Written Exam at the Department of Economics winter 2017-18
Advanced Development Economics – Macro aspects
Master's Course
December 20th , 2017
(3-hour closed book exam)

Solution manual

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

ANSWER A. Income and fertility.

Readings:

- Galor, Oded (2012), The demographic transition: causes and consequences, *Cliometrica* 6: 1-28.
- Andersen, Thomas B., Carl-Johan Dalgaard, and Pablo Selaya (2016), Climate and the Emergence of Global Income Differences. *Review of Economic Studies* 83(4): 1334-1363.
- Dalgaard Carl-Johan and Holger Strulik (2013), The History Augmented Solow model. *European Economic Review* 63: 134-49.
- Galor, Oded and David Weil (1999), From Malthusian stagnation to sustained growth. *American Economic Review* 89(2): 150-54.

A.1. The budget constraint

$$c + \tau n y = y \tag{1}$$

can be rearranged to get

$$c = (1 - \tau n)y, \tag{2}$$

which indicates that optimal consumption should be equivalent to the proportion of income remaining after covering the costs of raising children.

Therefore, replacing the rearranged budget constraint (2) into the utility function

$$u(c, n) = \gamma \frac{n^{1-\rho} - 1}{1 - \rho} + (1 - \gamma) \frac{c^{1-\rho} - 1}{1 - \rho}, \tag{3}$$

the optimal number of children can be found as

$$n = \arg\max_{n} \left\{ \gamma \frac{n^{1-\rho} - 1}{1 - \rho} + (1 - \gamma) \frac{[(1 - \tau n)y]^{1-\rho} - 1}{1 - \rho} \right\}. \tag{4}$$

The first order condition for solving (4) is:

$$\gamma n^{-\rho} - (1-\gamma)[(1-\tau n)y]^{-\rho}\tau y = 0.$$

Rearranging:

$$n^{-\rho} = \frac{1-\gamma}{\gamma}[(1-\tau n)y]^{-\rho}\tau y^{1-\rho}.$$

Taking $(\cdot)^{-\frac{1}{\rho}}$ on both sides and collecting terms:

$$n = \left[\frac{1-\gamma}{\gamma}\tau\right]^{-\frac{1}{\rho}}(1-\tau n)y^{\frac{\rho-1}{\rho}}.$$

Multiplying both sides by $\frac{1}{n}$:

$$1 = \left[\frac{1-\gamma}{\gamma}\tau\right]^{-\frac{1}{\rho}}(\frac{1}{n}-\tau)y^{\frac{\rho-1}{\rho}}.$$

Rearranging:

$$\left[\frac{1-\gamma}{\gamma}\tau\right]^{\frac{1}{\rho}} y^{\frac{1-\rho}{\rho}} = \frac{1}{n} - \tau.$$

The final result is:

$$n = \left[\left(\frac{1-\gamma}{\gamma}\tau\right)^{\frac{1}{\rho}} y^{\frac{1-\rho}{\rho}} + \tau\right]^{-1}. \tag{5}$$

A.2. From the budget constraint (1), one can see that an increase income has two conflicting effects on the optimal number on children. On the one hand, an increase in income (y) generates a positive income effect that tends to increase the number of children (n), as long as children are viewed as a normal good. On the other hand, the increase in y generates a negative substitution effect, given that raising children is costly in terms of time, and this increases the opportunity costs of raising a child, τy.

Given that the utility function (3) is not homothetic, the total effect depends on the elasticity of substitution between its two arguments, which in this case is equal to the inverse of the degree of relative risk aversion, ρ.

If ρ is low ($0 < \rho < 1$), the elasticity of substitution ($\frac{1}{\rho}$) is high, and we can therefore expect that the substitution effect will tend to dominate. Intuitively, a higher level of

income increases the alternative costs of raising children and thereby increases the relative price of n. Reducing n is *easier*, the higher the elasticity of substitution. We can see this in (5): if $\rho \in (0,1)$, then y's exponent is positive ($\frac{1-\rho}{\rho} > 0$), and therefore $\frac{\partial n}{\partial y} < 0$.

When ρ is high ($\rho > 1$), the inverse is true, and $\frac{\partial n}{\partial y} > 0$.

