INFLATION AND FINANCIAL DEPTH IN TRANSITION ECONOMIES

by

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Abstract

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In the paper we discuss the relationship between financial depth and inflation in transition economies. To address this issue we heavily rely on the implications from the theory developed by Boyd, Levine, and Smith (1996) and estimate the model constructed by Khan, Senhadji, and Smith (2001). The relationship of interest is suggested by previous studies to be non-linear, and non-monotonic. We use the data across 16 transition economies over 1994 – 2000 and conform these findings. In particular we found that there is a threshold level of 9 – 10.5% of annual inflation, after which inflation reduces rather than enhances financial depth. Among other variables we found that the openness to international trade positively affects financial depth, and financial suppression affects financial depth negatively.

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GLOSSARY

Bootstrapping. Econometric technique used to obtain a description of the sampling properties of empirical estimators using the sample data themselves (Greene 2000, p.173).

Credit rationing. A phenomenon on credit markets when borrower's demand is unfulfilled, although he is willing to pay the ruling market price (Baltensperger, 1978).

Financial depth. One of the quantitative measures of financial activity in the short run, and financial development in the long run.

Chapter 1

INTRODUCTION

It is difficult to find other two economic variables besides growth and inflation, which have attracted so much attention in economic literature. Not surprisingly, the question about the existence and nature of the link between these variables has been the subject of considerable interest and debate.

Conventional macroeconomics predicts that permanent and predictable changes in inflation rate do not have any substantial impact on the long run real activity[1]. However, more resent economic studies indicate that inflation has negative effect on growth[2]. Higher inflation hampers efficient resource allocation by distorting relative price signaling and therefore is harmful for real activity.

The newest approach to the link between growth and inflation rests on the idea of financial mediation. Specifically, inflation is seen to affect growth because changes in the rate of inflation may substantially influence financial activity, and affected financial activity may either enhance or impede growth.

Now it is well established both empirically and theoretically that higher degree of financial activity in the short run and more rapid financial development in the long run are really beneficial for growth. More developed financial sector improves channeling funds from borrowers to lenders, enhances liquidity of financial instruments, contributes to risk amelioration and so on.

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[1] See for example Romer (2001, p.245)

[2] See Barro (1991) or Bruno and Easterly (1998)

Hence, understanding how inflation affects financial sector may substantially contribute to clarifying the link between growth and inflation and therefore is an interesting and important subject for investigation.

Khan, Senhadji, and Smith (2001) use financial depth as a proxy for financial development and argue that besides inflation there might be several other factors affecting financial activity. Among them there are GDP per capita, the degree of openness and the share of public consumption in GDP as a measure of financial repression. Intuitively, the impact of these factors on financial development seems to be straightforward. A rise in GDP per capita and the degree of openness are likely to enlarge financial depth while a rise in financial repression and higher inflation seem to have an opposite result. Khan and Senhadji argue, however, that the effect of inflation on financial development is much more complicated. They hypothesize that a rise in inflation has a weak positive effect when initial rate of inflation is low and a negative effect at initially high inflation. If this hypothesis is true, then there is an inflation threshold in relationship between financial depth and inflation, and this threshold can be regarded as an optimum rate of inflation with respect to financial development and therefore be a target for monetary authorities.

In this paper we try either to confirm or reject the hypothesis about inflation thresholds for transition economies. Also, we try to reveal how other factors affect financial depth. To measure the latter we utilize several alternative indicators: domestic credit to the private sector as a share of GDP, and the ratio of broad money (M2) to GDP. The remainder of the paper proceeds as follows. Chapter 2 reviews literature on this subject. Chapter 3 develops a theory of the relationship between financial depth and inflation. Chapter 4 describes the data we are going to employ and discusses computational issues. Chapter 5 presents model specification and describes estimation technique. Chapter 6 provides estimation results and Chapter 7 concludes.

Chapter 2

LITERATURE REVIEW

Before we consider literature discussing relationship between the degree of financial markets development and inflation it is useful to review what have been written about the role of financial development in facilitating and promoting economic growth.

Gurley and Shaw (1955) pioneered exploring this area and were among the first indicating the importance of developed and well-functioning financial system. Moreover, they considered financial markets as central in economic activity. According to these authors differences in the quantity and quality of services provided by domestic financial system may partially explain why some countries grow faster than the others. The main emphasis in their research was made on the credit supply process. They state that economic process appears to be hampered if the economy is involved in self-financing or direct financing and the services of financial intermediaries are not accessible. Financial intermediaries facilitate channelling loadable funds by accumulating debt claims of surplus spending units (savers) and issuing and selling their own debt claims to deficit units (borrowers). Buying and selling debt claims is considered to be the main function of intermediaries. Thus, intermediaries and in particular banks help to reduce illiquidity that accumulates in the form of direct debt. More liquid assets lead to lower interest rates that, in turn, encourage individuals to invest more. Another important point is that under well-developed financial system with highly liquid markets a spending unit does not have to postpone its current consumption thereby increasing aggregate demand and enhancing growth.

In the large and comprehensive survey Levine (1997) presents more recent evidences on the importance of developed financial system. Reviewing more than a hundred of pre-1997 literature sources the author summarizes the following functions of the financial system promoting economic growth:

1) *Facilitating risk amelioration*. This function arises as a consequence of the specific information and transaction costs present in financial markets. In the presence of these costs financial institutions provide risk trading, hedging, and pooling. There are two types of risk considered: liquidity risk and idiosyncratic risk. Liquidity risk arises 'because some high-return projects require a long-run commitment of capital, but savers do not like to relinquish control of their savings for long periods' Levine (1997, p.692). Thus, in the absence of developed financial system potentially attractive long-term projects would not be realized thereby hindering economic activity. Besides reducing liquidity risk, the financial system helps to mitigate risks associated with individual projects, firms or countries. The projects with such risks become attractive as an ingredient of less risky investment portfolios and thus are not denied.

2) *Acquiring information about investments and allocating resources*. It is difficult and costly for individual savers to evaluate firms, managers, and market conditions. Therefore savers are usually reluctant to invest in projects about which they do not have enough reliable information. In contrast, financial institutions incur much less relative costs acquiring and processing information about investment opportunities and, therefore, may invest in projects, which would otherwise be denied by individual investors. Because of better information intermediaries allocate resources more efficiently thereby enhancing economic activity.

3) *Mobilizing savings*. Financial institutions agglomerate capital from many individual savers for investment. This allows investing funds even in projects that require enormous investment resources and which, otherwise, would not be

attractive for individual investors. Besides, households become able to hold small denomination instruments, which in turn allow for composing diversified portfolios, more efficient resource allocation and, consequently, faster growth.

4) *Facilitating Exchange*. Financial arrangements that lower transaction costs can promote specialization and technological innovation. More specialization and technological innovation require more transactions. Therefore, reduction in transaction costs facilitates these activities. Specifically, development of the financial institutions facilitates the exchange of technology in the market. On the one hand, this encourages creative individuals to make more innovations. On the other hand, the exchange of technology allocates it to the most efficient users thereby enhancing growth.

Besides theoretical studies there is a great deal of empirical researches about financial development-output nexus. The common approach in exploring the link between financial and real sectors involves running regressions of economic growth on the degree of financial development and controlling for other variables affecting economic activity.

Goldsmith (1969) uses the data on 35 countries from 1860 to 1963 to relate economies' growth rates and the value of financial intermediary assets divided by GNP. The latter measure is employed as a proxy for the degree of financial development under the assumption that the size of the financial system is positively correlated with the provision of financial services. Goldsmith finds that:

> 1) a rough parallelism can be observed between economic and financial development if periods of several decades are considered;
>
> 2) there are even indicators in the few countries for which the data are available that periods of more rapid economic growth have been accompanied, though not without exception, by an above-average rate of

> financial development (Goldsmith 1969, p.48, quoted in Levine 1997, p.704).

The work of Goldsmith, as Levine (1997) notes, has the following weak sides: a) the investigation comprises only 35 countries: b) it does not systematically control for other factors affecting economic growth; c) the size of financial system may not accurately measure the functioning of the financial system; and d) the close association between the size of the financial system and economic growth does not identify the direction of causality.

