FINANCIAL DEVELOPMENT AND THE TRANSMISSION OF MONETARY SHOCKS

Robert Lensink and Bert Scholtens

SOM-theme E: Financial markets and institutions

Abstract

We investigate whether the financial system dampens or exacerbates monetary shocks of inflation uncertainty to the economy. Our GMM-estimates for 88 countries over a period of 25 years show that inflation uncertainty has a positive and significant impact on the volatility of economic growth. More importantly, we find that financial development dampens the negative effects of inflation uncertainty on the volatility of economic growth. This confirms the importance of a well-developed financial sector.

1 INTRODUCTION

This paper contributes to the discussion on financial development and economic growth as well as to that on the impact of monetary shocks on the economy. We seek to address the question whether a well-developed financial system may dampen or exacerbate shocks caused by inflation. In contrast to most papers in this field, this paper does not examine the growth effects of financial development and shocks as such. In this literature, financial institutions emerge to lower transaction and information costs, to exert corporate control and to mobilize savings (see Levine, 1997; Allen and Santomero, 2001). From this, it is assumed that economies with more developed financial institutions may enjoy higher economic growth. In contrast, our aim is to examine whether financial development dampens or strenghtens the effects of inflation uncertainty on the volatility of per capita growth. This is because we are interested in the issue whether financial structure and development plays a role in the transmission of monetary shocks.

Previous papers that investigate the impact of financial development on macroeconomic volatility are inconclusive. Some find that financial development reduces macroeconomic volatility (e.g., Gavin and Hausmann, 1995; Denizer et al., 2000; Easterly et al., 2000). However, the transmission channel is left unaccounted for in these studies. Beck et al. (2001) find no robust relation between financial development and growth volatility. Furthermore, they asses that financial development magnifies the impact of inflation volatility in low- and middle-income countries as financial intermediaries act as a conduit for monetary policy propagation. However, they use a simple OLS-regression technique. This may bias the results because of endogeneity and measurement problems. We take a closer look at the issue and build on the research by Kiyotaki and Moore (1997). They illustrate that imperfections in the capital market may amplify the effects of productivity shocks. The effect of these imperfections on the net wealth (constrained) borrowers is to be held responsible for the amplifications. Then, fewer capital market imperfections, i.e. more developed financial intermediation and markets, would suggest a reduced impact of shocks. As such, financial development could have a dampening effect on the volatility of economic growth. Rajan and Zingales (2001) provide some arguments why financial development may have an opposite effect on the investment-uncertainty relationship. They argue that the current financial revolution, in the sense of technological, regulatory and institutional changes, has made finance more widely available and thereby has a major impact on how firms are organised. In particular, they argue that the financial revolution made alienable assets less unique as the financial revolution makes it less likely that new opportunities will be undertaken within the legal shell represented by the existing company. In other words, the financial revolution has led to a decoupling of growth options from assets in place.

This probably reduces private returns since the values of the growth options were included in the expected returns from investment in the past. Therefore, aggregate investment does not necessarily increase with the development of financial markets. Furthermore, one may derive arguments for a negative relationship between financial development and growth volatility from the literature that studies the credit channel of monetary policy transmission. For example, Bernanke and Gertler (1995) argue that monetary policy impacts on the economy through both the bond market and the credit market. Bonds and credit are imperfect substitutes. Private banks, as the main providers of credit, play a crucial role in the transmission of monetary policy. Interest rate changes will affect profitability, asset values and collateral. As such, they directly affect the borrowing capacity within the economy. Furthermore, if banks cannot easily manage their deposits and if their assets are not perfect substitutes, the supply of bank credit can also be affected. In that case, monetary shocks can be magnified by the banking sector.

We analyze how shocks affect per capita economic growth volatility for 88 countries over a period of 25 years. Though this objective is identical with the one chosen by Beck et al. (2001), our study differs in several respects. First, we estimate the relationships on the basis of GMM, instead of OLS. Furthermore, the specification of our model is completely different. Apart from determining the impact of the usual suspects that are behind economic growth and its volatility, we especially focus on how financial development behaves in this respect. As such, we measure financial development in two different ways namely as the overall size of the banking sector in relation to GDP and as the relative size of private sector credit within the economy. Moreover, our datasets differ: we cover more countries (88 vs. 63 countries) for a shorter time-period (25 vs. 36 years).

