Aid Volatility, Human Capital, and Growth

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Background

- Causes of aid volatility:

  - Aid responds countercyclically to exogenous shocks, e.g., terms of trade or natural disasters emergency aid); especially the case for LICs.

  - Reflection of recipient country's political status as well as its governance and macroeconomic performance, which are to some extent endogenous to the recipient country's actions.

  - Manifestation of budget cycles in donor economies.

- Adverse effect of aid volatility on economic growth.

- Documented in a number of empirical studies.

- In theory, a variety of possible channels.

- Agénor and Aizenman (2010): aid finances a large fraction of infrastructure investment.

- Aid volatility can make it difficult for recipient governments to formulate medium-term spending plans to spur growth.

- Consistent with evidence suggesting that aid shortfalls are often accompanied by cuts in public investment…

- …and that volatility in government spending has an adverse effect on economic growth.

- Paper explores an alternative, and possibly complementary, channel through which aid volatility may adversely affect growth.

- OLG model where the decision to invest in skills is endogenous.

- LIC where the cost of acquiring education benefits from public subsidies…

- …which are partly financed through domestic taxes and partly through aid.

- Low level of income and limited capacity to enforce compliance with the law: policymakers have limited ability to adjust tax rates to finance spending.

- Individuals cannot borrow to invest in education.

The Model

Basic Assumptions

- Continuum of agents who live for two periods, adulthood and old age.

- Population is constant.

- Individuals have identical preferences but are born with different abilities.

- Ability follows a uniform distribution.

- 2 categories of labor in the economy, skilled and unskilled.

- Individuals are born unskilled and must decide at the beginning of adulthood whether to become skilled or remain unskilled.

- Becoming skilled involves both a time cost and a pecuniary cost, with the latter benefiting from a public subsidy.

- Production of goods requires both types of labor as well as physical capital.

- Goods can be used for consumption of investment.

- Skilled labor is more productive.

- Government finances its spending through taxation and foreign aid.

Individuals

- Individuals have identical preferences but are born with different abilities, indexed by $x \in (0,1)$.

- Ability follows a uniform distribution.

- Individual maximizes utility and decides whether to enter the labor force as unskilled or (after training) skilled.

- Individual's ability partly determines his relative cost of acquiring skills.

- Adult with ability x can enter the labor force as an unskilled worker and earn w^U, which is independent of the worker's ability.

- Or the individual may choose to spend first a fraction of time $\varepsilon \in (0,1)$ of his time endowment at the beginning of adulthood in training…

- …and enter the labor force for the remainder of the period as a skilled worker, earning w^S.

- Training involves a direct pecuniary cost, partly financed by a government subsidy.

- Individual's discounted utility function:

$$U_t^h = \eta_C \ln c_t^{h,t} + \frac{\ln c_{t+1}^{h,t}}{1+\rho}, \quad h = U, S$$

- Only skilled workers are subject to taxation. Period-specific budget constraints:

$$c_t^{U,t} + s_t^U = w_t^U$$

$$c_t^{S,t} + s_t^S = (1 - \tau)[(1 - \varepsilon)w_t^S - e_t]$$

$$c_{t+1}^{h,t} = (1 + r_{t+1})s_t^h, \quad h = U, S$$

- Training cost:

$$e_t = \left(\frac{\omega - \mu_t}{x^{\chi}}\right)(1 - \varepsilon)w_t^S$$

$$\omega, \chi \in (0, 1) \text{ and } 0 \leq \mu_t < \omega$$

- Solution of optimization problem: gives optimal levels of consumption in periods *t* and *t+1*, for *h* = *U,S*.

- Substituting these results gives the indirect utility functions, V^h, with *h* = *U,S*.

- Threshold level of ability x^C, such that individuals with ability $x > x^C$ choose to become skilled obtained by setting $V^S = V^U$:

$$x_t^C = \frac{(\omega - \mu_t)^{1/\chi}}{0.5}\left[1 - \frac{w_t^U}{(1-\tau)(1-\varepsilon)w_t^S}\right]^{-1/\chi} - 1$$

- Relative supply of unskilled labor:

$$\theta_t^U = F(x_t^C) = \int_0^{x_t^C} f(x)dx = x_t^C$$

- Relative (effective) supply of skilled labor:

$$\theta_t^S = \frac{(1+x_t^C)}{2}(1 - x_t^C) = \frac{1-(x_t^C)^2}{2}$$

Production

- Production function:

$$Y_t = K_t^\alpha (Z_t L_t)^{1-\alpha} \qquad \alpha \in (0,1)$$

- *L*: composite labor input, defined as

$$L_t = \gamma L_t^S + L_t^U$$

- γ: productivity parameter, $\gamma(1-\varepsilon) > 1$; L^S and L^U:

$$L_t^S = (1-\varepsilon)\theta_t^S \bar{N}, \quad L_t^U = \theta_t^U \bar{N}$$

- Learning-by-doing effect :

$$Z_t = K_t / \bar{N}$$

- Profit maximization wrt L^S and $L^{U:}$

$$w_t^S = \gamma w_t^U$$

- Production:

$$Y_t = [\gamma(1 - \varepsilon)\theta_t^S + \theta_t^U]^{1-\alpha} K_t$$

Government

- Government budget constraint:

$$G_t^E + G_t^U = (\tau + a_t)(1 - \varepsilon)w_t^S N_t^S$$

- a_t: foreign aid share.