More recent researchers, however, try to overcome the above weaknesses. King and Levine (1993a) study 80 countries over the period of 1960-1989. They systematically control for other factors affecting long-run growth and construct additional measures of financial development. The authors find that there is a strong correlation between real per capita GDP and 1) financial depth measured as liquid liabilities of the financial system divided by GDP, 2) the ratio of credit allocated to private enterprises to total domestic credit and 3) credit to private enterprises divided by GDP.

In the next research King and Levine (1993b) analyse whether the level of financial development predicts long-run economic activity. In particular they study whether the value of financial depth predicts the rate of economic growth, capital accumulation, and productivity improvements over the next 30 years. The regressions they run indicate that financial depth in 1960 is significantly correlated with each of the growth indicators averaged over the period 1960-1989 and thus is a good predictor of the mentioned growth indicators. These findings, however, might be of weak importance because as Levine (1997, p.708) notes 'financial development may predict growth simply because financial systems develop in anticipation of future economic growth'.

Rousseau and Sylla (2001) investigate relationship between real and financial sectors employing data for seventeen countries over the period 1850-1997. They use real per capita growth as a dependant variable and a set of following explanatory variables: financial debt measured by the ratio of the broadest available monetary aggregate to output; participation in international trade measured as trade volume GDP ratio; and the ratio between government expenditure and GDP. To meliorate the impact of possible reverse causality from growth to additional finance the authors include initial values of the complete set of regressors as well as inflation as instruments. The results presented in the paper support the hypothesis that financial development is likely to contribute to the long-run growth. However, as the authors conclude, more investigation is needed to be highly confident that good financial system is a key ingredient in sustained economic growth.

The review presented above suggests that real activity and financial development is closely and robustly associated and that causal direction is likely to be from finances to growth. On the other hand both theoretical investigations and empirical evidences suggest that there is significant negative correlation between growth and inflation. Thus, there is a good reason to think that the growth-inflation link is intermediated by financial sector. In this light it is not surprisingly that over the recent times particular attention has been paid to the relationship between financial development and inflation.

Boyd, Levine, and Smith (1996) addressed this issue using the data on 119 countries over the period 1960-1989. They examine both linear and nonlinear relationship between financial progress and the rate of inflation. The measure of the former comprises: (a) financial sector lending to the private sector, (b) the quantity of bank liabilities issued, and (c) stock market liquidity and trading volume. The authors find that at moderate rates of inflation, there is a strong negative association between financial development and inflation. However, 'once inflation exceeds some 'critical level' there is - on average – a discrete decline in the amount of banking and equity market activity.' (Boyd, Levine, and Smith 1996, p.23). Further increase in inflation, as noted, is not accompanied by substantial fall in financial activity. So, the main feature of the financial development inflation nexus is apparent relationship non-linearities.

Boyd, Choi, and Smith (1996) provide some theoretical basis for the empirically observed non-linearities in the financial progress inflation relationship. They develop simple and interesting model relating economic growth financial development and inflation. In this model 'inflation reduces real returns to savings and, via this mechanism, exacerbates an informational friction afflicting the financial system' (Boyd, Choi, and Smith, 1996, p.13). Enhancing informational friction in turn leads to more severe credit rationing, lower investment and depressed long-run real activity. An interesting result of the model is that mentioned frictions may not be crucial at very low rates of inflation and, therefore, a slight rise of initially low inflation may cause no harm to investment activity and thus real growth.

Theoretical findings of the above authors laid the basis for the research conducted by Khan, Senhadji, and Smith (2001). They use financial depth as a proxy for the degree of financial development and hypothesize that there might be several factors affecting financial activity. Among them there are GDP per capita, the degree of openness, the share of public consumption in GDP, and inflation rate. Financial depth (*fd*) is measured by the following alternative indicators: (i) fd_1 – defined as domestic credit as a share of GDP; (ii) fd_2 – defined as fd_1 plus stock market capitalization as a share of GDP; and (iii) fd_3 defined as fd_2 plus private and public bond market capitalization as a share of GDP. Similarly as in the case of monetary aggregates financial depth measures here range from narrowly defined to widely defined indicators. This is very useful because different measures allow determining best responders to inflation shocks. The authors construct econometric specifications explicitly allowing for inflation threshold effects and test is utilizing the data on 168 countries over the period 1960-1999. Their findings support hypothesis that a rise in inflation has a weak positive effect when initial rate of inflation is low and a negative effect at initially high inflation. In particular, the authors find that threshold rates of inflation lie in the range 3-6 percent a year depending on the specific measure of financial depth that is used.

Barnes (2001) extends the study on the financial development inflation nexus. He adds a third component of the story (economic growth) and estimates threshold relationships among inflation, financial market development and growth. He finds that this trivariate relationship changes across inflation threshold of about 14%. In particular, author's findings are that below 14% the relationship between growth financial market development is positive, while above this rate no significant relationship was found; below 14%, the relationship between growth and inflation is positive, and above - negative. Financial development – inflation interaction term was found to have an interesting impact on growth. The results suggest that below the threshold level of inflation marginal increase in inflation diminishes the positive partial correlation between growth and financial market development, while above the threshold, marginal increases in inflation either increase or have no effect on the mentioned partial correlation.

Chapter 3

THE THEORY OF FINANCIAL DEPTH INFLATION NEXUS

At the first sight understanding the effect of higher inflation on financial depth seems to be an easy task. Really, it can be argued that the plausible mechanism through which higher inflation depresses financial system is that of inflation impact on savings.

Both theoretical and empirical evidences suggest that higher inflation reduces the rate of return received by savers[3]. For example, Khan, Senhadji, and Smith (2001, p.7) note that:

> In any economy, some agents hold real money balances either voluntary or involuntary. For instance, the banking system of virtually any economy holds a significant quantity of non-interest-bearing cash reserves. As is well understood, higher rates of inflation act like a tax on real balances or bank reserves. And, if this tax is borne, at least in part, by bank depositors, higher inflation must lead to lower real returns on bank deposits. Since bank deposits compete with a variety of assets, it is plausible that reduced real returns on bank deposits will result in reduced real returns on a variety of assets.

In other words, higher rates of inflation make more costly holding required reserves. For the bank the latter is equivalent to more costs incurred when attracting additional external funds. Therefore, banks try to reduce these costs and lower real price they pay to depositors.

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[3] In **Appendix A** we present a simple scatter plot of the real interest rate vs. the rate of inflation for transition economies.

Another reason, which may entail negative relationship between the rate of inflation and the rate of return, is nominal interest rate rigidity caused by regulatory measures. In transition economies banks are often restricted by monetary authorities to increase interest rates as the rate of inflation goes up. For example, Feldstein (2002) notes that central banks usually discourage commercial banks to increase nominal interest rate since higher interest rates are often seen as impeding growth. Kosse (2002) investigates the relationship between nominal interest rates and rates of inflation in Ukraine and finds a high degree of nominal interest rate rigidity attributed mainly to the to the administrative measures. Therefore, in this case, the rise in the rate of inflation automatically leads to the fall in the rate of return received by savers.

Whatever the reason of lower real interest rates at higher rates of inflation, a fall in returns may lead to the outflow of funds from the financial system and hence, to lower availability of investment capital. The latter limits the quantity of credits granted by financial system, depresses activity in financial markets and thus, lowers financial depth:

$$\pi \uparrow \Rightarrow i \uparrow \Rightarrow r \downarrow \Rightarrow C \downarrow \Rightarrow FD \downarrow$$

where π – inflation rate

i – nominal interest rate

r – real rate of return;

C – the amount of credit granted;

FD – financial depth.

The above explanation by itself, as noted by Boyd, Levine, and Smith (1996), might not be plausible for two reasons. First, empirically observed non-monotonicities and inflation thresholds require savings function to be bent backward. There are little or no evidences on support of this notion. Second, most of empirical evidence suggests that savings is almost inelastic to rates of return[4]. Thus, investment potential of the financial system is not likely to suffer from any detriment caused by lower rates of return received by savers.