We find that inflation uncertainty has a positive and significant impact on the volatility of economic growth. Financial development as such does not have a significant effect on the volatility of economic growth. However, we find a significant negative effect of financial development interacted with inflation uncertainty on the volatility of economic growth. This strongly suggest that financial development dampens the negative effects of inflation uncertainty on economic growth.

The structure of the paper is as follows. Section 2 is a description of our data. The estimation methodology is given in section 3. We provide and discuss our results in section 4. Section 5 concludes.

2 THE DATA

Our dataset includes 88 countries in all income ranges (see Appendix 1 for a list of countries). We employ a five-period panel (1976-1980, 1981-1985, 1986-1990, 1991-1995, 1996-2000). In all estimates, the same time periods and the same set of countries are used. However, the number of observations differs somewhat per estimate due to missing observations on some of the variables (see Appendix 2 for precise information on the number of observations per variable). We construct a dataset that is constituted on the basis of the following reasons: data availability, variation in time, and limited number of independent variables as – otherwise – we would have too many instruments in our GMM-analysis.

Almost all of the data are derived from the 2002 online version of the World Bank Development Indicators. The dependent variable is the standard deviation of per capita real GDP growth *(STDGROW)*. *STDGROW* is constructed by taking the standard deviation of real per capita growth figures (contructed from constant 1995 US$ GDP per capita figures, market rates) within each time period.

Our measures for shocks is the uncertainty in inflation (*INFU*). This measure can be regarded as a proxy for domestic uncertainty about monetairy policy. The proxy for inflation uncertainty is derived as follows. First, we estimate for all countries in the data set a forecasting equating for inflation (π) by using a second-order autoregressive process, extended with a time trend (T) and a constant (a_1)**:**

$$\pi_{i,t} = a_{i,1} + a_{i,2}\,T + a_{i,3}\,\pi_{i,t-1} + a_{i,4}\,\pi_{i,t-2} + \varepsilon_{i,t}$$

where $\varepsilon_{i,t}$ is an error term for country i in period t. The subscripts *i* and *t* refer to countries and time, respectively. This well-accepted method has been applied, among others, by Aizenman and Marion (1993, 1999). We inserted a trend term into the forecasting equation to deal with the problem of a stationary distribution of the unpredictable part of the stochastic process (see Ghosal and Loungani, 1996, 2000). The estimation period is 1970-2001. Next, we calculate for each country the standard deviation of the residuals of the forecasting equation for π within each time period distinguished in our panel. This gives per country, and per sub-period, a proxy for inflation uncertainty.

We have two measures for financial development. The logarithm of domestic credit provided by the banking sector as a percentage of GDP (*BANK)* and the logarithm of bank credit to the private sector as a percentage of GDP (*PRIV*). For both indicators, we use averages over the periods in the estimates. Both measures are widely used in studies about financial development and economic growth (see Levine, 1997). We would have liked to have more measures, for example about the role of non-bank financing, but due to numerous missing observations (especially in the 1970s and 1980s) we decided against.

Other variables used in the estimates are: the logarithm of the begin of period real GDP per capita (*GDPPC);* the logarithm of the period averages of general government final consumption expenditures as a percentage of GDP (*GOV);* the average annual growth rate of real GDP per capita per period. (*GROW)* ; the average inflation rate (*INFL)* and the logarithm of the period averages of trade as a percentage of GDP (*TRADE*). These are the main 'usual suspects' that are being used in the economic literature that assesses the relationship between growth and shocks.

Table 1 gives the descriptive statistics of the variables used in the estimates, whereas table 2 gives a the correlation matrix of the variables. Table 1 shows that our shock measures are 'shocking and shaking' indeed. Table 2 reveals high correlations between inflation and inflation uncertainty, as well as between the latter and the within period standard deviation of inflation, and between bank credit to GDP and private credit in relation to GDP.

