ISSN 1440-771X

MONASH University

Australia

Department of Econometrics
and Business Statistics

http://www.buseco.monash.edu.au/depts/ebs/pubs/wpapers/

Inflation, Financial Development and Growth in Transition Countries

Max Gillman and Mark N. Harris

November 2004

Working Paper 23/04

Inflation, Financial Development and Growth in Transition Countries*

Max Gillman
Central European University

Mark N. Harris
Monash University

October 2004

Abstract

The paper presents panel data evidence for 13 transition countries on inflation, financial development and growth. It contributes to the growth literature by showing that the transition countries conform to developed country evidence in particular with the strong negative effect of inflation on growth. It also contributes more evidence to the debate on the role of financial development. Once inflation and the investment rate are included in the model, a key measure of financial development no longer has a positive effect on growth, as some recent literature has found.

JEL Classification: C23, E44, O16, O42

Keywords: Transition, panel data, inflation, investment rate, financial depth, endogeneity

*We would like to thank Szilard Benk and Glenn Bunker for research assistance. Financial support from a Monash University Faculty Research Grant (Business and Economics 2004) no. B02002/1752095 is kindly acknowledged; and the first author also thanks Central European University for additional grant support.

1 Introduction

Levine's work on financial development (see King and Levine 1993, Levine 1997, Levine, Loayza, and Beck 2000) has brought a focus to what role it may play in economic growth, focusing mainly on developed countries. Growth has also been explained in terms of a negative effect from inflation. Gylfason and Herbertsson (2001) survey this literature; Judson and Orphanides (1996), Ghosh and Phillips (1998), and Khan and Senhadji (2001) document the negative inflation effect using panel techniques; and Barro (2001) and Gillman, Harris, and Matyas (2004) show this effect within the context of endogenous growth theory.

Bringing together financial development and inflation in explaining growth, Rousseau and Wachtel (2001) find a positive effect of financial development and a negative effect of inflation for a large data panel set. However Gillman and Harris (2003) include the investment rate as a proxy of the return to capital and find still a robust negative inflation effect, but an insignificant financial development effect, despite using Levine, Loayza, and Beck's (2000) data set the financial development measures. Here a secondary role for financial development, in affecting the magnitude of the inflation-growth effect, arises through an interaction term between financial development and inflation.

Economic growth in the transition country region is investigated by Dawson (2003). He also includes the investment rate and financial development variables, although not the inflation rate, and finds no significant effect for his measure of financial development that is one of the three measures in Levine, Loayza, and Beck (2000). This supports the conclusions in Gillman and Harris (2003) who suggest that financial development may be acting as a proxy for the return on capital; including the investment rate inserts a better measure of the return to capital so that financial development is no longer significant.

Dawson's (2003) investigation of financial development in transition is accompanied by alternative growth explanations in the literature that include inflation but not financial development. For example, Gillman and Nakov (2003) find in time series VARs that inflation Granger causes growth in a negative way, for two lead transition countries Hungary and Poland. Financial development enters that study only through its interpretation of the identified structural breaks, in a way similar to the role of financial development in Friedman and Schwartz (1982).

This paper investigates the joint role of financial development and inflation on growth in a panel of the same transition countries examined by Dawson (2003). We find a strikingly significant and robust inflation effect, a negative one consistent with the literature.

The investment rate remains significant as in Dawson (2003), Gillman, Harris, and Matyas (2004) and Gillman and Harris (2003). And as in Dawson (2003) and Gillman and Harris (2003) the financial development variable is not positively significant. Similar to the findings of Gillman and Harris (2003), the effect of financial development is almost always negative once inflation is included. However while Dawson (2003) finds it insignificant, the results here indicate some evidence of negative significance once the the interaction of inflation and financial development is included.

One qualification is that only the "Liquid Liabilities" variable of Levine, Loayza, and Beck's (2000) three proxies for financial development is used in Dawson (2003) and here, since it alone is available readily in a panel from mainstream international databases (World Bank and IMF). Levine, Loayza, and Beck (2000) caution that this variable, which is the monetary aggregate M2 divided by GDP, may not be as good as the others. However testing with all three of Levine, Loayza, and Beck's (2000) proxies in Gillman and Harris (2003) shows that both the Private Credit proxy and the Liquid Liabilities proxy have a similar type of significance in an OECD panel. This role for both proxies is found not as a stand-alone variable, which is insignificant, but rather through an interaction term between inflation and the financial development variable. The result of the statistical model, as seen in a three-dimensional graph, is that financial development tends to increase the negative effect of inflation on growth; this finding is also supported in Gillman, Harris, and Matyas (2004) in a comparison of OECD and APEC data samples.

In the transition study of this paper, results show again that the financial depth variable Liquid Liabilities alone is not generally significant nor of a positive sign without the interaction term. Including the interaction term makes the Liquid Liabilities term negatively significant as a stand-alone variable. As this is contrary to conventional wisdom, the paper discusses this finding at some length. Given that the Liquid Liabilities variable is the inverse of the GDP velocity of the monetary aggregate M2, the results are interpreted from a monetary theoretic perspective.