Boyd, Levine, and Smith (1996, p.23) suggest the following chain through which higher inflation affects financial system and consequently long-run growth:

> …higher rates of inflation reduce savers' real rates of return and lower the real rates of interest that borrowers pay. By itself, this effect makes more people want to be borrowers and fewer people want to be savers. However, people who were not initially getting credit represent "lower quality borrowers" or, in other words, higher default risks. Investors will be uninterested in making more loans to lower quality borrowers at lower rates of interest and therefore must do something to keep them from seeking external finance. The specific response here is that makes ration credit, and more severe rationing accompanies higher inflation. This rationing then limits the availability of investment capital and reduces the long-run level of real activity.

In other words, higher inflation reduces financial depth due to ever-worsening endogenous frictions arising in the process of allocating credit and capital. Putting this statement in a more simple way, higher inflation depresses financial depth because as inflation rises financial institutions incur more costs to select "higher quality borrowers" out of those applying for loans. So, the transmitting mechanism through which higher inflation affects financial depth and thus growth can be described by the following way:

$$\pi \uparrow \Rightarrow r \downarrow \Rightarrow AS \uparrow \Rightarrow CR \uparrow \Rightarrow C(FD) \downarrow \Rightarrow I \downarrow \Rightarrow g \downarrow$$

where π – inflation rate;

[4] This observation and further conclusions might not be valid for transition economies where swings in the rate of inflation and thus, in the real interest rate were so large that it is doubtful them not to affect savings in an important way, for example see Feldstein (2002).

r – real rate of return;

AS – adverse selection;

CR – credit rationing;

C – the amount of credit granted;

FD – financial depth;

I – investment;

g – growth.

Besides the reasoning of Boyd, Levine, and Smith (1996) we think that there might be one more cause of more severe credit rationing at higher rates of inflation. Ball (1992), Ball and Mankiw (1995) hypothesise that higher inflation necessarily raises inflation uncertainty[5]. Higher inflation uncertainty increases the riskiness of all credits and therefore even previously 'high quality borrowers' get treated as the risky ones. To assure that credits are paid back banks may resort to more severe credit rationing.

The mechanism just described explains why higher inflation may adversely affect financial depth and consequently long-run activity. Still there is one point to be clarified. As we noted above inflation need not reduce financial depth along the whole inflation scale, therefore, we have to account for this possibility.

Boyd, Levine, and Smith (1996) argue that at sufficiently low rates of inflation the adverse selection problem in credit markets is likely not to bind. In terms of "lower quality borrowers" and "higher quality borrowers" (or "natural borrowers" and "natural lenders " as Khan, Senhadji, and Smith (2001) call them) this means that low inflation rates and consequently high rates of return induce each type of borrowers to self-select. That is under sufficiently low inflation only "natural

[5] Bakun (2002) tests and confirms this hypothesis on the basis of Ukrainian data.

borrowers" are likely to apply for credits. Furthermore, because of high real rates of return some part of "natural borrowers" find it more attractive to take advantage of high rates of return and decide not to invest their own as well as potentially borrowed funds into efficient productive projects. If that is the case, then a slight rise in the rate of inflation induces "improperly behaving" "natural borrowers" to substitute away from cash into investments in physical or human capital and thus, promote growth:

$$\pi \uparrow \Rightarrow r \downarrow \Rightarrow C(FD) \uparrow \Rightarrow I \uparrow \Rightarrow g \uparrow$$

Here we use the same notation as in the above schemes.

Stiglitz and Weiss (1983) set a different adverse selection framework. In the model they develop adverse selection problem becomes more severe as real interest rates go up. Since high return projects are usually more risky then low return ones, a rise in real interest rates induces low risky investors to give up investment opportunities and not to apply for a loan. In other words, a pool of borrowers applying for loans becomes more risky as interest rates go up. Banks want to do loans only to the low risky borrowers and therefore resort to borrowers screening via credit rationing. Although credit rationing becomes more severe as interest rates go up, this does not mean that this phenomenon persists throughout the whole range of interest rates. According to the framework of the authors at low interest rates risky borrowers will constitute only a small share of those applying for loans. Therefore, given these conditions, credit rationing either will not exist at all or will not be substantial for financial activity[6]

Summarizing, theory suggests that inflation may have different impact on financial depth depending on whether initial rate of inflation is high or low. A rise

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[6] More on credit rationing see Poltavets (2002).

of initially low inflation may not lead to detrimental consequences for financial activity, whereas a rise in the rate of inflation that is initially high, may substantially depress activity on financial markets and entail reduction in financial depth:

$$\pi \uparrow \Rightarrow FD \uparrow, \quad if \pi \leq \pi *$$

$$\pi \uparrow \Rightarrow FD \downarrow, \quad if \pi > \pi *$$

where π^* – inflation threshold

FD – financial depth.

In other words, there should be some threshold rate of inflation, which is most desirable for financial activity and thus may serve as a policy target for the government.

C h a p t e r   4

DATA DESCRIPTION AND COMPUTATIONAL ISSUES

To carry out estimation procedure of the relationship between financial depth and inflation we employ annual data on sixteen transition economies from 1994 to 2000. In general, preceding data information and more broad countries sample are not used for the reason of data scarcity. Because data on transition economies is more available for later periods of transition we faced a tradeoff between countries sample and the data period. The employed estimation procedure requires balanced panel and, therefore, utilizing broader countries sample can be realized only at the cost of shorter data period and visa verse. Thus, we selected the combination of countries sample and data period so that to have data as rich as possible[7].

We use two data sources: latest issues of *'International Financial Statistics'* as well as the World Bank's *'World Development Indicators'*.

To address the issue of financial development measurement we use two indicators of financial depth:

- the ratio between the volume of domestic credit to private sector and GDP (FD1);
- the ratio of broad money (M2) to GDP (FD2).

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[7] We use data on the following transition economies: Armenia, Belarus, Czech Republic, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, Macedonia, Moldova, Poland, Romania, Russia, Slovakia, Slovenia, Ukraine.

The former measure indicates on how attractive and available financial institutions are for home borrowers. As we noted above, more developed financial system provides better services, in particular it offers more attractive terms of credit contract (i.e. lower interest rates, longer credit terms and so on). Therefore, other things being equal, more developed financial system is accompanied by higher relative amount of granted credit which is the ratio between the volume of credit and GDP

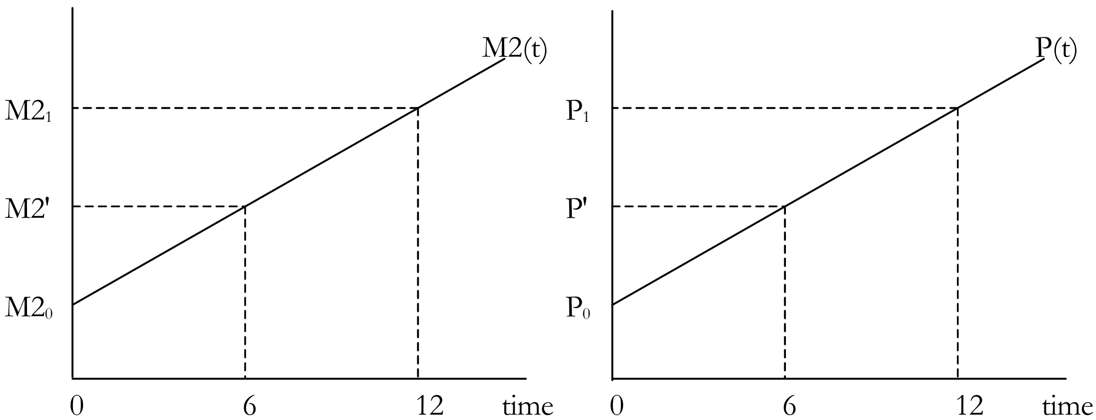
In the latter measure of financial depth broad money supply includes all types of deposits. Like in the previous case, more developed financial system offers better terms for depositors and therefore accumulates larger amount of external funds. Also, more developed financial system improves channelling free funds within the system itself. For example, a bank with free excessive reserves becomes able to lend funds more quickly and easily to the bank with liquidity need. This improvement is also reflected in higher broad money supply.