Table 1: Descriptive Statistics

	TRADE	*PRIV*	*INFL*	*BANK*	*GDPPC*	*GOV*	*INFU*	*GROW*	*STDGROW*
Mean	4.04	3.33	33.95	3.73	7.62	2.623	37.02	1.32	0.032
Median	4.04	3.38	8.58	3.81	7.37	2.64	4.05	1.39	0.027
Maximum	5.94	5.30	2846	5.71	10.72	4.03	5296.5	10.88	0.254
Minimum	2.39	-5.18	-3.19	-5.14	4.90	1.43	0.18	-7.47	0.002
Std. Dev.	0.57	1.08	189.89	1.00	1.67	0.39	296.4	2.69	0.024
Skewness	0.20	-2.52	11.37	-3.56	0.27	-0.12	14.38	-0.01	2.609
Kurtosis	4.01	18.63	145.99	28.27	1.76	3.26	237.80	3.84	18.646
Jarque-Bera	21.66	4909	384332	12488	33.41	2.23	1025909	12.85	4986.85
Proba-bility	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.0016	0.000000
Observa-tions	440	437	440	435	440	439	440	440	440

Table 2: Correlation Matrix

	TRADE	PRIV	INFL	BANK	GDPPC	GOV	INFU	GROW	STDGROW
TRADE	1								
PRIV	0.20	1							
INFL	-0.15	-0.04	1						
BANK	0.11	0.88	-0.01	1					
GDPPC	0.21	0.56	0.02	0.47	1				
GOV	0.31	0.28	-0.08	0.29	0.36	1			
INFU	-0.11	-0.03	0.95	-0.02	0.004	-0.08	1		
GROW	0.12	0.28	-0.16	0.17	0.19	-0.06	-0.14	1	
STDGROW	-0.05	-0.23	0.08	-0.17	-0.28	-0.04	0.06	-0.33	1

3 The Estimation Methodology

We specify equations of the following form:

$$STDGROW_{it} = \sum_a \alpha_{1,a} X_a + \alpha_2 FIN_{i,t} + \alpha_3 INFU_{it} + \alpha_4 FIN_{i,t} * INFU_{i,t}$$
$$+ \sum_z \alpha_{5,z} T_z + \sum_h \alpha_{6,h} R_h + \alpha_7 STDGROW_{i,t-1} + n_i + e_{i,t}$$

where X_a is a vector of explanatory variables. In the base regressions, $a \in$ ($INFL_{i,t}$, $GOV_{i,t}$, $TRADE_{i,t}$). In alternative regressions $a \in$ ($INFL_{i,t}$, $GDPPC_{i,t}$, $GOV_{i,t}$, $TRADE_{i,t}$), or $a \in$ ($GROW_{i,t}$, $GDPPC_{i,t}$, $GOV_{i,t}$, $TRADE_{i,t}$). We ignore *INFL* in one set of regressions because of the high multicollinearity between *INFL* and *INFU*. *FIN* is our proxy for financial development (*BANK* or *PRIV*). *T* is a vector of time dummies, with a one if t=z, a zero otherwise, z $\in$ (1976-1980, 1981-1985, 1986-1990, 1991-1995, 1996-2000). These time dummies are used as additional instruments. R_h is a vector of 'region' dummies. The dummy gets a one if a country *i* is in region *h*, a zero otherwise, $h \in$ (high income, upper middle-income, lower middle-income, lower income).[1] η is an unobserved country-specific effect (a country-specific error term) and ε is an overall error term.

Our aim is to examine the effects of financial development on the volatility of growth, and more specifically to consider whether financial development dampens or increases the impact of inflation uncertainty on the volatility of growth. The overall effect of financial development on the volatility of growth is given by $\frac{dSTDGROW}{dFIN} = \alpha_2 + \alpha_4 INFU$. The direct effect of financial development on the volatility of growth is given by α_2. The way how shocks are transmitted via financial development is reflected by α_4. Before going to the estimates, some remarks on the estimation methodology are needed. There are several problems with estimating the above equation by ordinary least squares (OLS). First, OLS assumes that the regressors are uncorrelated with the error term. However, as can simply be shown, the lagged dependent variable is correlated with the country-specific error term.[2] The

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[1] The classification of countries is based on the World Bank classification.

