Written Exam for the M.Sc. in Economics winter 2015-16-R
Advanced Development Economics – Macro aspects
Master's Course
(3-hour closed book exam)

Solution manual

ANSWER A.
Readings:

- Galor, O. (2012), The demographic transition: causes and consequences, *Cliometrica* 6:1-28, Sections 4.1 and 4.2.
- Andersen, Thomas B., Carl-Johan Dalgaard, and Pablo Selaya (2015), Climate and the Emergence of Global Income Differences. *Review of Economic Studies* (forthcoming).
- Ashraf, Quamrul and Oded Galor (2011), Dynamics and Stagnation in the Malthusian Epoch. *American Economic Review* 101: 2003-41.

A.1.
Utility is:

$$u = (1-\gamma)\ln c + \gamma\left[\ln n + \ln h\right], \qquad \text{where } \gamma \in (0,1) \text{ and } h = \frac{e}{e+g}$$

and the budget constraint:

$$c + (\tau^q + \tau^e e)n = y.$$

Then, optimal levels of e and n are:

$$(e,n) = \arg\max_{e,n} \left\{ (1-\gamma)\ln[y - (\tau^q + \tau^e e)n] + \gamma\left[\ln n + \ln\frac{e}{e+g}\right]\right\}. \tag{1}$$

FOC of (1) wrt e:

$$(1-\gamma)\frac{-n\tau^e}{y-(\tau^q+\tau^e e)n} + \gamma\frac{1}{e} - \gamma\frac{1}{e+g} = 0. \tag{2}$$

FOC of (1) wrt n:

$$(1-\gamma)\frac{-(\tau^q+\tau^e e)}{y-(\tau^q+\tau^e e)n} + \gamma\frac{1}{n} = 0. \tag{3}$$

Rearranging (2) and (3), and dividing (2) by (3):

$$\frac{(1-\gamma)\frac{n\tau^e}{y-(\tau^q+\tau^e e)n}}{(1-\gamma)\frac{(\tau^q+\tau^e e)}{y-(\tau^q+\tau^e e)n}} = \frac{\gamma\frac{1}{e} - \gamma\frac{1}{e+g}}{\gamma\frac{1}{n}}. \tag{4}$$

Simplyfying (4):

$$\begin{aligned}
\frac{n\tau^e}{(\tau^q + \tau^e e)} &= \frac{\frac{g}{e(e+g)}}{\frac{1}{n}} \\
\frac{\tau^e e}{\tau^q + \tau^e e} &= \frac{g}{e+g} \\
\frac{1}{\frac{\tau^q}{\tau^e e} + 1} &= \frac{1}{\frac{e}{g} + 1}.
\end{aligned} \tag{5}$$

Equation (5) implies:

$$\begin{aligned}
\frac{\tau^q}{\tau^e e} &= \frac{e}{g} \\
e^2 &= \frac{g\tau^q}{\tau^e} \\
e &= \left(\frac{g\tau^q}{\tau^e}\right)^{1/2}.
\end{aligned} \tag{6}$$

To find n, first rearrange (3):

$$\begin{aligned}
(1-\gamma)\frac{(\tau^q + \tau^e e)}{y - (\tau^q + \tau^e e)n} &= \gamma\frac{1}{n} \\
\frac{(\tau^q + \tau^e e)n}{y - (\tau^q + \tau^e e)n} &= \frac{\gamma}{1-\gamma} \\
\frac{1}{\frac{y}{(\tau^q + \tau^e e)n} - 1} &= \frac{1}{\frac{1}{\gamma} - 1}.
\end{aligned} \tag{7}$$

Equation (7) implies:

$$\begin{aligned}
\frac{y}{(\tau^q + \tau^e e)n} &= \frac{1}{\gamma} \\
n &= \frac{\gamma y}{\tau^q + \tau^e e}.
\end{aligned} \tag{8}$$

Inserting the optimal level of e (6) into (8) gives the optimal level of n:

$$\begin{aligned}
n &= \frac{\gamma y}{\tau^q + \tau^e \left(\frac{g\tau^q}{\tau^e}\right)^{1/2}}; \\
n &= \frac{\gamma}{\tau^q + \left(g\tau^q\tau^e\right)^{1/2}} y.
\end{aligned} \tag{9}$$

A.2.
Notice that:

$$\frac{\partial e}{\partial g} = \frac{1}{2}\frac{\tau^q}{\tau^e}\left(\frac{g\tau^q}{\tau^e}\right)^{-1/2} = \frac{1}{2}\left(\frac{\tau^q}{g\tau^e}\right)^{1/2} > 0.$$

An increase in the rate of techological progress "depreciates" the existing set of skills or knowledge. Increasing education (e) helps to reduce this effect. Then, everything else

constant, the housholds' optimal reaction to a faster changing technological environment is to invest more in the education of their children.