A.3. If $\rho = 1$, then

$$u(c,n) = \gamma \ln(n) + (1-\gamma)\ln(c),$$

and the optimal number of children is given by

$$n = \arg\max_{n} \{\gamma \ln(n) + (1-\gamma)\ln[(1-\tau n)y]\}. \tag{6}$$

The first order condition for solving (6) is:

$$\frac{\gamma}{n} - \frac{(1-\gamma)}{(1-\tau n)y}\tau y = 0.$$

Rearranging:

$$\begin{aligned} \frac{1-\tau n}{\tau n} &= \frac{1-\gamma}{\gamma} \\ \frac{1}{\tau n} &= \frac{1-\gamma}{\gamma} + 1 \\ \frac{1}{\tau n} &= \frac{1}{\gamma} \end{aligned}$$

The final result is:

$$n = \frac{\tau}{\gamma} \tag{7}$$

When $\rho = 1$, preferences are homothetic, and households are not inherently biased towards neither n nor c when y increases, which implies that the mentioned conflicting effects cancel each other out. This illustrates that optimal fertility does not need to depend a priori on y. It therefore also illustrates how any theory that predicts that income affects fertility in a certain manner (such as in Gary Becker (1960)) must rely on specific assumptions about households' preferences.

A.4. The results in A.2 and A.3 show that, in theory, the effect of income on fertility can be a priori ambiguous, including the case in which income has no theoretical effect on fertility decisions (A.3).

Gary Becker's theory is plausible only if households have preferences such that the substitution effect dominates the income effect, which is possible, but cannot be an accurate description of preferences under all circumstances – for example, in a historical perspective, that would be equivalent to assuming that households' have a bias towards a lower number of children after a certain level of income has been attained.

A.5. One of the empirical predictions of Gary Becker's (1960) theory is that an increase in income is associated with a lower optimal level of fertility. At the macro level, this idea provides with the testable prediction that countries with higher levels of income per capita should experience a decline in fertility earlier than the rest.

Historical evidence from different countries in Europe is not consistent with that prediction: the data shows that countries with substantially different levels of income per capita experienced a permanent decline in fertility more or less at the same time, between 1890 and 1930.

This type of evidence suggests that, historically, other factors besides the level of income per capita must have had a stronger impact on fertility choices. The literature on historical determinants of economic development revised in the course shows that one of these factors is the rise in the demand for human capital, that starts during the transition from stagnation to sustained growth, that is associated with an increase in the returns to human capital and skills accumulation, and that in turn provides families with further incentives to sustain larger investments in the education of their offspring, and to eventually reduce the number of their offspring permanently.

A.6. One of the main parts of the literature on the historical determinants of development revised in the course, is the one related to the role of the demographic transition, or the permanent reduction in fertility that is critical to consolidate the transition out of stagnation and into a path of sustained growth in income per capita.

Galor and Weil (1999) and Galor (2012) provide theoretical arguments and empirical evidence showing that the acceleration in the rate of technological progress during the second phase of the Industrial Revolution increased the demand for human capital and skills, and therefore induced parents to make higher investments in the human capital of their children. When these larger investments in the human capital of offspring become associated with further increases in the rate of technological progress, and thereby with even stronger incentives to accumulate human capital and skills, the whole technological environment provides incentives to reduce the *quantity* of children permanently, in order to facilitate larger investments in their education, or *quality*, permanently. A permanent reduction in fertility allows societies to keep total population levels in balance, and therefore to benefit from increases in technological progress by sustaining higher levels of income both in total and in per capita terms.

The empirical evidence supports this theory. Dalgaard and Strulik (2012), for instance, study the relationship between the timing of fertility decline and current levels of income per capita, and find evidence supporting the idea that an earlier demographic transition is associated with higher current levels of income per capita across (110)

countries. Andersen et al (2016) exploit disease ecology as an exogenous source of variation for the level of return to human capital accumulation, and provide strong evidence that differences in the timing of the demographic transition have indeed contributed to the emergence of global income differences.

In this sense, Justin Wolfer's conclusion is only partially true, because it does relate to the observed *correlation* between a country becoming richer and at the same time having lower fertility levels. However, based on the above mentioned empirical evidence, the line of *causality* goes in the opposite way: the fewer kids you have, the richer you get (and not the other way around).

ANSWER B. Gender norms.

Readings:

- Alesina, Alberto, Paula Giuliano and Nathan Nunn (2013). On the Origins of Gender Roles: Women and the Plough. *Quarterly Journal of Economics* 128(2): 469-530.
- Nunn, Nathan (2012), Culture and the Historical Process. *Economic History of Developing Regions* 27(S1): 108-126.
- Gershman, Boris (2017), *Long-Run Development and the New Cultural Economics*, in "Demographic Change and Long-Run Development", Matteo Cervelatti and Uwe Sunde (eds.) Cambridge, MA: MIT Press, 2017, Chapter 9, pp. 221–261.