It is widely recognized that transition economies are characterised by high and very high inflation. We argue that under such conditions conventional technique of computation may entail undesirable distortion in financial depth. This distortion may arise due to ever-increasing divergence in the unit of measurement of financial depth components as the rate of inflation goes up. As an example, let us consider the second measure of financial depth (M2/GDP). In this measure both M2 and GDP are expressed in current prices. However under high and very high inflation these prices are substantially different! M2 is a stock indicator. Therefore, it is correct to say that M2 is expressed in prices which are valid at the end of a year. GDP is a flow indicator. Annual GDP is the sum of corresponding sub period quantities (for example, monthly quantities). Therefore, GDP is expressed in prices of approximately the middle of a year. Under high and very high inflation prices at the middle and at the end of a year are substantially different, and this difference increases as the rate of inflation goes up and decreases as it goes down. Putting it differently, M2 price level grows faster relative to the price level of GDP as the rate of inflation goes up. Therefore, a sharp increase in the rate of inflation automatically leads to the illusive rise in financial depth even though real indicators might stay unchanged. This also means that under high and very high inflation the rate of inflation threshold can be easily overestimated and hence, lead to wrong conclusions and policy implications.

To correct for the just described distortion in the measurement of the ratio between stock and flow indicators Yushchenko et al. (1998) and Kulyk (2000) propose to use the average value of the stock indicator. For example, a pretty good computational technique is to use the average of corresponding monthly values of the stock variable.

Unfortunately data scarcity does not allow us to use directly either this technique or the technique based on real indicators. Instead we think that a good approximation can be obtained by using the average of annual values of the stock variable. The **Figure 1** illustrates the case when the nominal value of M2 increases over time by the pace of the price level (rising linearly), while the real M2 value stays unchanged. Numbers on the horizontal axes of the diagram denote months (0 – the end of the previous year, 6 and 12 correspondingly – the middle and the end of the current year). By the same token, $M2_0$, $M2'$, $M2_1$ and P_0 , P' , P_1 denote indicators at the end of the previous year, at the middle and at the end of the current year correspondingly. It is apparent that M2 in prices of the middle of the current year can be obtained simply by taking the average of the values at the end of the previous and the current year. Of course, the case illustrated in the figure is not likely to happen in real economies, but even so just described technique seems to be pretty good to correct for inflation distortion and therefore we will use it in addition to the standard technique[8].

Figure 1. Dynamics of M2 and P



Khan et al. (2001) hypothesise that besides inflation financial depth may be affected by several other indicators. Therefore, to control for these effects we also use the set of following variables:

- The degree of openness;
- The degree of financial suppression;
- The measure of real activity.

The degree of openness is defined as the ratio between the volume of trade flow (export plus import) and GDP. Openness to the world in international trade may

[8] This technique will be applied to the M2/GDP measure of financial depth only. Taking the ratio between the volume of domestic credit to private sector and GDP seems not to entail such a problem.

promote openness in financial sector. The latter in turn facilitates financial development and enhances financial depth.

The degree of financial suppression is defined as the share of government consumption in GDP. We presume that higher level of government consumption implies more severe tax burden born by economic agents and thus, by financial sector. Also higher level of government consumption financed through issuing additional government bonds may crowd out private investment and discourage financial development. Hence, higher level of government consumption is likely to reduce financial depth.

The measure of real activity is defined as real GDP per capita in 1987 PPP prices. We presume that higher real activity or real income may result in more than proportional rise in the necessity for financial services. Also, Khan et al. (2001) note that real GDP per capita is a good proxy for a variety of other variables which may affect financial depth. That is why we included this variable as well.

MODEL SPECIFICATION AND ESTIMATION TECHNIQUE

To test for the existence of a threshold effect we use the model similar to that presented by Khan, Senhadji, and Smith (2001):

$$FD_{it} = \gamma_1 \left(1 - d_{it}^{\pi^*}\right)\left(1/\pi_{it} - 1/\pi^*\right) + \gamma_2 d_{it}^{\pi^*}\left(1/\pi_{it} - 1/\pi^*\right) + \theta' X_{it} + e_{it} \quad (1)$$

$$d_{it}^{\pi^*} = \begin{cases} 1 & if \quad \pi_{it} > \pi^* \\ 0 & if \quad \pi_{it} \le \pi^* \end{cases} \qquad i = 1,\ldots,N \quad t = 1,\ldots,T$$

In the model FD_i is one of the measures of financial depth, π_{it} is inflation based on the CPI index, π^* is the threshold level of inflation, $d_{it}^{\pi^*}$ is a dummy variable that takes the value of one for inflation level grater than π^* and zero otherwise, X_{it} is a vector of other control variables: the degree of openness, the degree of financial repression, log of GDP per capita, and dummy for former Soviet Union countries.

Inflation enters the model in inverse form in order to capture convex relationship that has been suggested above. Depending on the actual rate of inflation one of the first two terms in the model specification is omitted in order to allow for thresholds effects. When the rate of inflation is below the expected threshold the model estimates γ_1. Similarly, when the rate of inflation is above the expected threshold the model estimates γ_2. We expect to obtain an estimation such that $\gamma_1<0$ and $\gamma_2>0$. Such values of γ_1 and γ_2 allow inflation to enhance financial depth when $\pi_{it} < \pi^*$ and reduce it when $\pi_{it} > \pi^*$.

As a matter of fact, utilizing an inverse form of inflation implies hyperbolic relationship between FD and π. Unfortunately hyperbolic relationship in the pure form entails discontinuity at the threshold level. To fix this problem we subtract $1/\pi^*$ from $1/\pi_{it}$. Such transformation assures that the relationship between financial depth and inflation is continuous for all positive π. Besides the point of threshold there is a point of zero inflation where the relationship suffers from discontinuity. However, as Khan et al. (2001, p.12) note, zero and negative inflation is rather a rare and unique phenomenon[9] and therefore is not likely to affect final outcome significantly. Specifically either utilizing logistic form of the relationship between financial depth and inflation which is continues everywhere or excluding observations with negative inflation yield results very close to those from the main specification.

If we knew π^* the model could be easily estimated by least squares[10]. Since the threshold is unknown it should be estimated in addition to other parameters. Khan et al. (2001, p.12) note that financial depth, as a function of inflation is nonlinear and non-differentiable in π^*. Therefore, gradient search technique cannot be applied for this model. Chan (1993) and Hansen (1997) recommend estimating threshold parameters by least squares. The easiest way to implement this procedure is through minimization of the sum of squared residuals as a function of expected threshold value. Hence the least-squares estimator of π^* is

$$\pi^* = \arg\min_{\pi} \left[S_1(\pi) \right]$$

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[9] Specifically, among observations we employ there are only two cases with negative inflation and no observation with zero rate of inflation.

[10] Toro-Vizcarrondo and Wallace (1968) argue that one may prefer restricted estimators and accept some bias in trade for a reduction in variance.

In general, the search range for the inflation threshold is confined by the lowest and the highest rates of inflation. However, Hansen (2000, p.6) notes that it is undesirable for a threshold to be selected in the tails of the corresponding distribution. Even more, the threshold search range may be confined by the region where we do expect the threshold should be. Therefore, we confine the search range by the inflation interval of [1%, 100%] with an increment of $\Delta\pi^*=0.1\%$. In other words, we will search inflation threshold among the following values of π^*: {1.0%, 1.1%, 1.2%,…, 100%}.[11]

Having estimated the threshold of inflation it is important to determine whether the estimate is statistically significant. Unfortunately, as Hansen (2000, p.6) notes, under the hull hypothesis of no threshold ($\gamma_1=\gamma_2$) classical tests have non-standard distributions and therefore are not appropriate for econometric inferences. This problem has been recently investigated by Hansen (1996, 2000). He suggests a bootstrap technique to simulate the empirical distribution of the following likelihood ratio test:

$$LR_0 = \frac{S_0 - S_1(\pi^*)}{\sigma^2}$$

where S_0 and $S_1(\pi^*)$ are the sums of squared residuals (SSR) under H_0: $\gamma_1=\gamma_2$, and H_1: $\gamma_1\neq\gamma_2$ respectively; and σ^2 is the residual variance under H_1. In other words S_0 is SSR without a threshold effect and $S_1(\pi^*)$ - SSR with a threshold effect of the equation (1).