[2] Consider a simple version of our equation to be estimated: $STDGROW_{it} = \alpha_2 FIN_{i,t} + \alpha_7 STDGROW_{i,t-1} + n_i + e_{i,t}$. Since $E(n_i^2) \neq 0$, $E[\eta_i (STDGROW_{it-1})] = E[\eta_i (\alpha_2 FIN_{i,t-1} + \alpha_7 STDGROW_{i,t-2} + n_i + e_{i,t-1})] \neq 0$. Therefore, the error term is correlated with the lagged dependent variable.

second problem is that OLS assumes that the regressors are exogenous. However, it is difficult to justify why some of the regressors, especially our indicators for financial development, are not determined simultaneously with the standard deviation of per capita growth. If these regressors are treated as exogenous, when they are not, this would result in biased parameter estimates.

Estimating our models using ordinary least squares might also be problematic due to measurement problems (we use constructed proxies). Therefore, we estimate our panel based models using an instrumental variable approach. The instrumental variable estimation technique controls for the fact that the explanatory variables are likely to be correlated with the error term and the firm-specific effect, and deals with possible endogeneity problems. More specifically, we estimate the investment models with the system generalized methods of moments (GMM) estimator, using DPD98 for Gauss (see Arellano and Bond, 1998). A method of moments estimator derives the coefficients from the so-called moment restrictions, i.e. restrictions on the covariances between regressors and the error term.

The system GMM estimator combines the differenced equation with a levels equation to form a system GMM. Blundell and Bond (1998) show that, under certain conditions, the system estimator provides more efficient estimators than a regression in first differences. Lagged levels are used as instruments for the contemporaneous differences and lagged differences as instruments for the contemporaneous levels. If the error terms are not serially correlated, Arellano and Bond argue that, starting from t-2, the whole history of the series (in levels) can be used as instruments for the first-differences. With respect to the levels equations, valid instruments for the regressions are the lagged differences of the corresponding variables. Here, only the most recent difference is used as the instrument. Additional lagged differences would be redundant since they are already covered by the instruments for the first differences.

The system GMM estimator is a two-step GMM estimator. In the first step, homoscedasticity and independent error terms are assumed. In the second step, these assumptions are relaxed by using a consistent variance-covariance matrix that is constructed from the first step residuals. However, the two-step estimator has weak small sample properties: the standard errors are biased downwards. The estimator becomes problematic, especially when there is a small number of cross-section units, in relation to the number of instruments, i.e. the number of time series units. In our case this might be problematic, although we have 88 cross-section units (countries) in our dataset. This might result in biased asymptotic inference. We address this problem by presenting coefficients and t-values using two step GMM estimates, based on robust, finite sample corrected standard errors. Windmeijer (2000) shows how the two step standard estimates can be corrected. We followed this approach.

The reliability of the system GMM estimation procedure depends very much on the validity of the instruments. We consider the validity of the instruments by presenting a Sargan test. The Sargan test is a test on overidentifying restrictions. It is asymptotically distributed as χ^2 and tests the null hypothesis of validity of the (overidentifying) instruments. P-values report the probability of incorrectly rejecting the null hypothesis, so that a p-value above 0.05 implies that the probability of incorrectly rejecting the null is above 0.05. In this case, a higher p-value makes it more likely that the instruments are valid.

The consistency of the estimates also depends on the absence of serial correlation in the error terms. This will be the case if the differenced residuals display significant negative first order serial correlation and no second order serial correlation. We present tests for first-order and second-order serial correlation related to the estimated residuals in first differences. The test statistics are asymptotically distributed as standard normal variables. The null hypothesis here relates to "insignificance" so that a low p-value for the test on first-order serial correlation and a high p-value for the test on second-order serial correlation suggests that the disturbances are not serially correlated. The serial correlation tests (M1 and M2 in the table) refer to the one-step GMM estimates.

We also present Wald tests. These test statistics are also asymptotically distributed as χ^2 variables. As such, we test for joint significance of all parameters (or for a subset of parameters). The null hypothesis refers to "insignificance", implying that low p-values suggest joint significance. Wald tests for the joint significance of the time dummies and the region dummies are presented.

