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INFLATION AND GROWTH

Inflation is often thought to be an evil distorting economic incentives and retarding economic growth, i. e. there exists negative relation between inflation and growth. Roubini and Sala-i-Martin [1] shows that this relation may be misinterpreted. Indeed it is financial repression that both leads to slow growth and stimulates governments to resort to inflation taxation. This result has an important implication for the empirical research in development in transition; hence, the decision to reproduce the result in a more general setup.

Introduction

Inflation is an important policy variable. Calming down inflation and often hyperinflation is one of the important stages of macroeconomic stabilization. Prolonged period of rapidly increasing price level is often associated with decelerated economic development or, as in case of transitional ecoi my, pronounced economic slowdown. People see inflation as an evil distorting the economy and hampering development. So do economists. Harberger [2, 21] writes:

«... policies that impede the accurate perception of real costs are ipso facto inimical to growth. ***Inflation*** is the most obvious, probably the most pervasive, and almost ***certainly the most noxious of such policies.»***

However, as Roubini and Sala-i-Martin [1] (henceforth R&S) shows this relation is misunderstood. In a formal way the authors show that high inflation and slow pace of economic growth may be results of financial repression, the latter being instrument of government seeking high seniorage revenues. In this article I reproduce the result obtained in R&S [1] in a slightly more general setup. The modifications I introduce into the model are the following. First, I remove money from the utility function. Money does not provide direct utility in my model; however, maintaining low money reserves has a cost of frequent visits to the bank. Second, I generalize the production function from the «AK» form to a more general funtional form, which is linearly homogeneous in its both inputs capital and labor. This modification has an important implication - in contrast to the «AK» model, growth of output per capita sets to zero in steady state due to diminishing returns. As a result, the model has transitional dynamics unlike the «AK» model that adjusts discretely.

The model

Households. The economy is populated by infinitely lived individuals deriving their utility from consumption. Their lifetime utility is given by:

$$U = \Sigma_t \rho^{-t} \ln c(t), \rho > 1. \quad (1)$$

In (1) $c(t)$ is consumption of a representative household at time t, and ρ is a discount rate.

Individuals own capital, rent it to firms and receive interest; they also supply labor to firms.

Firms. Due to the property of linear homogeneity of the production function production can be treated as one firm that operates all the available capital and labor in the economy [1]. The following notation is used.

$$Y(t) = F(K(t), N(t)),$$
$$F_K, F_N > 0, F_{KK}, F_{NN} < 0, F_{KN} > 0.$$

$K(t)$ and $N(t)$ is capital stock and population at time t respectively. In per capita terms the production function can be rewritten as follows:

$$y(t) = F(k(t), 1). \quad (2)$$

In new notation $y(t)$ is output per capita and $k(t)$ is capital stock per capita.

Profit-maximizing firm pays to capital and labor their marginal products. Therefore, real interest rate, $r(t)$, and real wage, $w(t)$, in the economy are determined by:

$$r(t) = F_K(k(t), 1), \quad (3.a)$$
$$w(t) = F_N(k(t), 1). \quad (3.b)$$

Then, an individual's disposable income is:

$$r(t)\,k(t) + w(t) = F_K(k(t), 1)\,k(t) + F_N(k(t), 1) = y(t).$$

An individual spends this income on consumption, $c(t)$, and capital accumulation, $dk(t)$. He or she also maintains money reserves, $m(t)$, to facilitate transactions; each period individual's money holdings change by $dm(t)$.

Financial Sector. There are some costs associated with financial intermediation. As in R&S [1]

[1] See Sargent [2].

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some resources are lost when investing in new capital: to place new investment of $dk(t)$ an individual needs $\varphi dk(t)$. In addition, I assume that banks charge β for each bank transaction. Therefore, holding amount $m(t)$ in money requires $c(t)/m(t)$ trips to bank (bank transactions), which curb individual's budget by $\beta c(t)/m(t)$.

Parameters β, φ need additional specification: both are negative functions of financial development.

$$\varphi = \varphi(F),\ \varphi > 1,\ \varphi_F < 0 \quad (4.a)$$
$$B = \beta(F),\ \beta > 0,\ \beta_F < 0 \quad (4.b)$$

Government. To close the model let me add another agent, which is government. For the sake of simplicity I assume that the government does not impose income tax and relies only on one source of revenue, which is inflation tax [1]. As a result of the government resorting to seniorage an individual incurs additional cost, $\pi m(t)$, which is also government revenue.