The other main issue in the econometric specification, besides the variables that enter the model, is that of the time period. The transition literature appears to be wary about how the early years of the transition period, from 1989 to 1993, are treated. This is because major recessions occured almost simultaneously across this whole set of countries, of which we include thirteen countries from Eastern Europe and the former Soviet Republic. We explore this issue in several ways in order to determine the sensitivity of the results to the time period. One approach, that follows Dawson (2003) , is to use a panel starting only with 1994. Another approach is to eliminate data that occurs during hyperinflation, defined by observations during which the inflation rate was above 100% and alternatively above 50%; this is to eliminate outliers that could bias the results. Both of these restrictions, of a panel starting in 1994 and alternatively with no hyperinflation, are also jointly imposed.

Dropping so much data either by curtailing the time period of the sample or by eliminating the hyperinflation data is a way to deal with unusual data outliers. But including unobserved time effects along with unobserved country effects are a methodologically non-arbitrary way to deal with such abnormalities while keeping the panel data set as non-compromised as possible. Using the full sample, annual data for 13 transition countries from 1990 to 2002, with time effects and instrumental variables for possible inflation endogeneity, we find consistently that inflation is exogenous. The results with the truncated samples indicate in contrast that inflation is statistically endogenous. The time effects in the full sample are highly significant. What emerges is that the unobserved country and time effects of the panel methods, without data truncation and with attention to endogeneity, appear to be a sufficient way by themselves to account for the transition experience. This is because of the nature of these time effects: they pick up unusual movements occuring simultaneously across all countries. And this is exactly what happened in the transitional recessions of 1989-1993. Thus the time effects enable a fuller data set that encompasses the transitional recession period while starting after the change in governments that occured in 1989.

The paper contributes extremely robust evidence that inflation negatively affects the growth rate in transition countries, and is the main explanatory variable along with the investment rate, using methods that well-consider the nature of the transitional recessions that comprise the early part of the full sample. A variety of methods are reported for estimating the panel: both fixed and random effects, time dummies, and alternative methods for the possibility of endogeneity of variables. Besides instrumental variables being used directly for inflation, results are also reported for when the unobserved effects are correlated with the explanatory variables and Ameniya-Macurdy methods are appropriate. Here joint endogeneity of both inflation and financial depth, as well as endogeneity of the their interaction, are considered. With these tools the paper extends the results of both Levine, Loayza, and Beck (2000) and Dawson (2003) by including inflation and the investment rate, as well as those of Gillman, Harris, and Matyas (2004) and Gillman and Harris (2003) by a focus on the transition countries.

2 Data

The data set is from the online World Bank Development Indicators, which Rousseau and Wachtel (2001) and Dawson (2003) also use. The data is annual from 1990 to 2002, and extended set relative to Dawson (2003). The countries included in the sample are the same as in Dawson (2003): Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Poland, Romania, Russian, Slovak, Slovenia and Ukraine.

Note that the World Bank presents data series that are constructed backwards from 1993 for the Czech and Slovak Republics based on the data from the former Czechoslovakia that was dissolved in 1993. An alternative data set is available from the online International Financial Statistics but this does not include data for the Czech and Slovak Republics before 1993. Growth rates are constructed as $\ln x_t - \ln x_{t-1}$, where ln denotes natural logarithm. The series are:

- dependent variable;
  - g : growth of real GDP at market prices in local currency units (LCUs);
- explanatory varibles used in Dawson (2003);
  - I/GDP: investment to GDP (at market prices) ratio, both in real LCUs;
  - gl : population growth rate (proxy for labour force growth);
  - $Depth$: real liquid liabilities (M2) as a proportion of real GDP, both in LCUs (proxy for financial development);
- additional explanatory varibles;
  - $Czech/GDP$: ratio of Czech Republic to local country real GDP, both measured in constant $US;
  - $\ln(1+\dot{p})$, denoted in short as $\dot{p}$: the inflation rate as defined by the rate of growth of the GDP deflator;
  - $\dot{p}lly$: product of the $Depth$ and $\dot{p}$ variables;
- extraneous instrumental variables;
  - M^s and M^s_{-1} : annual growth rate of the M1 money supply aggregate and the one-period lag of this in current local currency units.

Table 1: Descriptive Statistics

Variable	Mean	Std Dev	Minimum	Maximum
g	1.71	6.23	-36.96	9.34
I/GDP	24.25	7.32	9.66	55.80
gl	-0.43	0.58	-2.64	1.12
$Depth$	36.62	17.36	11.49	78.61
$Czech/GDP$	4.60	5.19	0.15	20.26
$\dot{p}$	21.10	24.49	-0.36	121.04
$\dot{p}lly$	65.80	75.82	-0.75	413.99
M^s	27.85	31.68	-19.81	231.10
1992×1	0.03	0.16	0	1
1993×1	0.06	0.24	0	1
1994×1	0.07	0.25	0	1
1995×1	0.11	0.31	0	1
1996×1	0.11	0.31	0	1
1997×1	0.11	0.31	0	1
1998×1	0.11	0.31	0	1
1999×1	0.11	0.31	0	1
2000×1	0.11	0.31	0	1
2001×1	0.10	0.30	0	1
2002×1	0.08	0.28	0	1

The sample is not restricted to be a balanced panel and the largest possible number of years are used in each estimation. The sample size for each country is dictated by its first non-missing observation across all variables included in the model.