4 RESULTS

The results of our analysis are in table 3. We find that the direct effect of financial development on the volatility of per capita economic growth is positive, although never significant. We also find that the direct effect of the shocks from unexpected inflation are as expected, that is positive. Furthermore, this effect is highly significant. Most importantly, in all regressions the interactive terms between inflation uncertainty and financial development are negative and highly significant. This holds for both our financial development proxies. From this, we infer that financial development dampens the negative effects of inflation uncertainty on the volatility of economic growth on a per capita basis.

As to the 'usual suspects', we find that increased government consumption positively and significantly affects the volatility of growth. Furthermore, more trade – although not always significantly – reduces growth volatility. The results for financial development are not significantly affected by the inclusion of the (logarithm of the) begin of period real per capita income at market rates (GDPPC) and the average annual real GDP growth (GROW) rate respectively. Again, the direct effects of financial development are positive, but insignificant, and the interactive terms are significantly negative. In all, we have robust results.

For the statistical diagnostics of our results, we have that all equations seem to be reasonably good. The SARGAN tests show that in all regressions we cannot reject the null hypothesis of the validity of the instruments. In addition, the M1 and M2 statistics show that the equations do not suffer from first or second order serial correlation. Finally the WALD tests (WTEST) show that the time dummies as well as the region dummies are jointly significant.

Table 3: Financial Development, Inflation Uncertainty and the Volatility of Growth

	1	2	3	4	5	6
INFL (*1000)	0.066 (2.62)	0.058 (2.58)		0.037 (2.47)	0.033 (2.11)	
GROW			-0.003 (-1.91)			-0.003 (-2.03)
GOV	0.0146 (2.02)	0.0124 (2.22)	0.0060 (1.04)	0.0123 (1.76)	0.012 (1.92)	0.0067 (1.37)
TRADE	-0.0128 (-2.13)	-0.0028 (-0.40)	-0.0029 (-0.36)	-0.0137 (-2.24)	-0.0041 (-0.64)	-0.0042 (-0.47)
STD-GROW(-1)	0.0138 (0.22)	0.089 (1.50)	0.119 (1.83)	0.0385 (0.55)	0.088 (1.52)	0.117 (1.86)
GDPPC		0.018 (2.53)	0.016 (2.17)		0.018 (3.21)	0.013 (1.67)
BANK	0.0036 (1.14)	0.0023 (0.81)	0.0012 (0.49)			
PRIV				0.0037 (1.22)	0.0017 (0.76)	0.002 (1.11)
INFU (*1000)	0.132 (3.87)	0.120 (3.70)	0.063 (2.56)	0.129 (3.35)	0.122 (3.20)	0.0075 (4.83)
INFU* BANK (*1000)	-0.047 (-3.58)	-0.043 (-3.49)	-0.015 (-2.42)			
INFU*PRIV (*1000)				-0.0048 (-3.44)	-0.044 (-3.14)	-0.021 (-4.61)
M1	-2.08 p=0.04	-2.15 p=0.03	-2.32 p=0.02	-2.106 p=0.035	-2.179 p=0.03	-2.331 p=0.02
M2	0.540 p=0.59	0.003 p=0.99	0.488 p=0.63	0.705 p=0.481	0.218 p=0.83	0.517 p=0.61
SARGAN	60.02 p=0.33	65.81 p=0.41	74.40 p=0.18	60.86 p=0.31	71.52 p=0.24	65.08 p=0.44
WTEST TIME	7.42 p=0.06	13.79 p=0.003	10.56 p=0.014	10.88 p=0.012	15.19 p=0.002	13.54 p=0.004
WTEST REG	20.11 p=0.00	35.63 p=0.00	18.73 p=0.00	22.82 p=0.00	30.29 p=0.00	25.15 p=0.00

Note: In all regressions, starting from t-2, the entire history of the series in levels are used as instruments for the first differences. For the levels equations, the one period lagged differences of the corresponding variables are used as instruments. The t-values are between brackets.

5 CONCLUSION

The aim of this paper is to examine whether financial development dampens or strenghtens the effects of inflation uncertainty on the volatility of per capita growth. This is because we are interested whether financial structure and development plays a role in the transmission of monetary shocks. We investigate this for 88 countries in all income ranges for a period of 25 years (1976-2001). We estimate the relationships on the basis of GMM and employ five five-year period panels.