Complete Model. The budget constraint for a representative individual is:

$$\varphi dk(t) + dm(t) = y(t) - c(t) - \pi m(t) - \beta c(t)/m(t) \quad (5)$$

Individual's optimization problem is to maximize utility, (1), subject to budget constraint, (5), given initial stock of capital and money holdings, accordingly $k(0)$ and $m(0)$. The set of first-order conditions for the individual's maximization problem are:

$$1/c(t) = \lambda(t)(1 + \beta(F)/m(t)) \quad (7.a)$$
$$\lambda(t)(\varphi(F) + r(t)) = \rho\varphi(F)\lambda(t-1) \quad (7.b)$$
$$\lambda(t)(1 + \beta(F)c(t)/m(t) - \pi) = \rho\lambda(t-1) \quad (7.c)$$

In addition to (7.a – c) solution must satisfy individual's budget constraint (5) and transversality condition.

The steady state solution to system (7) follows.

$$r^* = \varphi(F)(\rho - 1) \quad (8.a)$$
$$R^* = r^*/\varphi(F) + \pi = \rho - 1 + \pi \quad (8.b)$$
$$k^* = F_K^{-1}(\varphi(F)(\rho - 1)) \quad (8.c)$$
$$y^* = F(k^*, 1) \quad (8.d)$$
$$m^* = (-\beta(F)(R^* + \pi) + D^{1/2})/(2R^*) \quad (8.e)$$
$$D = \beta(F)^2(R^* + \pi)^2 + 4\beta(F)R^*y^*$$
$$c^* = m^{*2}R^*/\beta(F). \quad (8.f)$$

A new variable, i?*, is a nominal interest rate - a sum of effective real interest rate and inflation. As can be seen, financial development affects all the variables except for nominal interest rate; nominal interest rate, money holdings, and consumption are also affected by inflation.

Now let me evaluate the effect of financial development on steady state macroeconomic aggregates. Intuitively, the more developed financial sector the lower real interest rate, the higher capital stock and income per capita, and the lower money holdings must be in steady state. These results are confirmed by formal calculations:

$$\delta r^*/\delta F = (\rho - 1)\,\varphi_F < 0 \quad (9.a)$$
$$\delta k^*/\delta F = (1/F_{KK})(\delta r^*/\delta F) > 0 \quad (9.b)$$
$$\delta y^*/\delta F = (\delta k^*/\delta F)F_K > 0 \quad (9.c)$$
$$\delta m^*/\delta F = [m^* - \beta(F)y^*/D^{1/2}]\beta_F/\beta(F) < 0. \quad (9.d)$$

The derivative in (9.d) implies that repressing the financial sector induces individuals to hold larger money reserves, and, thus, a base for inflation tax increases. In addition, positive derivative of $nm(t)$ with respect to inflation, π, means that repressing financial sector and acceleration of the printing press are the two complement policies that increase government revenue, and, through the financial channel decrease steady state per capita output. Hence, the weaker the financial sector the greater are incentives for the government to resort to inflation taxation; weak financial sector, in its turn, retards development. If the above is true we must observe a negative correlation between inflation and development.

I want to stress that there is another beneficiary of financial repression. It is financial sector itself: under undeveloped financial sector more resources are spent on financial intermediation.

$$\text{Fin. Intermediation costs} = \beta c^*/m^* = m^*R^*$$
$$\delta(m^*R^*)/\delta F < 0.$$

Therefore, (large, influential) banks also must have their interest in financial repression[2].

Besides the link described in this article there may be other that «tie» inflation and development. Existence of such channels (or links) has important implications for empirical research of transition, which often include inflation as a determinant of slow economic development. For example, Fisher and Sahay [4] include inflation as a measure of macroeconomic imbalance in growth regressions for a panel of transitional economies and find a negative relation. As argued in this article and R&S [1] this relation may be spurious. The offered explanation is particularly alluring given that the mentioned research concerns first years of transition when resorting to printing press is especially tempting.

Empirical evidence

The question that remains is whether there exists any evidence that supports the above considerations. The «economic history» of Ukraine is depicted in Figure (secondary axis measures financial deepening).

Let me split period 1992-2001 into two. I choose 1995-1996 as breakeven years for several reasons:

actual reserve ratio dropped from 49 % to 17 % in 1995 meaning a substantial relief in the financial sector;

[1] Extending the model to include income tax does not change the main result, however it introduces unnecessary complication.

[2] Substantial fixed costs in financial sector is an important element that protects incumbent banks from new banks entering the market in observance of temporary profitability.