Table 1 contains descriptive statistics for the full estimation sample, defined by inclusion of all explanatory variables plus current and lagged money supply growth rates, and by 118 observations. There is an approximate equal split of obsevations across the years 1995 to 2001, with 1992, 1993, 1994 and 2002, being relatively under-represented in the sample. The first year of the sample, 1990 is lost due to growth rates and an additional year is lost if the money supply growth rate and its lag are used as intruments. Further, due to the fact that in several countries the money supply growth rate is not available until the mid-90s, additional years are lost when using this variable as instruments.

The real GDP growth rate has a sample mean typical of historical averages, and exhibits significant volatility. As Table 1 illustrates, average real GDP growth is 1.71%, with a range from -36.96 to 9.34%. Investment ratios are more stable, averaging around 24% over the period. Inflation is moderately high and volatile, with an average near 21%

and a range of -0.36 to 121%; similarly, the money growth rate averages 28% and ranges from -19.8% to a high of 231%. On average over the sample period, population growth is negative.

3 Econometric Models

Two models are specified. First the Dawson (2003) model is presented. This includes the investment rate and financial depth but not inflation. The second model is extended to include inflation plus other variables as related to a theory of endogenous growth.

3.1 The Dawson Model

Dawson (2003) considers the role of financial development on growth in a model that specifies the independent variables as the ratio of investment to GDP (I/GDP), or the investment rate, financial depth as measured by the ratio of the M2 monetary aggregate to GDP ($Depth$) , which Levine, Loayza, and Beck's (2000) denotes as Liquid Liabilities, and the population growth rate (gl). This is termed the *DAWSON MODEL*.

3.2 The Inflation Model: Encompassing Dawson

The second model adds variables to the Dawson (2003) model that are similar to those used in Gillman and Harris (2003) and Gillman, Harris, and Matyas (2004). These are the inflation rate ($\dot{p}$), the product of the inflation rate and the financial depth variable ($\dot{p}lly$), and the ratio of Czech GDP to each country's GDP ($Czech/GDP$) as a variable to capture transition path dynamics. Czech GDP is used instead of US GDP, which is used in Gillman, Harris, and Matyas (2004), because the Czech Republic has the highest income level in the region to which the other countries in the sample might converge.

The additonal variables allow the model to be consistent with one constructed from considerations of endogenous growth theory, as focused on in Gillman, Harris, and Matyas (2004). The theoretical justification behind the inclusion of each variable can be summarized. The investment rate acts as a proxy of the return to physical capital, or the real interest rate, a major determinant of growth theoretically. Financial development (financial depth), is included on the basis that it may represent financial "infrastructure" that helps increase the return of capital. Inflation is included to capture its effect as an implicit tax on human capital that lowers its return and so lowers the growth rate (see Gillman and Kejak (2005)). Population growth can be considered to show a possible role for the quantity of human capital, such as through positive externalities when a quickly growing population interacts. And the output ratio variable is designed to determine if possible convergence of incomes among countries in a region affects their growth rates. This model specification is termed the *INFLATION MODEL.*

4 Methodology

All of the estimated models can be written generically as

$$g_{it} = \alpha_i + \lambda_t + \mathbf{x}'_{it}\boldsymbol{\beta} + \varepsilon_{it}, \tag{1}$$

where g_{it} is country i's ($i = 1, \ldots, N$) GDP growth in year t ($t = \tau_i, \ldots, T_i$); $\mathbf{x}_{it}$ is the vector of explanatory variables (which varies across specification) with unknown weights $\boldsymbol{\beta}$; and ε_{it} are the usual disturbance terms. In addition to the "standard variables" in equation (1), the panel nature of the data also allows one to condition on both unobserved country effects (α_i) and unobserved time effects (λ_t). The former will account for any remaining unobserved country heterogeneity. The latter will account for any remaining unobserved heterogeniety that is constant across countries and varying over time (for example, business-cycle effects).

Two related approaches are taken in estimating equations of the form represented in (1), random and fixed effects estimation. Efficient estimation assumes that both sets of unobserved effects are random and a feasible-generalised least squares (F-GLS) approach is taken. However, if there are correlations among the unobserved effects and the observed country heterogeniety, a F-GLS approach will lead to biased and inconsistent estimates of the parameters of interest. In such a situation, a "fixed effects" approach is preferable, as this yields unbiased and consistent parameter estimates. In either case, the use of standard techniques are restricted to when there is no joint determination of the dependent and independent variables.