We find that inflation uncertainty has a positive and significant impact on the volatility of per capita economic growth. That is, more uncertainty about the inflation level increases this volatility. We also find that the direct effect of financial development on the volatility of per capita economic growth is not significantly different from zero. However, our estimates do show that the interactive term between financial development and inflation uncertainty is significantly different from zero. We interpret this as evidence for our view that financial development has a dampening effect on the impact of inflation uncertainty on this growth volatility. This is because we have a significant negative effect of financial development interacted with inflation uncertainty on the volatility of per capita economic growth. As such, we establish that financial structure and development indeed does play an important role in the transmission of monetary shocks to the economy.

Appendix 1: **Variables used in the estimates:**

If not indicated otherwise, variables are derived from data published in the on-line version of the 20002 World Bank development indicators.

BANK:	The logarithm of the period averages of domestic credit provided by the banking sector as a percentage of GDP. Number of observations: 435. Missing observations for Hong Kong (2); Hungary (1); Lesotho and Trinidad and Tobago
GDPPC:	The logarithm of the begin of period real GDP per capita. Number of observations: 440.
GOV:	The logarithm of the period averages of general government final consumption expenditures as a percentage of GDP. Number of observations: 439. Missing observation for Argentina.
GROW:	The average annual growth rate of real GDP at market rates per capita per period. This proxy is calculated by using figures on constant 1995 US$ GDP per capita data. Number of observations: 440.
INFL:	The average inflation rate for a period. Constructed by taking the average of annual inflation rates, based on GDP deflators. Number of observations: 440

INFU: Inflation uncertainty. Constructed by taking the standard deviation of the error terms from a second order autoregressive forecasting equation for inflation (based on annual GDP deflators). Number of observations: 440

PRIV: The logarithm of the period averages of credit to the private sector as a percentage of GDP, Number of observations: 437. Missing observations for Hong Kong (2) and Hungary (1).

STDGROW: Standard deviation of real per capita growth. Per capita growth is constructed from constant 1995 US$ figures on GDP per capita. Number of observations: 440

TRADE: The logarithm of the period averages of trade as a percentage of GDP. Number of observations: 440

Economies are divided among income groups according to 2001 GNI per capita, calculatèd using the World Bank atlas method:

- Low income: $745 or less
- Lower middle income: $746-2975
- Upper middle income: $2976-92006
- High-income: $9206 or more

Appendix 2: List of countries included in the analysis

Austria	1	Haiti	4	Panama	3
Bangladesh	4	Honduras	4	Papua New Guinea	3
Belgium	1	Hong Kong	1	Paraguay	3
Belize	3	Hungary	2	Peru	3
Benin	4	Iceland	1	Philippines	3
Bolivia	3	India	4	Rwanda	4
Brazil	2	Indonesia	4	Senegal	4
Burkina Faso	4	Ireland	1	Sierra Leone	4
Burundi	4	Israel	1	Singapore	1
Cameroon	4	Italy	1	Spain	1
Canada	1	Jamaica	2	Sri Lanka	3
Central Africar	4	Japan	1	Sweden	1
Chad	4	Kenya	4	Switzerland	1
Chile	2	Korea, Rep.	2	Syria	3
China	4	Lesotho	4	Thailand	3
Colombia	3	Luxembourg	1	Togo	4
Congo, Rep.	4	Madagascar	4	Trinidad and Tobag	2
Costa Rica	3	Malawi	4	Tunisia	3
Cote d'Ivoire	4	Malaysia	2	Turkey	2
Denmark	1	Mali	4	United Kingdom	1
Dominican Rep	3	Mauritania	4	United States	1
Ecuador	3	Mexico	2	Uruguay	2
Egypt	3	Morocco	3	Venezuela	2
El Salvador	3	Nepal	4	Zambia	4
Finland	1	Netherlands	1	Zimbabwe	4
France	1	New Zealand	1		
Gambia	4	Niger	4		

Note: 1=high income country; 2 =upper middle income country; 3 =lower middle income country and 4 = lower income country.

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