Written Exam for the M.Sc. in Economics winter 2016-17
Advanced Development Economics – Macro aspects
Master's Course
December 15th, 2016
(3-hour closed book exam)

Solution manual

Each of the 3 questions (A, B, and C) has a weight of 1/3 in the final grade.

ANSWER A.

Readings:

- Questions A.1. and A.2. are a variant of the model in Ashraf, Q. and O. Galor (2011), Dynamics and stagnation in the Malthusian epoch. *AER* 101: 2003-41, Sections IA–IC, p. 2005-9. The rest of the questions follow the model and results described in the paper.
- Galor, Oded and David Weil (1999), From Malthusian stagnation to sustained growth. *AER* 89: 150-54.

A.1.
Setup a Lagrangian:

$$\mathcal{L} = \gamma \ln(n_t) + (1-\gamma)\ln(c_t) + \lambda(y_t - [\rho + \tau y_t]n_t - c_t),$$

and compute the FOC taking y_t as given:

$$\begin{aligned} \mathcal{L}_{n_t} &= \frac{\partial \mathcal{L}}{\partial n_t} = \gamma n_t^{-1} - \lambda[\rho + \tau y_t] = 0 \quad (1) \\ \mathcal{L}_{c_t} &= \frac{\partial \mathcal{L}}{\partial c_t} = (1-\gamma)c_t^{-1} - \lambda = 0 \quad (2) \\ \mathcal{L}_{\lambda} &= \frac{\partial \mathcal{L}}{\partial \lambda} = y_t - [\rho + \tau y_t]n_t - c_t = 0. \end{aligned}$$

Dividing (1) by (2) we get:

$$\left(\frac{\gamma}{1-\gamma}\right)\frac{c_t}{n_t} = \rho + \tau y_t$$

or

$$\left(\frac{\gamma}{1-\gamma}\right)c_t = [\rho + \tau y_t]n_t. \quad (3)$$

Inserting (3) into the budget constraint, we find the optimal level of consumption:

$$\begin{aligned} \left(\frac{\gamma}{1-\gamma}\right)c_t + c_t &= y_t \\ c_t &= (1-\gamma)y_t. \quad (4) \end{aligned}$$

Finally, inserting (4) into the budget constraint, we find the optimal level of children:

$$\begin{aligned} [\rho + \tau y_t] n_t + (1-\gamma) y_t &= y_t \\ n_t &= \frac{\gamma y_t}{\rho + \tau y_t} \end{aligned} \tag{5}$$

A.2.
Compute $\frac{\partial n_t}{\partial y_t}$:

$$\begin{aligned} \frac{\partial n_t}{\partial y_t} &= \frac{\gamma[\rho + \tau y_t] - \gamma y_t \tau}{[\rho + \tau y_t]^2} \\ &= \frac{\gamma \rho}{[\rho + \tau y_t]^2} > 0 \end{aligned}$$

Comments: Given that both time and goods are required to finance the costs of raising children, we see two opposing effects of income on fertility: As the economy develops and wages increase, the time costs increase proportionately with the increase in income, and that provides incentives to reduce fertility. At the same time, the costs in terms of goods decline with the increase in income, which tends to increase fertility. The net effect is decreasing ($\partial^2 n_t / \partial y_t^2 < 0$) but always positive, which is in accordance with the Malthusian type of mechanisms that are at play in an economy during pre-modern times, which predict that increases in income translate in larger families.

A.3.
If $\tau = 0$, then the optimal number of children reduces in (5) to:

$$n_t = \frac{\gamma}{\rho} y_t$$

A.4.
If $\tau = 0$, the effect of income on fertility is strictly positive and constant:

$$\frac{\partial n_t}{\partial y_t} = \frac{\gamma}{\rho} > 0$$

Comments: The inclusion of time costs for raising children does not affect qualitatively the predictions of a simpler model, where the costs of raising children are constant and only necessary in terms of goods. The main reason is diminishing returns to labor: the positive but diminishing effects of growth on wages make the increase in time-costs to be more than compensated by the reduction of costs in terms of goods.