B.1. The relationship between the traditional practice of plough agriculture and current gender norms is based on Ester Boserup's (1970) hypothesis, which says that part of the differences in gender roles we observe across cultures at present, have their roots in the form of agriculture traditionally practiced in pre-industrial times.

To build this hypothesis, Ester Boserup identified important differences in the social norms that evolved from different types of traditional practices in agriculture. In particular, she compared the characteristics of *shifting* cultivation (which she noted as labor intensive and typically relying on handheld tools like the hoe and the digging stick for the preparation of soils), with those of *plough* cultivation (which is much more capital intensive and, unlike the hoe or the digging stick, requires significant upper body strength and grip strength to pull the plough or control the animal that pulls it, and for which men have a relative advantage compared to women).

Given that soil preparation is an essential part of agriculture, men's advantage to work in areas where plough agriculture is practiced generated a process specialization along gender lines: compared to shifting agriculture societies, men in plough agriculture societies tended to work outside in the fields; while women specialized in work within the home. This type of gender division of labor generated norms about the appropriate role of women in society: societies where plough agriculture was traditionally practiced developed the belief that the *normal*, or the *natural* place for women is within

the home.

Ester Boserup noted that these beliefs that become part of the local culture tend to persist even when the economy moves out of agriculture, which affects the participation of women in activities performed outside the home, in areas such as the labor market, firm ownership, or politics.

B.2. The correlation between the practice of traditional plough agriculture and female participation in the labor force presented in the graph cannot be interpreted directly as evidence of the causal effect of traditional agricultural practices on current female labor force participation. This is due to a number of challenges that appear in the design of an empirical study. Among these are: measurement error, omitted variables, joint determination, and reverse causality.

As an example of the problem of measurement error, consider the construction of the cross-national index of traditional plough agriculture, which consists of the aggregation of data on traditional plough use across the ethnic groups in Murdock's (1958) Ethnographic Atlas into areas in which a traditional language is predominant, and finally into administrative country borders. The data from the Ethnographic Atlas is measured across various ethnic homelands, but at different points in time. One could imagine that older data are more noisy than more recent data, which would introduce a systematic bias (for instance if more recent data is more common in places that practiced relatively more traditional plough agriculture). A feasible solution to reduce this type of measurement error consists in adding the year in which the underlying data was collected as a necessary control in all regressions.

As an example of problems related to omitted variables or joint determination, consider the role of initial political development levels: politically more disorganized areas may have offered less possibilities for women and men to participate in local political activities, which could be confounding the correlation between traditional plough use and the participation of women in politics. A direct solution to reduce this problem consists in controlling for the level of political centralization in the original ethnic homelands, as a proxy for the level of the level of initial political sophistication.

Finally, as an example of problems of reverse causality, consider the possibility that places with conditions that historically prevented or discouraged the participation of women in economic activity (for instance related to low technological progress or high average fertility rates), were also more successful in adopting agricultural techniques that prevented or discouraged the participation of women in agricultural activity. A viable solution to reduce this problem could be implemented by relying on external sources of variation for the traditional use of plough agriculture. As it was done in Alesina et al (2013), these sources could be the geo-climatic determinants of land suitability for growing crops that benefit of the use of a plough (such as wheat, barley, rye, and wet rice), compared to the conditions for crops that do not benefit from the use of a plough (such as maize, sorghum, or millet). These geo-climatic determinants are less likely to be affected by other reasons or mechanisms that historically prevented or discouraged the participation of women in economic life, and therefore increase the chances of getting a causal estimate of the effect of traditional plough agriculture on gender norms.

ANSWER C. Inequality.

Readings:

- Starmans, Christina, Mark Sheskin and Paul Bloom (2017), Why people prefer unequal societies. *Nature Human Behaviour* 1: 0082.
- Sen, Amartya (1992), *Equality of What?* Chapter 1 in "Inequality Reexamined". Oxford University Press.
- Ravallion, Martin (2014), Income inequality in the developing world. *Science* 344(6186): 851-855.

C.1. High inequality has been historically a risk factor for creating new, or amplifying existing social, economic and political problems. Increasing inequality has recently also sparked indignation – consider for instance the publication of an Oxfam report this year, in which the agency estimates that eight men own the same wealth as the 3.6 billion people who currently make up the poorest half of humanity. In that sense, the message of Pope Francis in Twitter adheres to the revived awareness about the problem of increasing inequality around the globe (Starmans et al 2017).