The growth literature typically considers that growth and inflation, and possibly also financial development, are jointly determined. If so, then this renders these variables as potentially endogenous regressors in the usual panel estimation of equation (1). To allow for inflation being endogenous in the estimated equations, we use instrumental variable (IV) techniques. As in Gillman, Harris, and Matyas (2004), current and lagged values of the rate of growth of the M1 money supply are used as instruments. For the full sample, the relevant Hausman test invariably reveals that one could not reject the null-hypothesis that the inflation rate, as entered into the estimated equations, is exogenous. The results also indicate a preference for the random effects model. Therefore, for the full sample, only the random effects without IVs are reported. For truncated samples, such as using the 1994-2002 data period, inflation is found to be endogenous. With such endogeneity the preference is for fixed effects IV results and these results are presented in one example.[1]

To allow for the fact that both inflation and financial development, and their interaction when it is included, are potentially endogenous and correlated with the unobserved country effects, the following procedure was adopted. Using the generic form of equation (1) it is possible to decompose $\mathbf{x}_{it}$ into $\mathbf{x}_{it} = (\mathbf{x}'_{1it}, \mathbf{x}'_{2it})'$, where $\mathbf{x}_{1it}$ is a subset of $\mathbf{x}_{it}$ that is independent of the unobserved effect (see Hausman and Taylor 1981, Amemiya and MaCurdy 1986, Breusch, Mizon, and Schmidt 1989). Generalized Method of Moments (GMM) estimation can be based upon the orthogonality conditions

$$E\left(\mathbf{z}'_{it}\alpha_i\right) = \mathbf{0}, \tag{2}$$

where $\mathbf{z}_{it}$ is based upon $\mathbf{x}_{1it}$, whilst still treating the λ_t as fixed constants. Based on the Sargan criteria of appropriate moment conditions (see Sargan 1958, Sargan 1988) the reported results are based on the Amemiya and MaCurdy (1986) estimator, which has $\mathbf{z}_i = (\mathbf{x}'_{1i0}, \mathbf{x}'_{1i1}, \ldots, \mathbf{x}'_{1iT})'$. Essentially this uses the full time series of observations on each of the strictly exogenous variables as instruments for the endogenous ones in each time period. Asymptotic efficiency of these estimators are improved by, as before, additionally using contemporaneous and one-period lagged money supply growth as additional instruments. Alternative tests to examine robustness are also conducted by excluding the money supply growth rate as an IV, treating only financial development as endogenous, and treating only the inflation rate as endogenous.

5 Results

5.1 The Dawson Model

Dawson (2003) uses data from 1994-1999. Updating this data to 1994-2002, Table 2 presents the results of the DAWSON MODEL with the updated data. These results compare closely with those of Dawson (2003) in that only the investment rate is significant.

Using the full sample over the years of 1990-2002, still with the same specification, yields significantly different results. The random effects model is marginally favoured by

[1] This was not the case though for results from the truncated time sample, in which endogeneity is detected.

Table 2: One-Way Random Effects: Dawson Model

Model Estimates				
Variable	Coefficient	Standard Error	Specification Tests	
I/GDP	0.320	$(0.10)^{**}$	$\widehat{\sigma}_{\alpha}^{2}$	5.52
gl	0.230	(2.08)	$\widehat{\sigma}_{\varepsilon}^{2}$	16.00
$Depth$	0.011	(0.04)	LM	0.09
Constant	-7.265	(3.07)	$Hausman$	0.56

**Significant at 5% size; *Significant at 10% size.

LM refers to the p-value of Lagrange Mutiplier test of $H_0 : \sigma_{\alpha}^{2} = 0$; $Hausman$ to the p-value of $H_0 : E\left(\mathbf{x}'\boldsymbol{\alpha}\right) = \mathbf{0}$, p-values in excess of 0.05 are support for the random effects specification.

the Hausman test and shows no significance for any of the variables. The fixed effects model shows only *Depth* to be significant, but negatively so.

Including the time effects, the test results now indicate that the preferred model is the random effects one with time effects included. Here again none of the variables are statistically significant.

Restricting the sample by excluding data during which there is hyperinflation indicates that the prefered model is random country and time effects. The investment rate becomes significantly positive, as does the population growth rate. Financial depth is negative and insignificant.

The experiments with the DAWSON MODEL show mixed results for the significance of the investment rate, but find that financial depth does not have the conventionally found positive significance in any case. The lack of a significant positive effect from financial depth is confirmation of the main point of Dawson's (2003) study. The main qualification is that if the model is missing significant variables, then these results may be biased.

5.2 The Inflation Model

Extending the model to include inflation finds that the previous model's results on investment, positively significant with limited robustness, and financial depth, negatively insignificant, tend to hold up. However, these results are dominated by the uniform robustness, without exception, of a highly significant negative inflation effect. This effect is found both with the full data set (1990-2002), in which inflation is found to be exogenous, and with the truncated data set, in which inflation is found to be endogenous.