In the context of a panel Hansen (2000, p. 6) recommends the following technique:

---

[11] In **Appendix C1** we present Eviews program that makes such estimation.

- draw (with replacement) a sample of size n out of the original distribution so that each individual (in our case each country) would represent one observation;
- using this sample estimate the model under H_0 and H_1;
- calculate the bootstrap value of the likelihood ration statistic;
- repeat this procedure a large number of times;
- calculate the percentage of draws for which the simulated statistics exceeds the actual one.

This bootstrap procedure attains the first-order asymptotic distribution[12]. Therefore, the last step yields a p-value which is asymptotically valid. To carry out bootstrapping procedure we composed an Eviews program which is represented in the **Appendix C2**.

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[12] Hansen (1996)

Chapter 6

ESTIMATION RESULTS

For each measure of FD we run 990 regressions to estimate the value at which inflation becomes detrimental for financial depth. Corresponding sums of squared residuals as a function of expected inflation threshold are depicted in **Appendix D**. Threshold estimation for FD1 yields π*=9.1%. The same estimate for FD2 and FD2avr yield π*=9.9% and 10% correspondingly. Bootstrap estimation for the significance of threshold estimates yields very small p-values. So each threshold estimate is significant at 1%.

Then each specification was re-estimated with corresponding threshold. Extended estimation results are reported in **Appendix F1**. The summary of estimation statistics is reported in the **Table 1** below.

Table 1. Estimation summary

Variable	FD1	FD2	FD2avr
Gamma1	-0.038863	-0.094959**	-0.075204**
Gamma2	1.094570***	1.204808***	1.280580***
Fin_rep	-0.234651	-0.142462	-0.216906
Logpppgdp	0.035798***	0.051204***	0.045538***
Openness	0.050770**	0.052686	0.065162**
Dum_FSU	-0.090551***	-0.142079***	-0.138097***
π*	9.1%***	9.9%***	10%***
R^2	0.49	0.47	0.55

Note: * - significant at 10%
** - significant at 5%
*** - significant at 1%

Above estimates may suffer from endogeneity problem. Therefore, the model was also re-estimated using first lags as instrumental variables[13]. Extended estimation results with instruments are reported in **Appendix F2**. The summary of estimation statistics is reported in the Table 2 below.

Table 2. Estimation summary (with instruments)

Variable	FD1	FD2	FD2avr
Gamma1	-0.032129	-0.081421	-0.083152**
Gamma2	1.381914***	1.573300***	1.664510***
Fin_rep	-0.229884	-0.180670	-0.213192
Logpppgdp	0.036112***	0.052679***	0.049865***
Openness	0.045199*	0.046895	0.042026
Dum_FSU	-0.086176***	-0.131077***	-0.120417***
π*	9.9%***	10.5%***	10.5%***
R^2	0.52	0.47	0.58

Note: * - significant at 10%
** - significant at 5%
*** - significant at 1%

As we can clearly see from the **Table 1**, the results strongly support the hypothesis about the existence of threshold effects. Coefficients on Gamma1 for each estimation mean that inflation growing at rates below 9.1% (FD1) or 9.9% (FD2) is not detrimental for financial activity. Even more, the negative sign of the coefficients provides a week support on the theoretical prediction that a rise in the inflation rates may even enhance financial activity. However, the coefficients

13 Khan et al. (2001) argue that lagged variables are a good choice as instruments. Barro (1991) suggests using first lag of inflation.

are small and not statistically significant, that is why we speak about the week support. On the other hand insignificance of those coefficient is not crucial. What is crucial is that the coefficients on Gamma2 are all positive, large and highly statistically significant. This implies that once the rate of inflation exceeds specified thresholds the relationship between financial depth and inflation becomes robustly negative[14].

Other variables besides inflation provide us with expected results. We found that more severe financial suppression depresses financial depth. The coefficient for FD2, however, is not statistically significant. Openness to international trade has a slight positive impact on financial sector. The growth in the log of pppgdp per capita also positively affects financial development. The coefficient is very small though of high statistical significance.

Estimation with instrumental variables yields slightly higher threshold estimates (9.9% - 10.5%). The estimates however are also highly statistically significant. The rest of the results are similar to the original one. Thus, all previous comments apply to this estimation as well.

[14] **Appendix E** presents the effect of inflation on financial depth based on estimated coefficients.

C h a p t e r 7

CONCLUSION

The research conducted in this paper supports the hypothesis about the existence of non-linearities and non-monotonicities in the relationship between financial depth and inflation. Putting it differently, there are inflation thresholds which determine the direction of the inflation effect on financial depth.

Specifically the finding is that a rise in the rate of inflation, which is initially lower than 9% -10.5%, is not detrimental for financial depth. However, once the rate of inflation starts growing faster, financial activity is going to be substantially harmed by higher inflation.

Thus, the found inflation thresholds may be considered as the optimum inflation rates and therefore may be selected as a policy target by policy makers.

WORKS CITED

Bakun, Oleksiy. *Price Variability, Inflation and Uncertainty: Evidence from Ukraine,* EERC Master Thesis, NaUKMA, 2002.

Ball, L and G. Mankiw. *Relative-Price Changes as Aggregate Supply Shocks,* **Quarterly Journal of Economics,** 1995, pp.161-193.

Baltensperger, Ernst, *Credit Rationing: Issues and Questions*, **Journal of Money, Credit and Banking**, 1978, vol.10, No 2 pp. 170-183

Barnes, Michelle L. *Threshold Relationships Among Inflation, Financial Market Development and Growth*, http://www.economics.adelaide.edu.au/mbarnes/tpg-294.pdf

Barro, Robert, *Why Does High Inflation Raise Inflation Uncertainty?* **Journal of Monetary Economics**, Vol.29, No. 3, 1991, pp.371-388.

Boyd, John H.,. Ross Levine, and Bruce D. Smith. *Inflation and Financial Market Performance*, Federal Reserve Bank of Minneapolis, **Working Paper 573D**, October 1996.

Boyd, John H.,. Sangmok Choi, and Bruce D. Smith. *Inflation, Financial Markets, and Capital Formation,* **Federal Bank of St. Louis Review**, Vol.11, May/June 1996.

Bruno, Michael and William Easterly, 1998, *Inflation Crisis and Long-Run Growth*, **Journal of Monetary Economics**, Vol.41, February, pp.3-26.

Chan, K.S, *Consistency and Limiting Distribution of the Least Squares estimator of a Threshold autoregressive model*, **The Annals of Statistics**, 21, p.520-533.

Feldstein, Martin. *Economic and Financial Crises in Emerging Market Economies: Overview of Prevention and Management,* *http://www.nber.org/papers/w8837.pdf*

Greene, William H. *Econometric Analysis*, 4th edition, 2000.

Goldsmith, Raymond, W. *Financial Structure and Development.* New Haven, CT: Yale University Press, 1969.

Gurley, John G., and Edward S. Shaw. *Financial Aspects of Economic Development,* **American Economic Review,** vol. 65, 1955.

Hansen, Bruce. *Inference When a Nuisance Parameter is not Identified Under the Hull Hypothesis*, **Econometrica**, 64, pp.413-430

Hansen, Bruce. *Threshold Effects in Non-Dynamic Panels: Estimation, Testing, and Inference.* **Journal of Econometrics,** Vol.93, No.2, 1999.

Hansen, Bruce. *Sample Splitting and Threshold Estimation.* http://fmwww.bc.edu/EC-P/WP319.pdf

Khan, Mohsin S., and Abdelhak Senhadji, 2000, *Threshold Effects in the Relationship Between Inflation and Growth*, **IMF Working Paper WP/00/110.**

Khan, Mohsin S., Abdelhak Senhadji, and Bruce D. Smith. *Inflation and Financial Depth,* **IMF Working Paper WP/01/44.**

King, Robert G., and Ross Levine. *Finance, Entrepreneurship, and Growth: Theory and Evidence,* **Journal of Monetary Economics,** Vol.32, 1993a.

King, Robert G., and Ross Levine. Finance and Growth: *Schumpeter Might be Right*, **Quarterly Journal of Economics**, August 1993b, 108(3), p.717-737.

Kosse, Volodymyr. *Interest Rates and Their Role in the Economy During Transition. The Problem of High Interest Rates. Case of Ukraine,* EERC Master Thesis, NaUKMA, 2002.