The concern that people express about inequality is also found in controlled laboratory studies, which reveal inequality aversion, or egalitarian motives and a desire for equal distributions since early stages in human development, and that tend to be present across different cultures.

However, there is also puzzling evidence found in political psychology and behavioral economics. When people are asked to distribute resources among a small number of people in a lab setting, they tend to insist on an exactly equal distribution, but when they are asked about redistribution of resources among a large number of people in the actual world, they reject equal distributions and prefer a certain extent of inequality. For instance, Starmans et al (2017) report with data for the US, that respondents claim that the ideal share of wealth to the top 20% of the distribution should be above 30%; the share for the second and third 20% in the distribution should approximately correspond to the next 20% of wealth for each, which leaves the fourth and fifth (poorest) ventiles in the ideal distribution with a share of 10% of the remaining wealth for each.

Starmans et al (2017) investigate this puzzle, and propose the idea that people are actually not concerned about *inequality*, but about *unfairness*. They explain that lab experiments tend to find preferences for equal distributions, because equality and fairness tend to coincide in the applied experimental designs. They propose that in the real world, people e.g. value effort, merit, or moral deservingness, which allows for unequal distributions that are considered fair. One can also consider the role of voluntary lotteries: people value impartial procedures and sometimes this may involve participating in voluntary lotteries that may end in the most unequal distribution, but which may ultimately considered fair.

One of the main points in Sen (1992) is related to this, in the sense that he recalls that humans are different in a multitude of external characteristics such as the different

natural and social environments in which we live, but also in ideas, and personal characteristics, that are important for assessing inequality. For example, Sen recalls that equal incomes can still leave much inequality in our capacity to do what we value most doing, or, put differently, that equality in one space may bring us in the direction of inequality in an arguably equally important space.

This type of reasoning leads Sen (1992) to formulate the importance of asking two key questions in any analysis of (in)equality: *why equality?* and *equality of what?*

In light of this literature, the tweet of Pope Francis may certainly be more accurate if it would point to the negative effects of unfairness, given that equality in some purely economic dimension may actually end up being much more unfair and actually give rise to more social evil.

C.2. Martin Ravallion (2014) recalls a prevailing view for many decades in the context of the developing world, namely that a period of rising inequality is to be expected in poor countries, as something more or less inevitable as a feature of early stages of development, and in particular something not to worry about if the incidence of poverty is falling. In terms of policy, the consistent actions with this pro-poor inequality views required giving a priority to reforms aimed at creating and sustaining economic growth, and leaving reforms aimed at creating redistribution in a secondary order of importance – Ravallion recalls for example that another related and commonly held view was that policy efforts to reduce inequality were likely to impede growth and (hence) poverty reduction.

The performance of developing countries in terms of sustaining growth and equality and the fight against poverty has been quite diverse. However, the evidence presented in Ravallion (2014) points towards three important roles through which inequality influences the pace of progress in reducing poverty.

First, changes in inequality during the growth process have implications for how much that growth affects poverty. Ravallion estimates that among growing developing countries, those experiencing falling inequality see the amount of people living in poverty falling at a median rate of about 1.30% points per year, which is at least three times faster than the rate of poverty reduction in countries with rising inequality. That is, poverty tends to fall with economic growth, but it falls much faster in countries where inequality is falling rather than increasing.

Second, high initial levels of inequality tend to reduce the growth elasticity of poverty reduction, or the degree of responsiveness of poverty measures to growth in average income. As Ravallion (2014) explains, the reason is very direct: "the more unequal the original distribution, the smaller the share of the growth accruing to the poor and the lower the poverty reduction arising from that growth. The converse holds too: In more unequal societies, the poor tend to be more protected from aggregate economic contractions."

Third, a high initial level of inequality can mean less growth and therefore less progress against absolute poverty. This can happen through a variety of channels. High initial

inequality can for example be associated with borrowing constraints and credit market failures affecting disproportionately more to the poorest. Another type of arguments point towards the capacity of relatively privileged subgroups to capture rents and restrict economic opportunities for the less privileged groups. Some different arguments also point to the potentially lower cooperation to build public goods or solve collective action problems under conditions of high inequality; or finally to the absence of a middle class that is typical in very unequal societies, which can reduce the chances to have a more diversified economy.

Therefore, there seems to be a number of valid arguments and supporting evidence from modern development economics that suggest that we should not expect any substantial trade-off between progress in the fight against poverty and progress in the reduction of inequality. As Ravallion (2014) points out, "[I]ndeed, the evidence suggests that falling inequality tends to come with falling poverty incidence."