A.5.
The average level of income per capita in the economy is

$$y_t = \frac{Y_t}{L_t} = \frac{(AX)^\alpha L_t^{1-\alpha}}{L_t} = \left(\frac{AX}{L_t}\right)^\alpha \tag{6}$$

Total population in $t+1$ is

$$L_{t+1} = n_t L_t. \tag{7}$$

Plugging the optimal level of n_t (5) and the level of y_t (6) into (7):

$$
\begin{aligned}
L_{t+1} &= \frac{\gamma}{\rho} y_t L_t \\
L_{t+1} &= \frac{\gamma}{\rho} \left(\frac{AX}{L_t} \right)^{\alpha} L_t \qquad (8) \\
L_{t+1} &= \frac{\gamma}{\rho} (AX)^{\alpha} L_t^{1-\alpha} \equiv \phi(L_t; A, X, \gamma, \rho, \alpha) \qquad (9)
\end{aligned}
$$

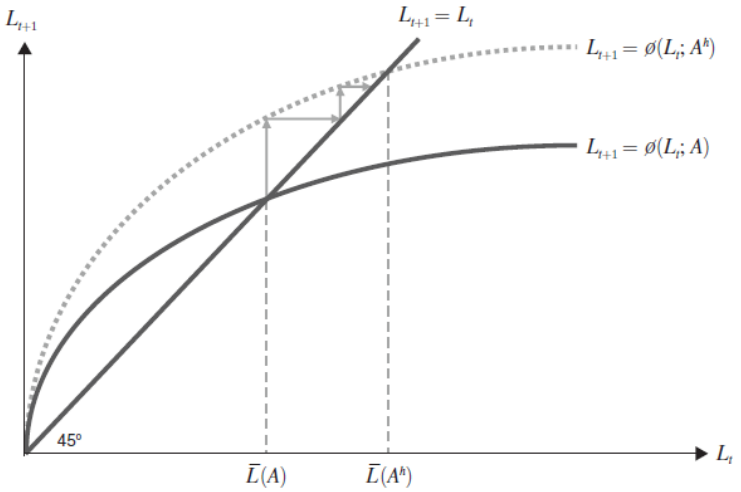
To check the Inada conditions for ϕ, verify that: $\phi(0) = 0$, $\phi_{L_t} > 0$, $\phi_{L_t L_t} < 0$, $\lim_{L_t \to 0} \phi_{L_t} = \infty$, and $\lim_{L_t \to \infty} \phi_{L_t} = 0$:

- $\phi(0) = 0$
- $\phi_{L_t} = \frac{\partial L_{t+1}}{\partial L_t} = \frac{\gamma}{\rho} (AX)^{\alpha} [1 - \alpha] L_t^{-\alpha} > 0.$
- $\lim_{L_t \to 0} \phi_{L_t} = \infty$, and
- $\lim_{L_t \to \infty} \phi_{L_t} = 0$ since $0 < \alpha < 1$.
- $\phi_{L_t L_t} = \frac{\partial}{\partial L_t} \left(\frac{\partial L_{t+1}}{\partial L_t} \right) = \frac{\gamma}{\rho} (AX)^{\alpha} [1 - \alpha] (-\alpha) L_t^{-\alpha - 1} < 0.$

Given that the Inada conditions are fulfilled (or that ϕ starts in the origin it is strictly concave), the fixed point theorem can be applied, and we can conclude that the 45 degree line intersects ϕ twice: at 0, and at some level $\overline{L} > 0$.

Since $L_0 > 0$ is a condition, $\overline{L}$ is the only globally stable equilibrium: wherever L starts (other than 0), it converges to $\overline{L}$. Therefore the system has a unique stable steady state at $\overline{L}$.

The phase diagram looks like:



Source: Ashraf and Galor (2011).