A set of these results are is presented below in Tables 3 to 8. The variations concern

Table 3: Two-Way Random Effects: Inflation Model

Model Estimates				
Variable	Coefficient	Standard Error	Specification Tests	
I/GDP	0.167	$(0.09)^{*}$	$\widehat{\sigma}^2_\alpha$	15.65
gl	2.991	$(1.56)^{*}$	$\widehat{\sigma}^2_\lambda$	19.02
$Depth$	-0.032	(0.04)	$\widehat{\sigma}^2_\varepsilon$	27.37
$\dot{p}$	-0.177	$(0.02)^{**}$	LM	0.07
$Czech/GDP$	-0.000	(0.00)	$Hausman$	0.30
Constant	2.147	(3.34)		

**Significant at 5% size; *Significant at 10% size.

The LM falls on the cusp of significance at 5% size; LM refers to the p-value of Lagrange Mutiplier test of $H_0 : \sigma^2_\alpha = \sigma^2_\lambda = 0$. $Hausman$ refers to the p-value of $H_0 : E\left(\mathbf{x}'\boldsymbol{\alpha}\right) = E\left(\mathbf{x}'\boldsymbol{\lambda}\right) = \mathbf{0}$; p-values in excess of 0.05 indicate support for the random effects specification.

how possible endogeneity is treated, and whether an inflation-depth interaction term is included.

Consider first the *INFLATION MODEL* with all of the variables except the inflation-depth interaction term. Table 3 displays the specification tests which indicate that the favoured model is the two-way random effects model that includes both unobserved random country and time effects. The investment rate and the population growth rate are positive and significant, while inflation is strongly negatively significant at the zero confidence level. Note also that the coefficient on inflation is -0.177, which is near the -0.19 to -0.25 range found in Gillman and Harris (2003) for an OECD country sample. Re-estimating the model with only the significant variables shows some decrease in the significance of the investment rate, and increased significance of population growth and inflation.

The inflation-depth interaction term is next added to the model as an extension, in order to allow for the possibility that inflation and financial depth also have a joint effect upon growth. Table 4 shows that the interaction term is insignificant and the results remain largely unchanged in terms of the significance of the remaining variables. Note that the LM statistic tests whether the variances of the unobserved country and time effects are jointly equal to zero. With a p-value of 0.079, it is on the cusp of significance at a 5% size, similar to the results in Table 3. A way to interpret this test statistic further is to compare the absolute size of the estimated variance components. This indicates that the time effects have over twice the magnitude of the country effects and suggests that the time effects are quite significant while the country effects are less so.

Table 4: Two-Way Random Effects: Inflation Model with Interaction

Model Estimates				
Variable	Coefficient	Standard Error	Specification Tests	
I/GDP	0.176	$(0.09)^{**}$	$\widehat{\sigma}^2_\alpha$	17.08
gl	2.896	$(1.52)^{*}$	$\widehat{\sigma}^2_\lambda$	39.43
$Depth$	-0.091	(0.08)	$\widehat{\sigma}^2_\varepsilon$	27.34
$\dot{p}$	-0.217	$(0.05)^{**}$	LM	0.08
$\dot{p}lly$	0.001	(0.00)	$Hausman$	0.23
$Czech/GDP$	0.000	(0.00)		
Constant	3.784	(3.75)		

**Significant at 5% size; *Significant at 10% size.

LM refers to the $p-$value of Lagrange Mutiplier test of $H_0 : \sigma^2_\alpha = \sigma^2_\lambda 0$; $Hausman$ to the p-value of $H_0 : E(\mathbf{x}'\boldsymbol{\alpha}) = E(\mathbf{x}'\boldsymbol{\lambda}) = \mathbf{0}$, p-values in excess of 0.05 are support for the random effects specification.

Table 5: Two-Way Fixed Effects IV: Inflation Model with Truncated Time Sample

Model Estimates				
Variable	Coefficient	Standard Error	Specification Tests	
I/GDP	0.152	$(0.05)^{**}$	$\overline{R}^2$	60.00%
gl	0.589	(2.90)	F	0.00
$Depth$	-0.024	(0.07)	LR	0.00
$\dot{p}$	-0.240	$(0.05)^{**}$		
$Czech/GDP$	0.00	(0.00)		
Constant	3.563	(3.77)		

**Significant at 5% size; *Significant at 10% size.

F refers to the p-value of $F-$test for null hypothesis of constant only in the regression; LR to the p-value of Likelihood ratio Test of $H_0 : \boldsymbol{\alpha} = \boldsymbol{\lambda} = \mathbf{0}$ (no time or country effects).

Robustness experiments again involve truncation of the data by using only the 1994-2002 period, and by eliminating data during periods in which the inflation rate exceeded 100%. Both of these restrictions are also jointly applied. Inflation is found to be endogenous in these cases, and only IV fixed effects models are appropriate. The results show that time effects are still strongly present. With respect to explanatory variables, the only significant ones are the investment rate and the inflation rate in all of these cases. For example, based on the 1994-2002 data, Table 5 presents two-way fixed effects IV results using money supply growth rates as instruments.

The next set of experiments involve allowing both inflation and financial development to be potentially endogenous using the techniques proposed by Amemiya and MaCurdy

Table 6: Consistent Random Effects Estimates: Inflation and Financial Development Endogenous

	Model Estimates			
Variable	Coefficient	Standard Error	Specification Tests	
I/GDP	0.011	(0.06)	$\overline{R}^2$	58.66%
gl	0.565	(0.88)	$Sargan$	0.48
$Depth$	-0.020	(0.03)		
$Czech/GDP$	-0.213	$(0.10)^{**}$		
$\dot{p}$	-0.159	$(0.02)^{**}$		
Constant	-0.567	(3.27)		
Time Dummies	YES			

**Significant at 5% size; *Significant at 10% size.

Sargan refers to the p-value of Sargan test $H_0 : E\left(\mathbf{z}'\boldsymbol{\alpha}\right) = E\left(\mathbf{z}'\boldsymbol{\varepsilon}\right) = \mathbf{0}$.