A.3.
Notice that:

$$\frac{\partial n}{\partial g} = \gamma y \left(-\frac{1}{2}\right) \left(g\tau^q\tau^e\right)^{-1/2} \tau^q\tau^e = -\frac{\gamma y}{2} \left(\frac{\tau^q\tau^e}{g}\right)^{1/2} < 0.$$

As explained in the previous question, faster technological progress depreciates the existing stock of knowledge. Families find optimal to increase the level of education in children, to reduce this effect. Everything else constant, households will then find optimal having less children (n) to finance extra education expenses.

A.4.
In the extreme case where $g = 0$, the model will predict an equilibrium with $e = 0$ and $n = \frac{\gamma}{\tau^q} y$. This is consistent with the idea that technological progress during the long era of Malthusian stagnation was very low, and therefore that investments in human capital were also low, and that increases in technology would tend to translate mostly into higher fertility rates.

A.5.
An increase in the rate of technological progress has a positive effect on the demand for human capital (or the optimal level of education for children), because it is optimal from the households' point of view efforts trying to compensate for the "depreciation" effect of technological progress on the existing set of skills and human capital.

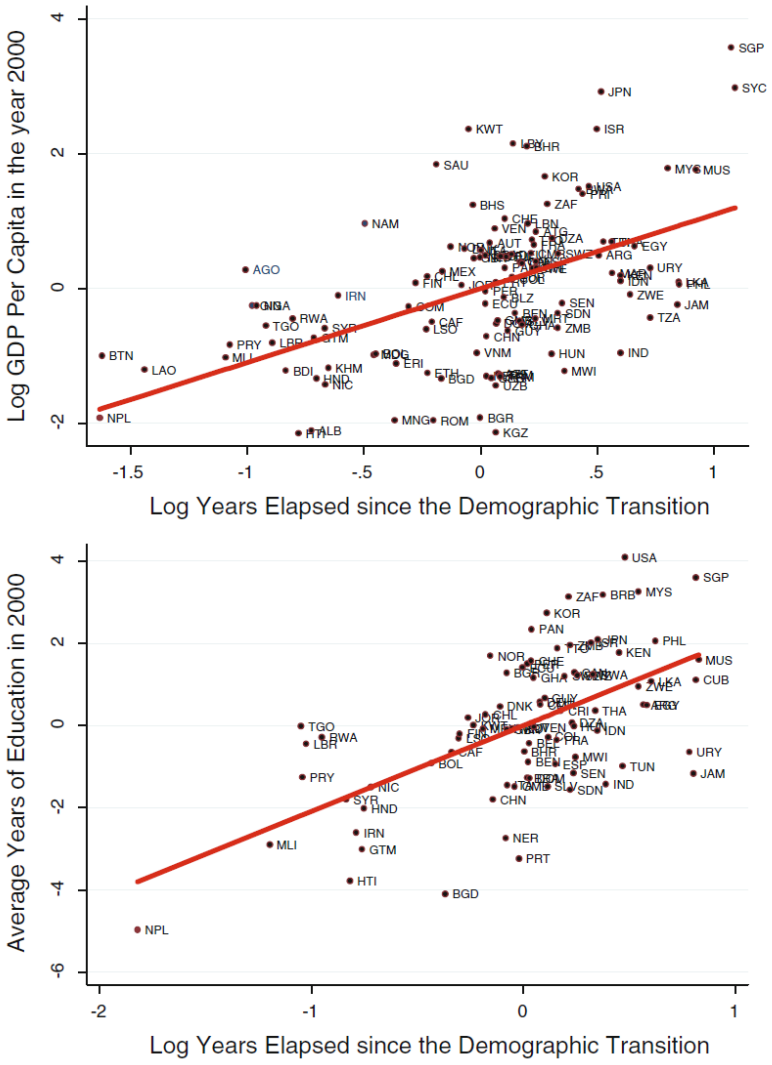
The effect of an increase in the rate of technological progress on fertility is negative, essentially because households need to reduce the total costs of rearing children to finance larger investments in their education.

Therefore, the model predicts a *trade-off* between fertility decisions and the demand for human capital, or a child *quantity-quality* trade-off.

A.6.
The demographic transition enables economies to divert the benefits of factor accumulation and technological progress from fueling population growth, and rederict them toward the formation of human capital. This allows an economy to sustain higher levels of income per capita, and probably also to sustain faster rates of technological progress, which can help to consolidate a transition to a regime of sustained economic growth and development.

A.7. The empirical literature supports the previous proposition, and shows that delays in the onset of the demographic transition are associated with lower levels of income per capita (and also with lower average numbers for years of education) when we examine data across countries.

For example, Galor (2012) displays the following correlations:



Source: Galor (2012)

Andersen, Dalgaard and Selaya (2015) also show evidence supporting the idea. One of their findings is that differences in the timing of the fertility decline that come from particular aspects of differences in the disease ecology across countries, have contributed to shaping differences in the current global income distribution.