Kulyk, Andriy, *The Coefficient of GDP Monetization: How much Money Does Ukraine Need*, Bachelor Thesis, NaUKMA, 2000.

Levine, Ross. *Financial Development and Economic Growth,* **Journal of Economic Literature,** Vol.35, No.2, 1997.

Poltavets, Ivan. *Significance of Credit Ration in Ukraine*, EERC Master Thesis, NaUKMA, 2002.

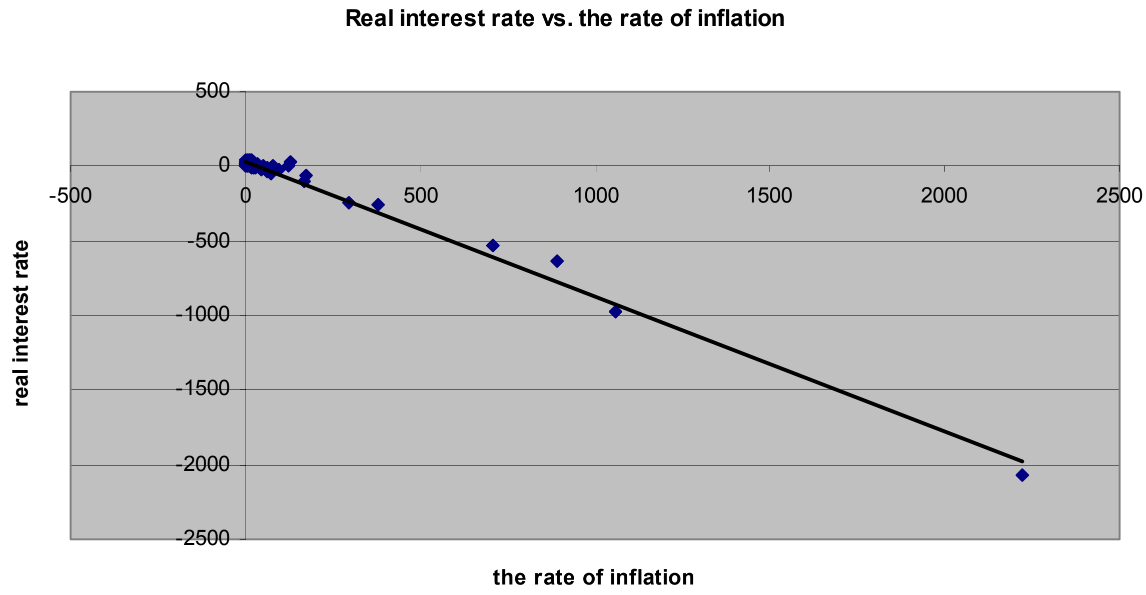
Romer David. *Advanced Macroeconomics*, 2nd edition, 2001

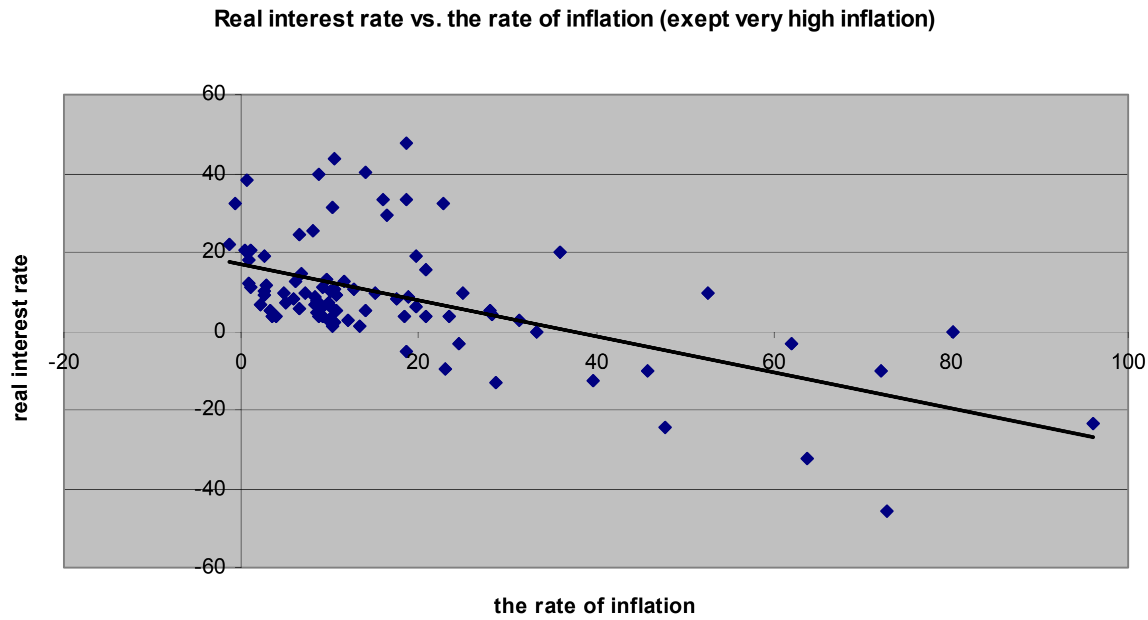
Rousseau, Peter L., Sylla, Richard. *Financial Systems, Economic Growth, and Globalization*, unpublished.

Toro-Vizcarrondo, Carlos, and Wallace, T. D. *A Test of the Mean Square Error Criterion for Restrictions in Linear Regression*, **Journal of the American Statistical Association**, 63 (1968), 558-572.

Yushchenko, Victor, and Lysytski, Victor, *The Development of Money Demand and Money Supply in Ukraine*, Skarby Print, 1998.

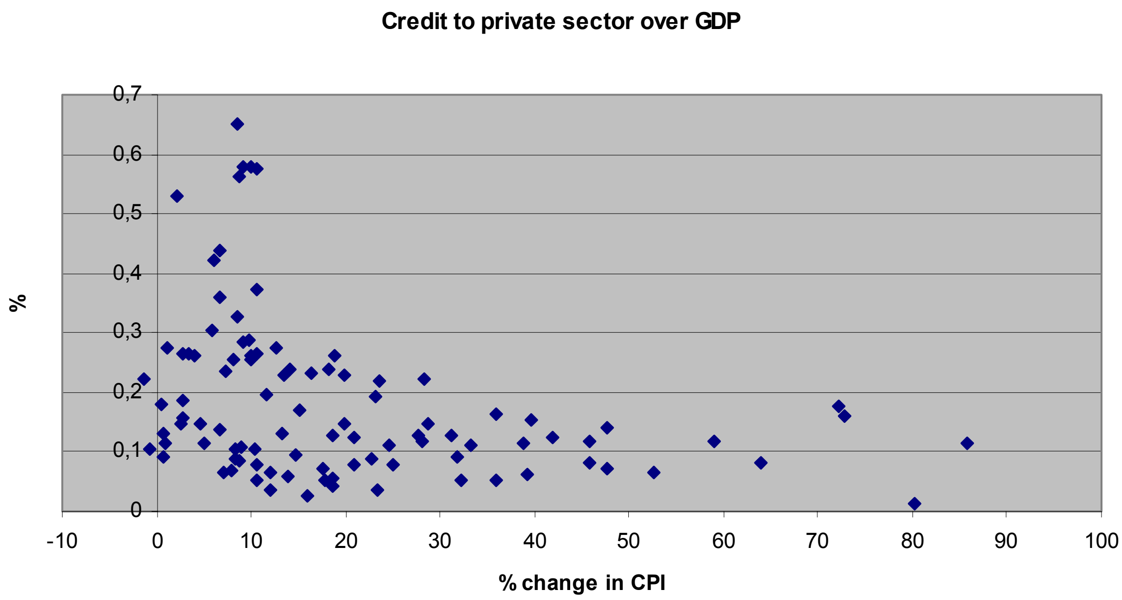
Appendix A. **Real interest rate vs. the rate of inflation in transition economies**