A.6.
To compute $\overline{L}$, set $L_{t+1} = L_t = \overline{L}$ in the law of motion:

$$\begin{aligned}
\overline{L} &= \frac{\gamma}{\rho}(AX)^{\alpha}\left(\overline{L}\right)^{1-\alpha} \\
\overline{L} &= \left[\frac{\gamma}{\rho}(AX)^{\alpha}\right]^{\frac{1}{a}} \\
\overline{L} &= \left[\frac{\gamma}{\rho}\right]^{\frac{1}{a}} AX
\end{aligned}$$

Dividing this equation by X:

$$\begin{aligned}
\overline{P} &= \frac{\overline{L}}{X} = \frac{\left[\frac{\gamma}{\rho}\right]^{\frac{1}{a}} AX}{X} \\
\overline{P} &= \left[\frac{\gamma}{\rho}\right]^{\frac{1}{a}} A
\end{aligned}$$

Then

$$\frac{\partial \overline{P}}{\partial A} = \left[\frac{\gamma}{\rho}\right]^{\frac{1}{a}} > 0.$$

A.7.
An exogenous increase in the level of technological sophistication, A, generates a transition process in which population gradually increases from its initial steady-state (intuitively, better technologies facilitate the creation of income, which has a positive effect on fertility). Therefore, the prediction is that, during pre-modern times, technological progress increases population density in the long-run.

In the process of convergence to the new equilibrium, the decline in income per capita associated with the increase in total population reduces the fertility rate, which allows the system to converge to the new steady-state. This mechanism, which dilutes the per capita benefits of technological progress by creating larger populations, is in line with the described Malthusian paradigm, and helps to understand why technological progress in pre-modern times did not create permanently richer societies, and instead just more densely populated societies, as supported by the empirical evidence in Ashraf and Galor (2010).

ANSWER B.

Readings:

- Acemoglu, Daron and James A. Robinson (2010), The Role of Institutions in Growth and Development. *Review of Economics and Institutions* 1(2): 1-33.
- Rodrik, Dani (2008), Second-Best Institutions. *AER* 98(2): 100-104.

B.1.
Acemoglu, Johnson and Robinson (2005) argue that "[...] economic (and political) institutions are not always chosen by the whole society (and not for the benefit of the whole society), but by the groups that control political power at the time (perhaps as a result of conflict with other groups)." (AJR *HEG* 2005). In Acemoglu and Robinson (2010), they also argue that institutions can be an incidental and persistent outcome of history, but if/when agents decide to change them, they can change them: examples of those processes are the Meiji Restoration in Japan, the French Revolution, and the independence of Latin America.

In their theory of institutional development, they highlight two elements:

- the role of incentives, and
- the presence of conflicts of interest.

These two elements are present in the different parts of their theory:

1. Economic institutions matter for economic development because they shape incentives and provide constraints for individual behavior. They influence investments in human and physical capital, and technology, and also the orgranization of production. Therefore economic institutions determine the size of aggregate output, and also the distribution of that output:

$$\text{Economic institutions}_t \rightarrow \begin{array}{l} \text{Economic performance}_t \\ \text{Distribution of resources}_{t+1} \end{array}$$

2. Economic institutions are endogenous: They are determined as collective choices, because of their economic consequences. Different groups prefer different distributions, and therefore *conflicts of interest* appear. This means that the *political power* of different groups determines which institutions prevail:

$$\text{Political power}_t \rightarrow \text{Economic institutions}_t$$

3. With conflicts of interest, political institutions are the device to distribute political power. But it is useful to distinguish different types of political power. *De jure* political power is the type of political power that originates in political institutions. Political institutions, as economic institutions, determine constraints and incentives in political terms (for example, are related to whether a country is a democracy or a dictatorship, or to the constraints on politicians and political elites), and are therefore the device that allocates political power:

$$\text{Political institutions}_t \rightarrow \text{De jure political power}_t$$

4. Groups that do not have *de jure* political power can have *de facto* political power: they can use their own resources to revolt, use arms, hire mercenaries, co-opt military, or use costly and peaceful protests, to impose their wishes in society. *De facto* political power then depends on groups' ability to solve collective action problems (for example to organize peasants and rebel), and also on groups' *economic resources* to use political institutions or other means to impose their wishes:

$$\text{Distribution of resources}_t \rightarrow \text{De facto political power}_t$$

5. Path dependence in the political equilibrium: Political institutions affect the allocation of *de jure* political power, which affects political institutions again in the future. Similarly, *de facto* political power also changes the way in which political institutions are implemented. Therefore, the political equilibrium exhibits path dependence:

$$\text{Political power}_t \rightarrow \text{Political institutions}_{t+1}$$

These elements explain the logic in AR's theory of institutional development. They highlight the idea that the type of economic institutions that prevail in a society, are determined by the existing political equilibrium and the political institutions that determine the political equilibrium, and therefore that change in economic institutions is closely connected to change in the political equilibrium and the characteristics of political institutions.