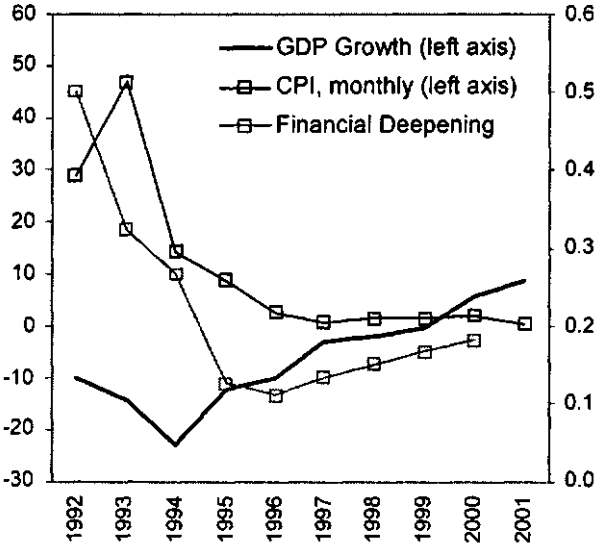

Figure. Growth, Inflation, and Financial Development

a new currency, Hryvnya, was introduced in 1996;

national bank became more independent than before, and government rulers were denied access to the printing press.

In the first period monthly rate of inflation averaged from 28,9 % in 1992 to 9 % in 1995, which are high by any standard. Financial deepening (M2/GDP), as indicator of financial development, although was higher than in the second period was declining substantially, ***i.e.*** financial environment was worsening considerably every year; growth rate reached trough of -22,9 % in that period. The first period perfectly fits the model: the government in pursuit of additional revenue hindered financial development; as a consequence, high inflation rate and accelerated economic slow down resulted.

In the second period financial deepening indicator started to recover. Low inflation and improved economic growth prospects are consistent with the model.

This bold analysis gives some credit to the model considered in this article. In my opinion, financial intermediation link between high inflation and slow economic development has some explanatory power and should be tested more thoroughly. However, the model misses one important component: pursuit of maximum revenue cannot be the sole goal of a government R&S [1] considers government's behavior; unfortunately the optimization problem does not have a closed form solution. Hence, adding optimizing behavior of the government would be the next step in improving the model and a next step in our understanding of the link between growth, inflation, and financial development.

Conclusions

In this article I reproduce the model developed in R&S [1] that shows that the relation between inflation and growth may be spurious. Although high inflation is usually perceived as a source of slowed development this may be not true. Thus, in transitional economies high (and often hyper) inflation was thought to be a cause for the stalled economic development. But as shown in the article both slow economic development and inflation may be caused by financial repression. The latter allows government to increase seniorage revenue, which is especially important in a case of transitional economy in which income tax is often ineffective.

The result in this model has an important implication for the growth research. One way to escape the uncovered pitfall would be to follow Barro [5], which includes variation in inflation (a measure of distortion and uncertainty) as a growth determinant. In any case, I want to add, intuition cannot be the only guide in running regressions.

1. *Roubini, Nouriel, and Xavier Sala-i-Martin.* **A Growth Model of Inflation, Tax Evasion, and Financial Intermediation** *//* **NBER Working Paper.- N 4096, May 1992.**
2. *Harberger, Arnold* **A Vision of the Growth Process** *//* **The American Economic Review, vol. 88(1), March 1998.**
3. *Sargent, Thomas.* **Macroeconomic Theory.- 2nd ed.- London: Academic Press, 1987.**
4. *Fischer, Stanley, and Ratna Sahay.* **The Transilion Economies After Ten Years** *//* **NBER Working Paper.- N 7664, April 2000.**
5. *Barro, Robert J.* **IDeterminants of Economic Growth: A Cross-Country Empirical Study- Cambridge, Massachusetts: The MIT Press, 1997.**

Циренніков В.

ІНФЛЯЦІЯ ТА ЗРОСТАННЯ

Інфляція часто вважається причиною спотвореної системи економічних стимулів та сповільненого економічного розвитку держави, тобто існує негативна залежність між інфляцією і зростанням. Рубіні та Сала-і-Мартін [1] показують, що такий зв'язок може бути неправильно інтерпретований. Автори доводять: причиною, яка призводить до сповільненого зростання, а також мотивує уряд вдаватись до інфляційного фінансування, є фінансове репресування. Як наслідок - негативна кореляція між економічним зростанням та інфляцією, що насправді не відобраоїсає причинно-наслідкового зв 'язку. Такий висновок має важливе значення для емпіричних досліджень, тож у цій статті автор робить спробу відтворити даний результат за більш загальних припущень.