In the context of an augmented Solow model, Dalgaard and Strulik (2013) also present evidence of a positive effect of earlier demographic transitions on current levels of income per capita.

ANSWER B.
Readings:

- Alsan, Marcella (2015). The Effect of the TseTse Fly on African Development. *American Economic Review* 105(1): 382-410.

- Acemoglu, Daron (2010), Chapter 4: Fundamental Determinants of Differences in Economic Performance, in "Introduction to Modern Economic Growth," Princeton University Press. Sections 4.1 and 4.3.

B.1.
The findings seem to be robust. First, the coefficient on TSI remains statistically significant throughout columns 1-4, where controls for climate (such as temperature, humidity, % of land area in the tropics), the presence of malaria, geographical characteristics (land suitability for agriculture, absolute latitude, longitude, proximity to the water bodies or the coast), and country fixed effects, are sequentially included.

This control strategy reduces the concerns about potential confounders driving differences in the level of, both, TSI and economic development; or that the results suffer from omitted variables bias. Second, the coefficient of TSI remains fairly stable in size during the sequential inclusion of sets of controls, which indicates that the role of unobserved factors driving the results is not likely to be very large.

B.2.
The study of the effects of the Tse Tse fly on development in Africa proposes that differences in the presence of the fly in different regions (proxied by the potential conditions for the fly to survive) reduced those regions capacity to sustain higher agricultural surplus (for example, as shown in Panel B of the table, due to a lower presence of cattle or husbandry animals, that could be of substantial help for certain agricultural activities).

The lower capacity to sustain high argicultural outputs historically translated into difficulties to sustain higher levels of population density, which in turn made difficult to achieve higher levels of political centralization (and probably also higher levels of urbanization).

Given that political centralization is a marker of state and institutional development, and that these type of institutional features are *fundamental* causes of differences in economic performance, the results displayed in the table suggest that regions that remained sparsely populated and could not achieve higher levels of institutional development in the past are probably going to remain poor today.

B.3.
Geography and climate are considered fundamental causes of differences in economic performance because they can affect economic development through a variety of proximate correlates of economic performance.

Examples of specific dimension of geography and climate that affect proximate causes of differences in economic performance include the suitabilitiy of soils for different types of agriculture, topography, the disease environment, the endowment of natural resources, or specific aspects of climate like variation in the levels of temperature or rainfall.(topography,for instance, can affect transportation and communication costs; the disease environment can affect the level of life expectancy and related decisions

like the level of investments in acquiring human capital; and the type and quality of soils for agriculture can affect the composition of production).

Geography and climate have also been shown to shape the type of economic and political institutions in different societies, which reinforces their role as fundamental factors to understand differences in levels of economic development.

ANSWER C.
Readings:

- Nunn, Nathan (2012), Culture and the Historical Process. *Economic History of Developing Regions* 27(S1): 108-126.
- Tabellini, Guido (2010), Culture and institutions: economic development in the regions of Europe. *Journal of the European Economic Association* 8(4):677-716.
- Gorodnichenko, Yuriy and Gerard Roland (2015), Culture, Institutions and the Wealth of Nations. *Review of Economics and Statistics* (forthcoming).

C.1.
Culture in this literature has been defined for example, as "decision making heuristics, or 'rules of thumb', that have evolved given our need to make decisions in complex and uncertain environments." (Nunn 2012)

Culture has emerged as one of the fundamental causes of differences in economic performance, because different heuristic techniques for making decisions across societies give rise to different sets of values, beliefs, social norms and preferences, which are likely to affect incentives and decisions that map into the amount of resources that a society can accumulate, the rate of technological progress it can sustain, and other aspects affecting the level of economic development that a society can attain. Recent research also emphasizes that culture and institutions coevolve, which reinforces the importance of culture as a fundamental cause of differences in economic performance.

C.2.
Higher levels of generalized trust in others and respect for others, facilitate transactions and anonymous exchange, and can reduce the need of external enforcement of contractual agreements. In general, this contributes to a better functioning of markets. Generalized trust and respect for others can also help the solution of coordination and collective action problems, and thereby facilitate the provision of public goods, for instance. In contrast, lack of generalized trust and respect of others can increase costs for transactions outside of the local community, and therefore reduce the amount of trade, and limit division of labor.

Higher appreciation of the virtues of individualism can be conducive to more entrpreneurial environments, where individuals might be seeking to take advantage of economic opportunities. This can lead, for instance, to faster dynamics for innovation and the creation of new technologies. Higher levels of individualism in a society can

arguably also fuel fractionalization, which might have negative consequences – for example give rise to conflict. But given that faster technological progress is one of the most important forces to sustain higher levels of economic development and its effects can potentially be longer in time, the consequences of relatively higher appreciation of the virtues of individualism can have larger dynamic benefits and outweight its potential costs.