country setting. Hence the authors exploit that there is an empirical link between height and adult survival rates (ASR). Hence, if $ASR = a*z$, we have $v = \exp((\phi/a)ASR)$, which is then used.

With a measure of v in hand SW find, by way of otherwise standard development accounting techniques, that about 20% of the cross-country differences in income per worker can be accounted for by health.

Question A1c. A strength of the analysis is that the mapping from health to productivity is likely to reasonably well identified at the micro level. This means that their accounting results should be free from the kind of endogeniety bias which inevitably would be present if an aggregate regression exercise was performed. Naturally, one may try to deal with the ensuring bias by applying an IV estimator. But good instruments are hard to come by in the aggregate.

Drawbacks:

It is not obvious that $v = \exp(\phi z)$ is a sound measure of health human capital; it suggests that as z (height) is increased the contribution from health increases at an increasing rate. This "exponential formulation" may well contribute to an overestimation of the contribution of health (through this particular channel). At the lectures we have discussed an alternative, $v = (1+z)^{\phi}$, which is consistent with the Mincer evidence (for z small), yet implies diminishing returns to height.

The above mentioned strength has another side to it. It implies that we are deliberately missing potentially important indirect effects of health on productivity. For instance, Hazan and Zoabi (2006) motivates that greater health in a population stimulates schooling. Yet this sort of influence is not assigned to health in the accounting exercise. In short: this exercise does not allow us to gauge general equilibrium effects (by construction)

Finally, one may worry that height has a genetic component to it. That is at least what the biological literature says. If so, it may well be inappropriate to use height differences as a measure of health differences, as two individuals can be equally healthy at different height levels if they are "living up to their asymptotic size". That is, low stature may not signal childhood stunting as clearly as implicitly assumed. In some tasks (like pushing or pulling things) it is an advantage to be large. A force argument would then put height back in the production function. But this is conceptually a different argument than "health". Moreover, there are production tasks that are easier if individuals are small. Hence, the way in which body size enters the production function is then not obvious.

Question A2a. The rate at which settlers perished when arriving in various colonies would likely influence how many Europeans settled. With extensive European settlements, the argument goes, one would expect to see pressure for institutions similar to what was known from "back home". That is, institutions that ensured that checks and balances in government were imposed leading to greater protection of property rights. Since early institutions, influenced by the settlers, tend to exhibit great persistence over time, one would expect current institutions to equally be affected by these early developments (late 19th century say). With this in mind one might propose to use the settler mortality rates (SMR) as an instrument for current institutions. AJR find a very large impact of property rights institutions on development.

Question A2b. The exclusion restriction says that SMR cannot be correlated with current income above and beyond their impact via institutions. Naturally, this is a debatable proposition. Most importantly, one may argue that SMR probably are at least correlated with local mortality rates, or morbidity, which easily could have a direct impact on productivity. Studies discussed in class involve the detrimental impact from say Malaria or hookworm. Moreover, SW study, discussed above, ties in health with productivity via the production function. Hence, if SMR are correlated with a more hostile disease environment and thus morbidity SW's study would be enough to cause concerns with the exclusion restriction.

A counter argument however would be based on a later paper by AJR entitled "reversal of fortune", which documents that among the set of colonized countries the ex ante most successful where ex post the least successful, measured by income per capita. AJR argue that this suggests that climate-induced differences in mortality and morbidity cannot be first order, as this would require a positive correlation between early development and current development (geography is after all persistent). In contrast, the institutional hypothesis could be consistent with the reversal. If colonial powers chose to put in place "extractive institutions" in ex ante successful economies (because they would be worth "exploiting") this would eventually lead to poor development outcomes. Whether, or the extent to which , geography holds a direct impact on productivity is still in debate.

B questions

Question B1

The calculation is

$$L_{t+1} = n_t L_t \Rightarrow \left(A / y_{t+1}\right)^{1/\alpha} X = \eta y_t \left(A / y_{t+1}\right)^{1/\alpha} X$$

Where the first part follows from the fact that people reproduce in proportion to their number; the second part uses the production function (where L is isolated) and inserts the solution for n. Straight forward rearrangements leads to the result stated in the text.

Question B2

The student should demonstrate the following properties of ϕ

$$\phi(0) = 0, \phi'(y) > 0, \phi''(y) < 0, \lim_{y \to 0} \phi'(y) = \infty, \lim_{y \to \infty} \phi'(y) = 0$$

The Phase diagram can then be constructed, mirroring the definition of the steady state:

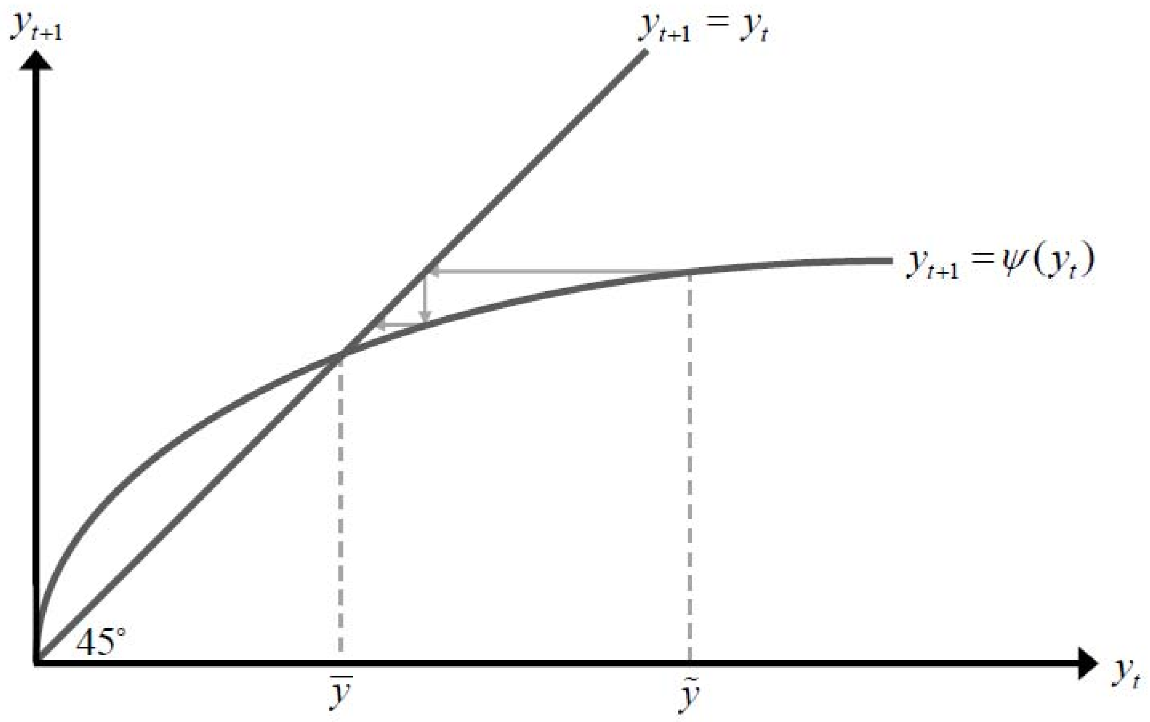

FIGURE 2: The Evolution of Income per Worker

Evidently there exist a unique non-trivial steady state. Stability can either be shown by a geometric argument , or by showing that 0<ϕ'(y*)<1. The steady state is stable.

Solving for y*. Use the law of motion and steady state definition

$$y^* = \eta^{-\alpha}\left(y^*\right)^{1-\alpha} \Rightarrow y^* = \eta^{-1}.$$

Hence long-run income per capita only depends on preference parameters and unit cost of children (cf text)

Question B3

Initially y goes up on impact. The impact effect is captured by an increase in y from $\bar{y}$ to $\tilde{y}$ in the figure above. This follows simply from looking at the per capita production function and by observing that in the short run L is given. Over time y declines towards steady state, which is unaffected by A.

The economics is that higher income per capita will work to increase fertility, which in the next generation works to lower income per capita due to diminishing returns. The process continues, involving gradually declining y, until n=1 and the economy is once again in the steady state.

Question B4. Use the production function to show

$$y^{*}=A\left(\left[X/L\right]^{*}\right)^{\alpha}\Rightarrow\left(L/X\right)^{*}=\left(A/y^{*}\right)^{1/\alpha}.$$

Inserting the solution for y* gives the final result. The key insight is that higher productivity leads to greater population density in the long-run. But, as we saw above, not to greater income per capita. The economics should be apparent from the discussion above: the permanent increase in y leads to temporary population growth. This temporary growth leads to permanently higher density.

Question B5.

The first thing to bring up is that the model provides a good account of why income stagnated in the presence of technological change for most of human history. Only very recently have growth started to take hold. Hence, the model captures this "stylized fact". More substantially, it would be relevant for the student to discuss the work of Ashraf and Galor, which shows that the key predictions derived above are relevant for all countries around the world, prior to industrialization.

In terms of policy predictions. Here it would be relevant for the student to observe that the model, in theory, should be relevant to any country which as yet have to undergo the demographic transition. Hence, in many poor countries to this day the model may be of some relevance.

For instance, foreign aid initiatives which works to increase productivity (A) – e.g. things like infrastructure investments– may not increase income per capita. If the model above is relevant they will work to increase population density. On the other hand: in poor countries where the demographic transition *has* occurred the same initiative could impact positively on growth. Accordingly the model suggests that foreign aid should be tailored to the condition prevailing in the countries one would like help growth, The empirical work by Acemoglu and Johnson and Cervaletti and Sunde on longevity and growth might be relevant empirical evidence to bring into the discussion: The latter contribution shows for instance that increasing life expectancy, brought on by a host of medical advances in the 1940's (chiefly, perhaps, penicillin), did no increase income in countries that had *not* undergone the demographic transition at the time the advances arrived, yet increased population density. In contrast, in countries in the *post*-transition regime growth increased.