(1986), whereas previously only inflation was treated as potentially endogenous. Retaining money supply growth rates as additional instrumental variables means that inflation and financial depth are jointly explained by the these variables and all of the remaining exogenous variables in the model. The key criterion of the validity of the instruments here is whether the regressions pass the Sargan test (see Sargan 1958, Sargan 1988). Table 6 shows that this specification clearly passes the Sargan test and indicates that only inflation and the Czech GDP ratio variables are significant.

Re-estimateing the model again using the procedure sugested by Amemiya and MaCurdy (1986), but now with only financial depth as endogenous, the specification again clearly passes the Sargan test with little change in the results as compared to Table 6 although these results are not reported.

Given the possibility of some interaction between inflation and financial depth, the next set of reported experiments examine consistent random effects estimation of the *INFLATION MODEL* with this interaction term included. Contrary to the results above, in which the issue of financial depth endogeniety was not addressed, and again using the full sample period with the money supply growth rates used as additional instruments, the interaction term proves significant. This is true when inflation and financial depth are both assumed to be endogenous, and when only financial depth is assumed to be endogenous. These Amemiya and MaCurdy (1986) estimations pass the Sargan test and Table 7 presents the results for the one in which both inflation and financial depth are assumed to be endogenous. They show significance of the inflation rate, the investment rate, depth and the interaction term. Also the coefficient estimates of the inflation rate,

Table 7: Consistent Random Effects Estimates: Inflation and Financial Development Endogenous, Money Supply used as Instruments

Model Estimates				
Variable	Coefficient	Standard Error	Specification Tests	
I/GDP	0.231	$(0.09)^{**}$	$\overline{R}^2$	47.34%
gl	0.659	(0.94)	$Sargan$	0.99
$Depth$	-0.154	$(0.05)^{**}$		
$Czech/GDP$	-0.213	(0.13)		
$\dot{p}$	-0.300	$(0.05)^{**}$		
$\dot{p}lly$	0.051	$(0.02)^{**}$		
Constant	1.424	(3.50)		
Time Dummies	YES			

**Significant at 5% size; *Significant at 10% size.

$Sargan$ refers to the p-value of Sargan test $H_0 : E(\mathbf{z}'\boldsymbol{\alpha}) = E(\mathbf{z}'\boldsymbol{\varepsilon}) = \mathbf{0}$.

the investment rate, and depth rise in magnitude substantially relative the those found respectively in Table 6.

A final set of experiments allow the interaction term between inflation and depth also to be endogenous, while the money supply growth rate instruments are included. This improves the model results modestly and again the specification passes the Sargan test. Table 8 presents the results and indicates that now the Czech GDP variable is also significant along with the investment rate, depth, inflation and the interaction term.

Graphical techniques enhance the ability to interpret the results that include a significant interaction term between inflation and depth. Figure 1 graphs the results of Table 8 and shows that inflation and financial depth each negatively affect growth. However inflation and depth appear not be related to each other. This can be seen by the fact that the profile of the inflation and growth relation is the same at each level of financial depth; as the inflation rate goes up the growth rate falls at the same rate regardless of the level of financial development. Further the inflation-growth profile shows some of the typical non-linearity in the inflation-growth profile: the growth rate falls by more as the inflation rate rises from zero than the growth rate falls when the inflation rate is rising up from a higher level.[2] The negative financial depth effect on growth is interpreted in the following section.

[2]See Gillman and Kejak (2005) for a theoretical explanation of this non-linearity, and see Gillman, Harris, and Matyas (2004) for evidence in support of it.

Table 8: Consistent Random Effects Estimates: Inflation, Financial Development Endogenous and Interaction Endogenous, Money Supply used as Instruments

Model Estimates				
Variable	Coefficient	Standard Error	Specification Tests	
I/GDP	0.235	$(0.08)^{**}$	$\overline{R}^2$	47.93%
gl	0.702	(0.84)	$Sargan$	1.00
$Depth$	-0.175	$(0.05)^{**}$		
$Czech/GDP$	-0.234	$(0.10)^{**}$		
$\dot{p}$	-0.308	$(0.05)^{**}$		
$\dot{p}lly$	0.052	$(0.02)^{**}$		
Constant	6.656	$(3.13)^{**}$		
Time Dummies	YES			

**Significant at 5% size; *Significant at 10% size.

$Sargan$ refers to the p-value of Sargan test $H_0 : E(\mathbf{z}'\boldsymbol{\alpha}) = E(\mathbf{z}'\boldsymbol{\varepsilon}) = \mathbf{0}$.