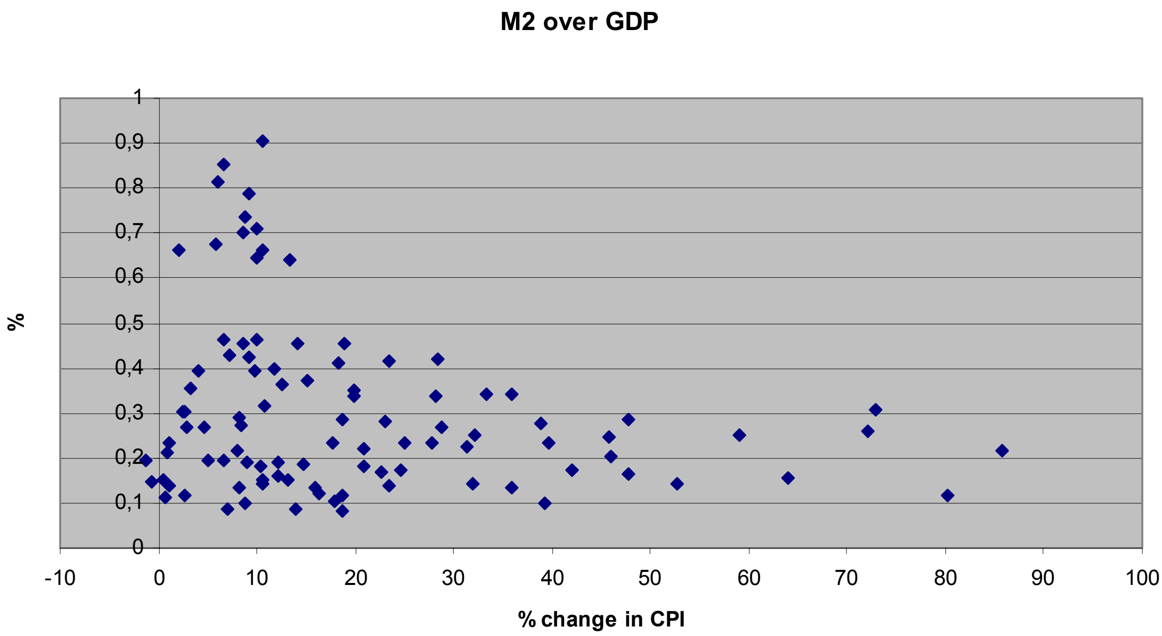




Note: The data comprise the period of 1994 – 2000 across 16 transition economies: Armenia, Belarus, Czech Republic, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, Macedonia, Moldova, Poland, Romania, Russia, Slovakia, Slovenia, Ukraine.
Source: *International Financial Statistics* (IMF), *World Development Indicators* (World Bank).

Appendix B. Financial depth vs. inflation in transition economies





Note: The data comprise the period of 1994 – 2000 across 16 transition economies: Armenia, Belarus, Czech Republic, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, Macedonia, Moldova, Poland, Romania, Russia, Slovakia, Slovenia, Ukraine. Observations with very high inflation (over 100%) are excluded in order not to distort measurement scale.

Source: *International Financial Statistics* (IMF), *World Development Indicators* (World Bank).

Appendix C1.

Eviews Program that computes LS estimate of the inflation threshold

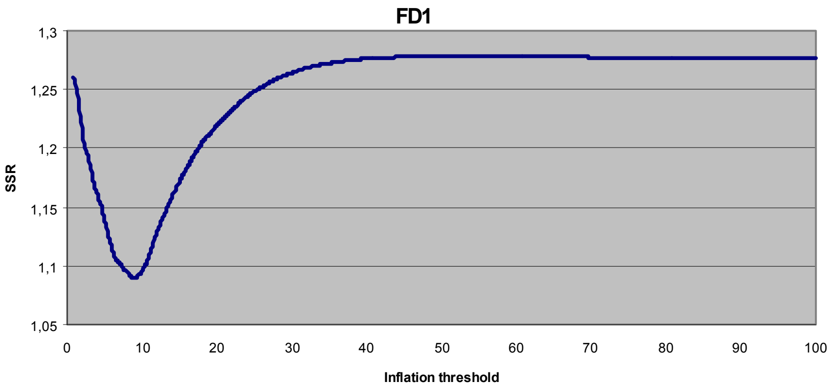
```
delete all_av
pool all_av
all_av.add _ARM _BLR _CZ _EST _HNG _KAZ  _LAT _LIT _MAC _MLD
_POL _ROM _RUS _SLV _SLN _UKR
   all_av.genr dum?=0
   all_av.genr unit?=1
vector(1000) ssrvec
for !j=0.1 to 100 step 0.1
  all_av.genr threshold?=!j
  all_av.genr dummy?=@recode(dum?, pi?>!j,1)
     all_av.genr gama1?=(unit?-dummy?)*(1/pi?-1/threshold?)
     all_av.genr gama2?=dummy?*(1/pi?-1/threshold?)
        all_av.ls(n) fd2? gama1? gama2? fin_rep? logpppgdp? openess?
ssrvec(!j*10)= all_av.@ssr
next
ssrvec.line
```

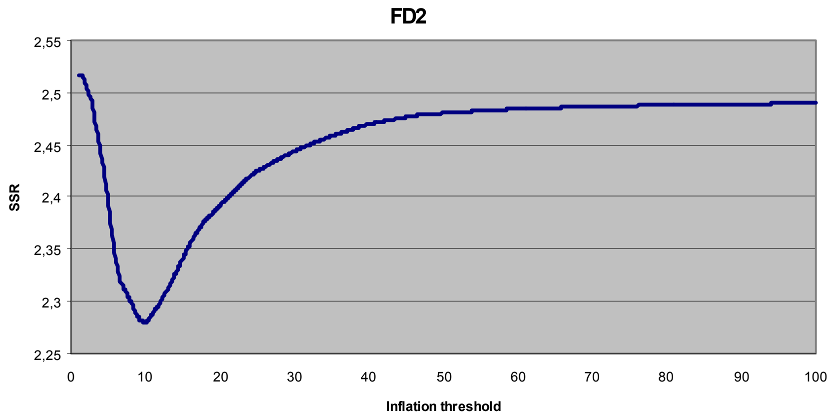
Appendix C2.

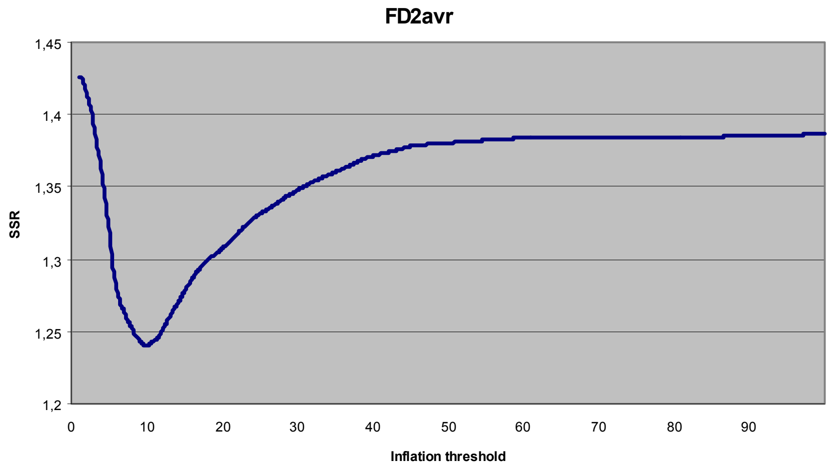
Eviews program simulating bootstrap LR test distribution

```
load transition_econ.wf1
!buf=0
!i=0
!p=0
all_av1.genr dummy?=@recode(dum?, pi?>%0,1)
     all_av1.genr gama1?=(unit?-dummy?)*(1/pi?-1/%0)
     all_av1.genr gama2?=dummy?*(1/pi?-1/%0)
         all_av1.ls(n) fd1? gama1? gama2? fin_rep? logpppgdp? openess?
all_av0.genr gama?=(1/pi?-1/%0)
     all_av0.ls(n) fd1? gama? fin_rep? logpppgdp? openess?
     !LR0=(all_av0.@ssr-all_av1.@ssr)/all_av1.@se^2
for !k=1 to 100
rowvector(1) w
for %co _ARM _BLR _CZ _EST _HNG _KAZ _LAT _LIT _MAC _MLD
_POL _ROM _RUS _SLV _SLN _UKR
     !i=!i+1
     rndint(w, 6)
     !rnddate=1994+w(1)
     for %ind fd1 gama1 gama2 fin_rep logpppgdp openess pi
          !buf=@elem({%ind}{%co}, @str(!rnddate))
       load boots_help.wf1
          {%ind}.fill(o=!i) !buf
          save
       close boots_help
     next
next
load boots_help.wf1
  equation H1.ls fd1 gama1 gama2 fin_rep logpppgdp openess
      genr gama=(1/pi-1/%0)
  equation H0.ls fd1 gama fin_rep pppgdp openess
     !LR1=(H0.@ssr-H1.@ssr)/H1.@se^2
if !LR0<!LR1 then !p=!p+0.001
endif
next
```