- Total cost of subsidies to education:

$$\mu_t(1 - \varepsilon)w_t^S \theta_t^S \bar{N}$$

- Share of resources spent on subsidies: $\upsilon \in (0,1)$.

- Subsidy rate is given by

$$\mu_t = \upsilon(\tau + a_t)$$

- Aid share is

$$a_t = a + \delta_t$$

- $a > 0$ (mean); δ_t: aid shock, uniform distribution over $(-\delta, \delta)$ with $\delta > 0$ and $\delta < a$.

- Increase in δ: mean-preserving spread in the distribution of aid shocks; increase in aid volatility.

Savings-Investment Equilibrium

$$K_{t+1} = s_t^U \theta_t^U \bar{N} + s_t^S \theta_t^S \bar{N}$$

Stochastic Equilibrium

- See definition in paper.

- (Stochastic) threshold level of ability:

$$x_t^C = g(a_t) = \Lambda[\omega - \upsilon(\tau + a_t)]^{1/\chi} - 1$$

$$\Lambda \equiv \frac{1}{0.5}\left[1 - \frac{1}{(1-\tau)(1-\varepsilon)\gamma}\right]^{-1/\chi} > 0$$

- Easy to verify that $g' < 0$ and $g'' > 0$.

- Let σ denote the savings rate (same for both types of workers).

- **Stochastic growth rate of capital:**

$$\frac{K_{t+1}}{K_t} = f^K(a_t) = \frac{\sigma(1-\alpha)}{\{\gamma(1-\varepsilon)0.5[1-g(a_t)^2]+g(a_t)\}^\alpha}$$

$$\times\left\{g(a_t) + \left[1 - \frac{\omega-\upsilon(\tau+a_t)}{[0.5(1+g(a_t))]^\chi}\right]\gamma(1-\tau)(1-\varepsilon)0.5[1-g(a_t)^2]\right\}$$

- **Stochastic growth rate of output:**

$$\frac{Y_{t+1}}{Y_t} = f^Y(a_t, a_{t+1}) = \left\{\frac{\gamma(1-\varepsilon)0.5[1-g(a_{t+1})^2]+g(a_{t+1})}{\gamma(1-\varepsilon)0.5[1-g(a_t)^2]+g(a_t)}\right\}^{1-\alpha}f^K(a_t)$$

Aid Volatility and Growth

- Mean value of ability threshold (around *a*):

$$\mathbb{E}x_t^C \simeq \Lambda[\omega - \upsilon(\tau + a)]^{1/\chi}\left\{1 + \frac{0.5}{[\omega - \upsilon(\tau + a)]^2}\frac{\upsilon^2}{\chi}\left(\frac{1}{\chi} - 1\right)\right\}\sigma_a^2$$

- Increase in aid volatility raises the mean threshold level of ability.

- More volatility in aid leads to more volatility in the subsidy rate and thus greater uncertainty…

- …about the average relative return from investing in skills (wage ratio).

- Mean growth rates of capital and output (around *a*):

$$\mathbb{E}(\frac{K_{t+1}}{K_t}) \simeq f^K(a) + 0.5\frac{d^2 f^K}{da_t^2}\sigma_a^2$$

$$\mathbb{E}(\frac{Y_{t+1}}{Y_t}) \simeq f^Y(a,a) + 0.5(\frac{\partial^2 f^Y}{\partial a_t^2} + \frac{\partial^2 f^Y}{\partial a_{t+1}^2})\sigma_a^2$$

- Second-order derivatives in these expressions: too complex to be derived analytically.

- Numerical evaluation, using Mathematica.

- Values: σ = 0.12, ε = 0.15 (advanced training requires about 4 years), ω = 0.1, α = 0.3, τ = 0.22.

- Variable parameters: γ (initially 1.3, so wage premium is $\gamma(1-\varepsilon)$ = 0.11), and χ = 0.7.

- γ varied in (1.3,1.45) and χ in (0.7,0.85).

- f^K and f^Y are concave (vicinity of a).

- Gain associated with a more qualified pool of workers as a result of a favorable aid shock (and thus a higher subsidy rate to education)…

- ...less than compensates the loss resulting from an unfavorable shock.