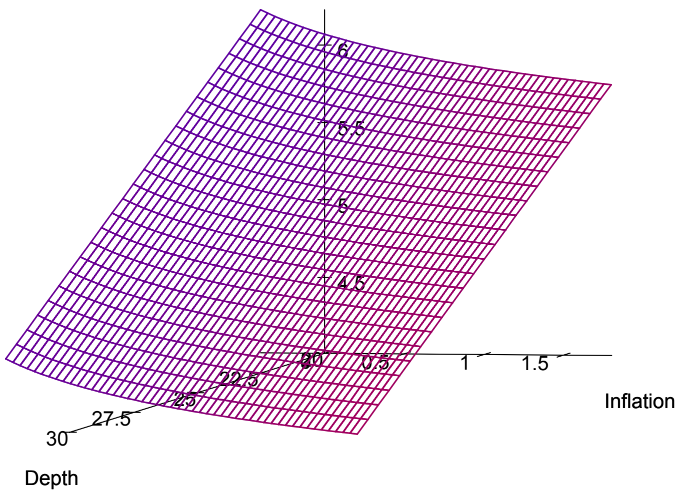

Figure 1: Inflation, Financial Depth, and Growth (vertical axis)

6 Discussion

The negative effect of inflation comes through in parameter estimates that range from -0.16 to -0.31, which is close to the -0.19 to -0.25 range in Gillman and Harris (2003) for an OECD country sample. The magnitude of the estimates of the inflation coefficient, along with the magnitude of the coefficients of the investment rate and depth, tends to rise gradually as more variables are allowed to be endogenous as a comparison across Tables 3 to 8 reveals. The rising strength of these variables lends support to the possibility that the most inclusive model, presented in the Table 8, is in some sense the "best" model.

The negative significance of the financial depth variable in Tables 7 and 8 stands contrary to conventional wisdom. Yet a similar negative effect is found in Gillman and Harris (2003) for an OECD panel data set. The plausibility of the result may depend upon its interpretation.

Consider the nature of this financial depth proxy: it is defined as M2/GDP. This variable has a different meaning in monetary theory. It is the inverse of the output velocity of the demand for money, defined with the broad M2 aggregate. The estimation results indicate that when M2 velocity is high, the growth rate is also high; or it could be said that the M2 velocity is pro-cyclical if taking a business cycle view of the flucuations in the growth rate. Such a positive relation with growth may not indicate that financial development is detrimental to growth, as the results seem to indicate.

The M2 aggregate contains currency, non-interest bearing demand deposits, and interest-bearing time deposits. The reasoning for why M2/GDP indicates the level of financial development is that if there is a large quantity of such interest-bearing instruments relative to GDP, then there is likely to be a well-developed financial sector that can provide such instruments. These time deposits tend to be short term liquid instruments. One influence on these can be the inflation rate. When inflation increases, there tends to be substitution from the non-interest bearing instruments to the interest-bearing instruments. This substitution typically cancels out in an aggregate like M2 that is so broad, and indeed US M2 velocity tends not to move with nominal interest rates; a narrower aggregate like the monetary base in contrast does tend to move with nominal interest rates as is clear from an examination of base velocity (see Gillman and Kejak (2004)). Thus the M2 aggregate is not heavily influenced by inflation and can still be a valid measure of financial depth.

However another possible influence on the magnitude of M2 velocity is substitution from short term, liquid, instruments to longer term, less liquid, instruments as the business cycle heats up and the growth rate rises. This substitution to longer term investment would cause the M2 velocity to rise in an endogenous fashion. Investment is strongly procyclical and involves the shifting from liquid mutual funds into less-liquid equity portfolios. It could be argued that the higher is M2 velocity for a given growth rate, the more funds are directed towards longer term investments rather than staying in shorter term investments. Greater long term investment can be indicative of a more developed financial system, in that it can be more efficient to have more long term investment. This interpretation suggests that a negative effect of M2/GDP on growth may nonetheless indicate that there is a positive relation between a greater degree of the conversion of liquid into less-liquid investment and the level of the growth rate. And this implies that the result on depth may indicate a positive role of financial development on growth.

Another result that needs to be noted is the negative sign of the ratio of Czech GDP to each country's GDP. Typically these transition variables are expected to be of a positive sign. In particular, the farther away the income of a country is from the highest income country in the region, the quicker is its growth rate expected to rise. However such growth convergence does not appear in the results here. An interpretation is that one difference in the transition country experience relative to developed countries is that a country lagging behind another in the transition region actually has worse conditions by which its income may rise, such as the lack of sufficient infrastructure. And as it may take decades for such infrastructure to be rebuilt so that growth rates can accelerate, the growth rates of low income transition countries such as Ukraine are simply not yet converging to those growth rates of the higher income countries in the region.

7 Conclusions and Qualifications

The paper presents strong and new panel evidence that inflation very significantly and negatively affects economic growth in transition countries. This shows that their experience, contrary to some convential wisdom, is not different from developed countries in this aspect. Second, as in developed country samples, once inflation and the investment rate are included, financial depth as measured by "liquid liabilities" does not positively affect growth, as in Gillman and Harris (2003). However an interpretation is provided for the results on financial depth that may nonetheless allow for a positive role of financial development, on the basis that M2/GDP may be indicating the degree of substitution between short and long term investment instruments.