B.2.

Following the last arguments, institutional reforms focused exclusively on the change of economic institutions will tend to be ineffective, in case that the reforms do not address or ultimately alter the political equilibrium.

Moreover, focusing on reforming only specific economic institutions may not be just insufficient, it may even backfire (AR 2010). The basic reason is that there are different ways to implement an economic reform, in the same way that there are different instruments to achieve a specific goal. Removing one constraint without altering the balance of power or the existing political equilibrium, can just lead to replacing one instrument for another, and creating a constraint in a different part of the economy.

Rodrik (2008) discusses several examples of pitfalls of reform. Acemoglu and Robinson (2010) also present several examples. One of them is related to the reforms implementing the recommendations in the Washington Consensus – for instance those implemented in Argentina during the government of the Peronist Party and Carlos Menem after 1989.

Some of the reforms prescribed by the Washington Consensus were in principle reasonable instruments – for example those aimed at reducing macroeconomic problems, like the introduction of anchors to reduce inflation and instability in financial markets. However, if the implementation of such reforms fails to remove inefficiencies that were rooted in the political equilibrium, then the reforms may just be replaced by other inefficient instruments that, in the end, could be bend to continue creating instability or inequalities favoring specific groups of the population (AR, 2010).

ANSWER C.

Readings:

- Nunn, Nathan and Nancy Qian (2014), U.S. Food Aid and Civil Conflict. *AER* 104(6): 1630-1666.
- Lecture Slides Week 36 – OLS recap

C.1.
As the authors explain, the OLS estimates of the effect of food aid on conflict would tend to be biased upwards if, for example, the feedback effect from conflict on the demand for food or humanitarian aid is positive. That is, if the presence of conflict increases the need for food aid, then OLS coefficients would be biased upwards (this would be an example of reverse causality biasing a OLS estimate upwards).

An upward bias may also be the result of the presence of third factors that jointly affect the demand for humanitarian aid and the prevalence conflict. An example would be the occurrence of political and economic crises, that tend to increase both the incidence of conflict and the demand for aid (this is an example of joint determination creating an upward bias).

On the other hand, OLS estimates in this study may also be biased downwards. For example if donor governments reduce the amount of aid to countries engaged in conflict, we would observe reverse causality creating a downward bias. One can imagine that this type of situations may arise for political or logistical reasons, when donors decide to cut aid to countries under certain type of conflict.

In addition, the presence of classical measurement error would lead to attenuation bias of a the OLS estimates.

C.2.
The finding that an increase of food aid from the US (a major aid donor) increases the incidence and the duration of civil conflict, shows that the concerns of some critics and observers of humanitarian aid, and food aid in particular, have some support – at least when the topic is studied from a macro perspective, and the analysis uncovers the average, net effect across countries.

The authors show that these results are robust and not confounded by a list of additional factors. For example, they are not due to food aid crowding out other types of aid, which could be creating favorable conditions to extend an existing conflict, for instance. Extending that type of checks, the authors conclude that part of the increase in civil conflict across food aid recipients is strongly related to an increase in aid.

Those results may be taken in a pessimistic way. But such an interpretation may be misleading. The finding that the average results are mainly driven by the effect of food aid in countries with a recent history of conflict, "isolates the problematic consequences

we detect to a well-defined and observable subset of food aid recipients " (Nunn and Qian 2014). This can be very useful in order to design or redesign the way in which specific types of aid could be allocated. At the same time, the study only focuses on one of the many consequences of food aid, and in no way contradict other existing evidence of the potential benefits of food and humanitarian aid.