- On average, the growth rates of both investment and output are thus decreased by a mean-preserving spread in the distribution of the shock.

- Reflection of Jensen's inequality.

- In effect, the economy would be better off getting the amount of aid a with certainty, rather than getting the same amount on average, but with a non-zero variance.

- Aid shocks affect average output growth through two channels: an education incentive-human capital channel and an investment channel.

- In the present setting, both of these effects operate in the same direction.

- Because aid volatility translates into volatility of the subsidy rate to education, it leads to greater volatility in wages and lowers the mean value of the relative supply of skilled workers.

- In turn, this translates into a lower mean growth rate of output, both directly and indirectly…

- …because higher volatility in wages leads to lower mean savings and thus lower mean investment.

- This, in turn, magnifies the direct effect on aid volatility on the mean growth rate of output.

Parameters γ and χ, and Second-Order Derivative of $f^K()$
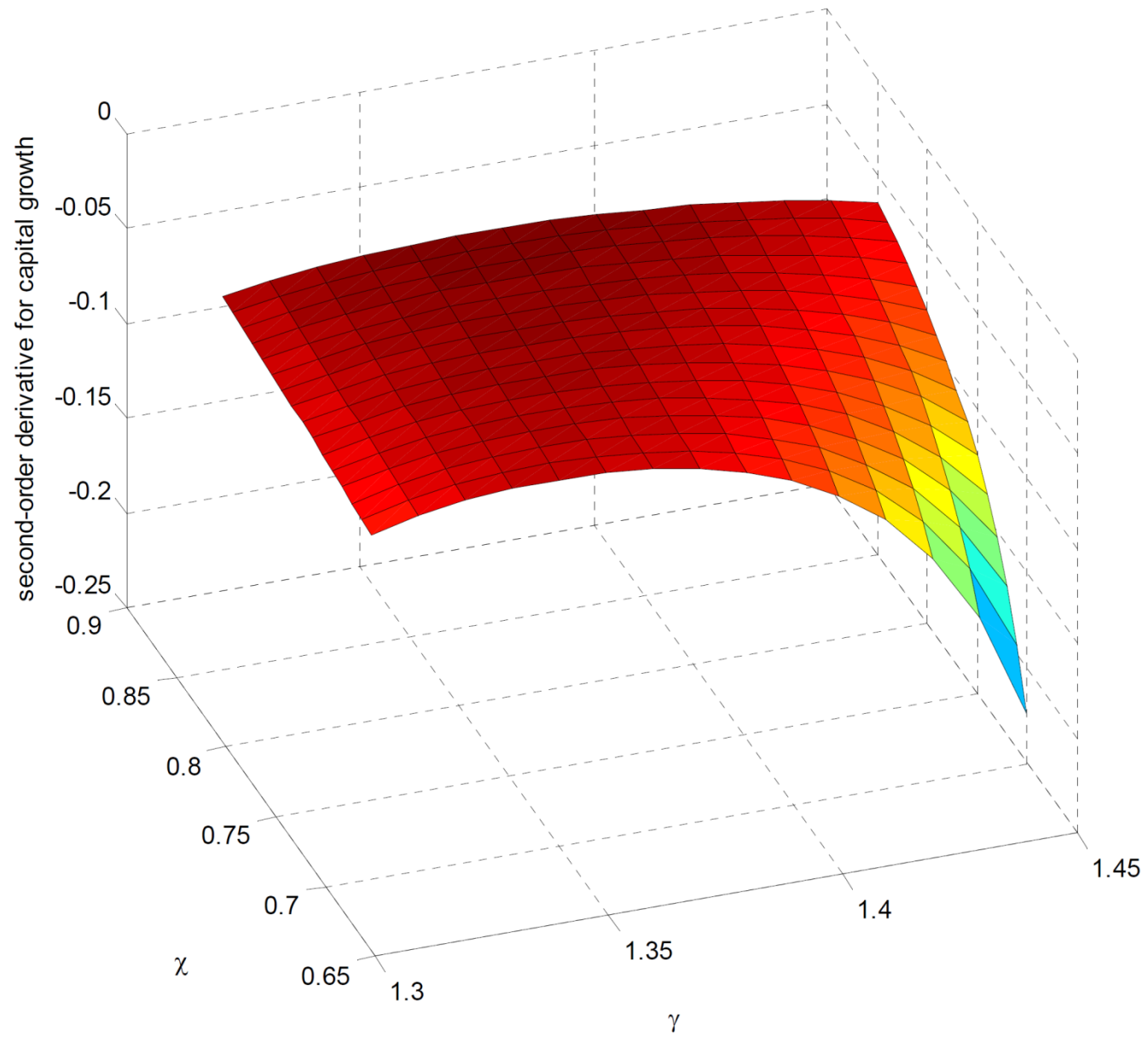
Parameters γ and χ, and Sum of Second-Order Derivatives of $f^Y()$
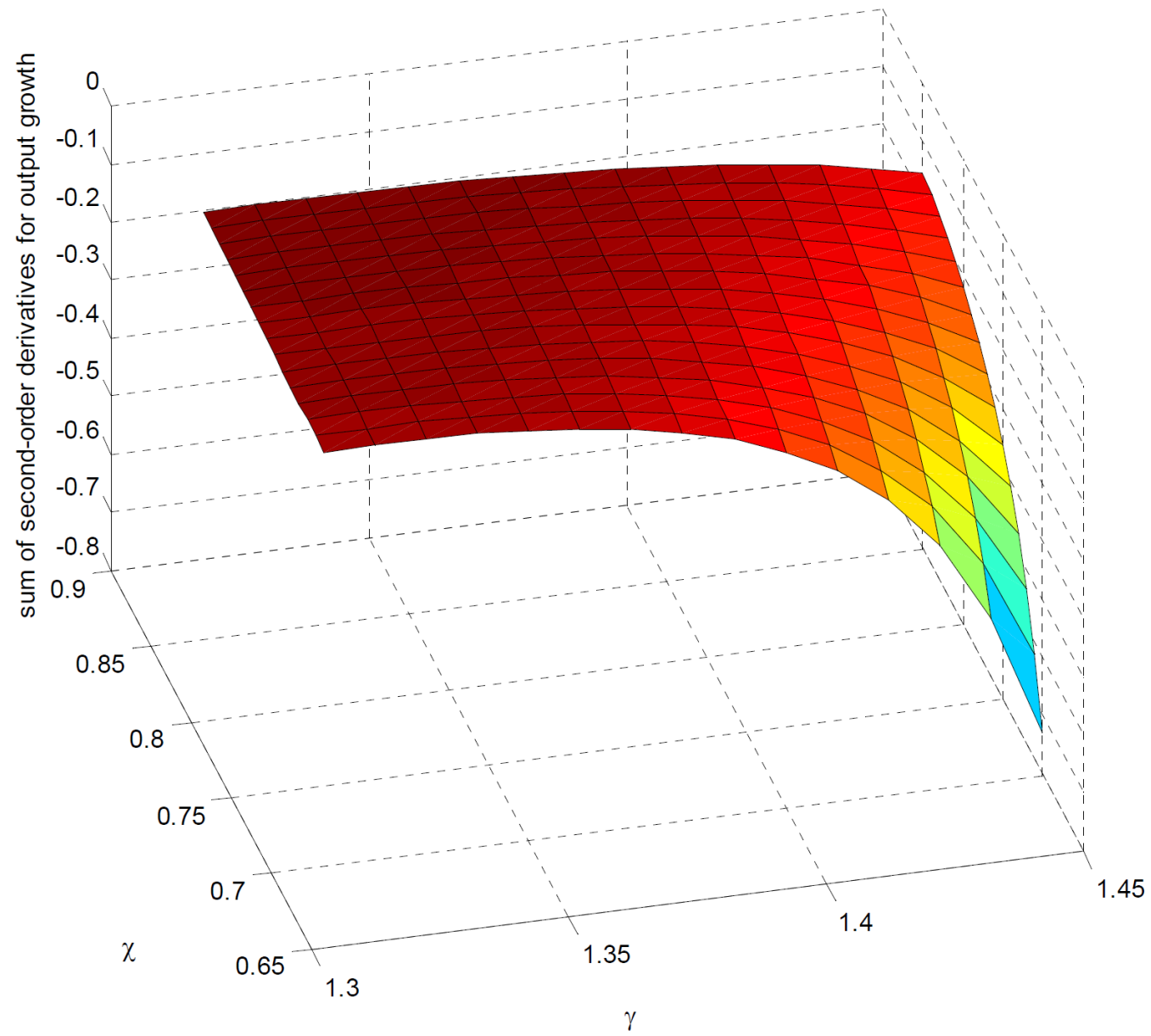
Extensions

- 1. Taxation of unskilled workers as well (same rate); subsidy rate remains endogenous.

- 2. Endogenous tax rate; subsidy rate exogenous.

- Qualitatively similar results in the first case.

- Second case: similar results as well, if either the unskilled are not taxed, or taxation is progressive (unskilled workers taxed at a lower rate).

Conclusions

- Consider whether a contingency fund financed partly through domestic taxation and partly through aid proceeds, can mitigate the adverse effect of aid volatility on long-term growth.

- Agénor and Aizenman (2010): trade-off between the moral hazard effect of a contingency fund (level of aid may depend on fund size) and the benefits of a more stable flow of resources.

- Dynamic setting here; shape of trade-off?