Related growth results for transition countries appear to have been restricted to cross-sectional and time-series methodologies. The panel study of this paper is not inconsistent with such results and even further places the transition countries squarely in line with the developed country experience, such as that of Judson and Orphanides (1996), Ghosh and Phillips (1998), Khan and Senhadji (2001), Gillman and Harris (2003) and Gillman, Harris, and Matyas (2004). This suggests that rather than needing special analysis designed just for transition countries, as is sometimes argued, application of standard panel techniques can estimate well this experience.

Only the result that indicates a lack of growth convergence in the transition country region is a feature that characterizes the transition results in contrast to developed country results. Yet this is still consistent with the theory of growth convergence that suggests the importance of having a modern infrastructure in order to have the ability to converge.

There is a certain clean logic in the finding that the sign of the model's transition path variable is the only difference in the results for the transition region as compared to results of developed country samples. And the paper shows that use of unobserved time effects can help to capture this transitional experience in a sound methodological way that does not require truncating the data sample. The methods here include fixed and random effects with extensive analysis of potential endogeneity.

We conclude that monetary policy can affect growth just as perversely in transition as in developed countries. And this should make EU accession to the Maastrict criteria, with its low inflation rate dictate, for such countries just as beneficial as it was for Southern European countries in terms of inflation and growth. And the paper suggests that infrastructure development in the accession countries may also be just as important as it is for Western European countries for growth convergence.

References

AMEMIYA, T., AND T. MACURDY (1986): "Instrumental Variable Estimation of an Error Components Model," *Econometrica*, 54, 869–881.

BARRO, R. (2001): "Human Capital and Growth," *American Economic Review*, pp. 1–7.

BREUSCH, T., G. MIZON, AND P. SCHMIDT (1989): "Efficient Estimation Using Panel Data," *Econometrica*, 57, 695–700.

DAWSON, P. J. (2003): "Financial Development and Growth in Economies in Transition," *Applied Economic Letters*, 10, 833–836.

FRIEDMAN, M., AND A. SCHWARTZ (1982): *Monetary Trends in the United States and the United Kingdom*. The University of Chicago Press, Chicago.

GHOSH, A., AND S. PHILLIPS (1998): "Inflation, Disinflation and Growth," IMF Working Paper WP/98/68.

GILLMAN, M., AND M. HARRIS (2003): "Inflation, Financial Development and Endogenous Growth," *manuscript*.

GILLMAN, M., M. HARRIS, AND L. MATYAS (2004): "Inflation and Growth: Explaining a Negative Effect," *Empirical Economics*, 29(1), 149–167, Reprinted in Baltagi, Badi H (Ed), 2004, Studies in Empirical Economics, "Panel Data: Theory and Applications", Physica-Verlag.

GILLMAN, M., AND M. KEJAK (2004): "The Demand for Bank Reserves and Other Monetary Aggregates," *Economic Inquiry*, 42(3), 518–533.

——— (2005): "Inflation and Balanced-Path Growth with Alternative Payment Mechanisms," *Economic Journal*, Forthcoming January Issue.

GILLMAN, M., AND A. NAKOV (2003): "A Revised Tobin Effect from Inflation: Relative Input Price and Capital Ratio Realignments, US and UK, 1959-1999," *Economica*, 70(279), 439–450.

GYLFASON, T., AND T. HERBERTSSON (2001): "Does Inflation Matter for Growth?," *Japan and the World Economy*, 13(4), 405–428.

Hausman, J., and W. Taylor (1981): “Panel Data and Unobservable Individual Effects,” *Econometrica*, 49, 1377–1398.

Judson, R., and A. Orphanides (1996): “Inflation, Volatility and Growth,” *Board of Governors of the Federal Reserve System Finance and Economics Discussion Series*, 96(19).

Khan, S., and A. Senhadji (2001): “Threshold Effects in the Relationship Between Inflation and Growth,” IMF Staff Papers 48(1), International Monetary Fund.

King, R. G., and R. Levine (1993): “Finance and Economic Growth: Schumpeter Might Be Right,” *Quarterly Journal of Economics*, 108(3), 717–737.

Levine, R. (1997): “Financial Development and Economic Growth: Views and Agendas,” *Journal of Economic Literature*, 35(2), 688–726.

Levine, R., N. Loayza, and T. Beck (2000): “Financial Intermediation and Growth,” *Journal of Monetary Economics*, 46, 31–77.

Rousseau, P., and P. Wachtel (2001):. "Inflation, Financial Development and Inflation," in Economic Theory, Dynamics and Markets: Essays in Honor of Ryuzo Sato, Edited by T. Negishi, R. Ramachandran and K. Mino, Kluwer Academic Press.

Sargan, J. D. (1958): “The Estimation of Economic Relationships Using Instrumental Variables,” *Econometrica*, 26, 393–415.

——— (1988): *Testing for Misspecification After Estimating Using Instrumental Variables*Cambridge University Press, Cambridge.