Appendix D. **The sum of squared residuals as a function of inflation threshold**

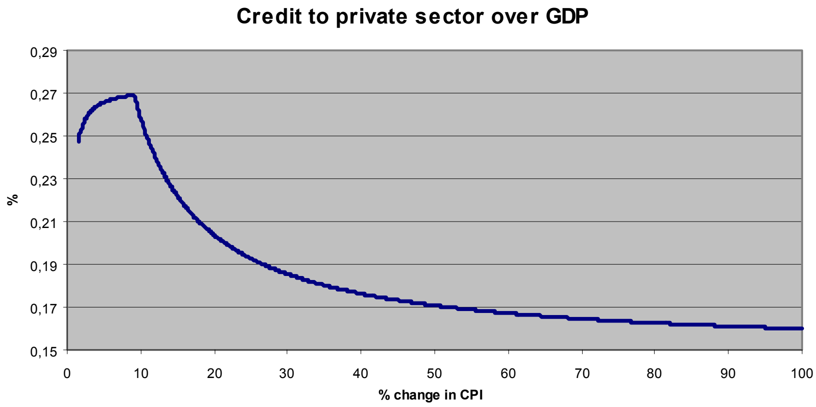


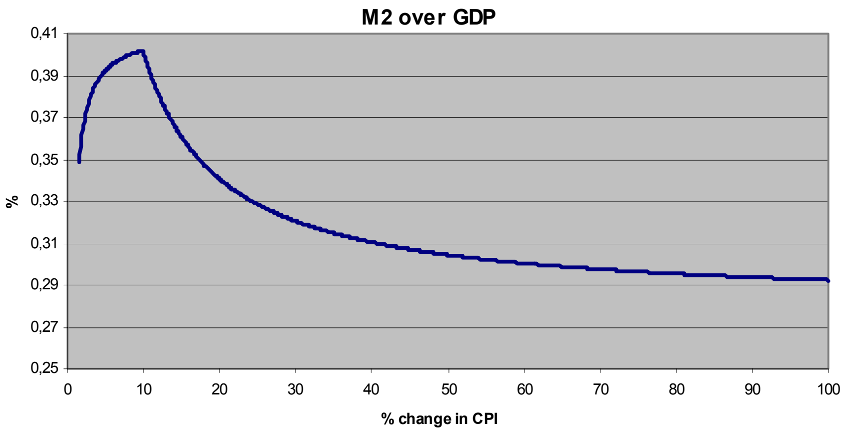


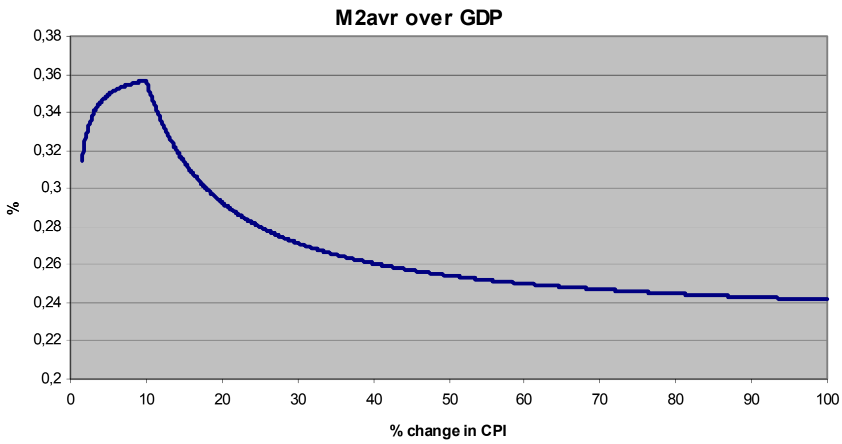


Note: The minimum of the SSR sequence determines the threshold estimate for each measure of financial depth.

Appendix E. Effect of Inflation on Financial Depth







Note: The effect of inflation on financial depth is shown on the basis of the coefficient estimates from the Table 1 and average values of other control variables.

Appendix F1.

Eviews estimation output

Dependent Variable: FD1
Method: Pooled Least Squares
Sample: 1994 2000
Included observations: 7
Total panel observations 112

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GAMMA1	-0.038863	0.030388	-1.278886	0.2037
GAMMA2	1.094570	0.258137	4.240275	0.0000
FIN_REP	-0.234651	0.227870	-1.029759	0.3055
LOGPPPGDP	0.035798	0.005625	6.364201	0.0000
OPEN	0.050770	0.025552	1.986949	0.0495
DUM_FSU	-0.090551	0.021610	-4.190322	0.0001
R-squared	0.487219	Prob(F-statistic)		0.0000000

Dependent Variable: FD2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GAMMA1	-0.094959	0.043758	-2.170088	0.0322
GAMMA2	1.204808	0.402629	2.992355	0.0034
FIN_REP	-0.142462	0.329334	-0.432576	0.6662
LOGPPPGDP	0.051204	0.008074	6.341598	0.0000
OPEN	0.052686	0.036977	1.424831	0.1571
DUM_FSU	-0.142079	0.031222	-4.550579	0.0000
R-squared	0.456992	Prob(F-statistic)		0.000000

Dependent Variable: FD2AVR

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GAMMA1	-0.075204	0.035380	-2.125604	0.0363
GAMMA2	1.280580	0.377889	3.388773	0.0010
FIN_REP	-0.216906	0.281232	-0.771272	0.4426
LOGPPPGDP	0.045538	0.006835	6.662274	0.0000
OPEN	0.065162	0.031043	2.099080	0.0386
DUM_FSU	-0.138097	0.027602	-5.003145	0.0000
R-squared	0.547624	Prob(F-statistic)		0.000000

Appendix F2.

Eviews estimation output (with instruments)

Dependent Variable: FD1
Method: Pooled Least Squares
Sample: 1994 2000
Included observations: 7
Total panel observations 112

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GAMMA1	-0.032129	0.035105	-0.915220	0.3622
GAMMA2	1.381914	0.268041	5.155609	0.0000
FIN_REP	-0.229884	0.219613	-1.046768	0.2976
LOGPPPGDP	0.036112	0.005391	6.698856	0.0000
OPEN	0.045199	0.024824	1.820804	0.0715
DUM_FSU	-0.086176	0.020405	-4.223311	0.0001
R-squared	0.518949	Prob(F-statistic)		0.000000

Dependent Variable: FD2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GAMMA1	-0.081421	0.051658	-1.576150	0.1180
GAMMA2	1.573300	0.421999	3.728211	0.0003
FIN_REP	-0.180670	0.324219	-0.557246	0.5785
LOGPPPGDP	0.052679	0.007944	6.631025	0.0000
OPEN	0.046895	0.036662	1.279133	0.2036
DUM_FSU	-0.131077	0.030143	-4.348525	0.0000
R-squared	0.469125	Prob(F-statistic)		0.000000

Dependent Variable: FD2AVR

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GAMMA1	-0.083152	0.041103	-2.022992	0.0461
GAMMA2	1.664510	0.367713	4.526651	0.0000
FIN_REP	-0.213192	0.269746	-0.790345	0.4314
LOGPPPGDP	0.049865	0.006750	7.387695	0.0000
OPEN	0.042026	0.030570	1.374725	0.1727
DUM_FSU	-0.120417	0.026431	-4.555953	0.0000
R-squared	0.577270	Prob(F-statistic)		0.000000