Laboratoire
de Recherche
en Gestion
& Economie

LARGE

LARGE

Papier

Papier

n° 2008-03

Financial Intermediation and Macroeconomic Efficiency

Yves Kuhry , Laurent Weill

Février 2008

Faculté des
sciences économiques
et de gestion

PEGE
61, avenue de la Forêt Noire
67085 STRASBOURG Cedex
Tél. : (33) 03 90 24 21 52
Fax : (33) 03 90 24 20 64
www-ulp.u-strasbg.fr/large

Institut d'Etudes Politiques
47, avenue de la Forêt Noire
67082 STRASBOURG Cedex

Financial Intermediation and Macroeconomic Efficiency

Yves Kuhry[*], Laurent Weill[†]

Abstract

Abstract: This paper evaluates whether financial intermediary development explains cross-country differences in macroeconomic efficiency. Stochastic frontier approach is applied at the aggregate level to estimate efficiency on a panel of 41 countries for the period 1991-1995. Generalized method-of-moments (GMM) dynamic panel techniques are then adopted to control for potential endogeneity of the regressors. We find evidence of a positive role of financial intermediary development on efficiency, with differences in terms of robustness according to the measure of financial intermediary development.

Keywords: financial development, income, aggregate productivity, efficiency.

JEL Classification: C33, O11, O16, O47.

[*]Université Louis Pasteur, 61 avenue de la Forêt Noire, 67085 Strasbourg, France. kuhry@cournot.u-strasbg.fr

[†]Corresponding author. Université Robert Schuman, Institut d'Etudes Politiques, 47 avenue de la Forêt Noire, 67082 Strasbourg Cedex, France. laurent.weill@iep.u-strasbg.fr

1 Introduction

What explains the cross-country differences in economic development? In the last decade, there have been two major contributions to this key economic issue. The first major contribution is the extensive empirical literature that shows the positive role of financial development on growth (King and Levine, 1993), and especially the positive impact of the development of financial intermediaries (Levine et al., 2000).

The second contribution has been provided by recent growth accounting literature, which supports the fact that factor accumulation is not the dominant engine of growth. Easterly and Levine (2001) notably observed that productivity growth accounted for the greater part of cross-country growth differences. Similarly, Caselli (2005) concludes in his analysis of the development accounting literature that cross-country differences in income mainly result from differences in productivity.

As a consequence, these both contributions suggest that the investigation of the role of financial development on productivity would provide new insights on the cross-country differences in economic development.

The aim of this paper is therefore to investigate the relationship between financial intermediary development and productivity, estimated with the frontier efficiency techniques. These techniques have been widely applied at the microeconomic level, with notably a wide set of studies in the banking industry. However, a couple of works have also extended their application to aggregate production functions (Färe et al., 1994; Moroney and Lovell, 1997). The estimation of aggregate production frontiers allows the computation of aggregate technical efficiency, which we will call macroeconomic efficiency. It consists in measuring countries' relative distance to an estimated common production frontier. Macroeconomic efficiency then measures how close a country's production is to its optimal production, using the same bundle of inputs.

Several techniques can be adopted to measure macroeconomic efficiency. In this work, we will use the stochastic frontier approach, following the works of Moroney and Lovell (1997) and Adkins et al. (2002). There are several reasons why macroeconomic efficiency is more relevant than standard aggregate productivity indicators, such as total factor productivity. First, macroeconomic efficiency provides a synthetic measure of performance. Indeed, unlike basic productivity measures such as per capita income, the efficiency scores allow to include several input dimensions in the evaluation of performances. As a result, output is not only compared to the labor stock, but also to the stocks of physical capital and human capital. Second, it provides relative measures of performance. Namely, the estimated common production frontier allows us to compare each country to its best possible practice given its endowments. Other measures of productivity compare countries whose endowments may differ greatly, which casts doubt on the meaning of such comparisons. Third, stochastic frontier approach has an additional advantage in respect to standard productivity measures. While total factor productivity measures performance with the difference between a country's actual and estimated productions, the stochastic frontier approach allows us to split the distance to the production frontier between an inefficiency term and a random error, taking exogenous events into account.

To our knowledge, two studies have already estimated aggregate production frontiers in an attempt to investigate the relationship between financial intermediary development and efficiency. However, they suffer from major limitations at varying degrees. Notably, none of them controls for potential endogeneity between financial intermediary development and macroeconomic efficiency.

Arestis et al. (2006) investigate this issue on a sample of 26 OECD countries for the period 1963-1992. They estimate macroeconomic efficiency with DEA, a frontier approach based on linear programming techniques. Financial intermediary development is proxied by the ratio of domestic credit to the private sector to GDP. The conclusion is a positive relationship between financial intermediary development and macroeconomic efficiency. This study however presents major shortcomings. Next to the small size of the country sample, the absence of developing economies in the sample may influence the results. Furthermore, this connection is tested through a regression of efficiency scores on financial intermediary development which undoubtedly lacks control variables. Even worse, the estimated production frontier does not include human capital. This is a major limitation since human capital has an important influence on growth and productivity. Finally, the analysis does not account for the potential endogeneity between the regressors.

However Méon and Weill (2006) solve two of these problems but not the last and greatest one. They investigate the relationship between financial intermediary development and macroeconomic efficiency on a sample of 47 countries. Adopting the stochastic frontier approach to estimate efficiency, they provide evidence of a positive influence of financial intermediary development on efficiency, which is dependent on the tested dimension of the financial intermediary development and increases with the level of economic development.

Unlike both of these papers, our work investigates the relationship between financial intermediary development and efficiency by using the generalized method-of-moments (GMM) dynamic panel estimators developed by Arellano and Bond (1991) and Arellano and Bover (1995). Panel data provide additional information for the analysis of the relationship between financial intermediary development and efficiency, resulting in more precise estimates. However, they raise the potential problem of the possible simultaneity between financial intermediary development and efficiency. The dynamic panel GMM techniques address potential endogeneity in the data. We then bring new findings on the role of financial intermediation on the cross-country differences in efficiency, which adopt refined econometric techniques.

The structure of the paper is as follows: next section describes the theoretical background of the influence of financial intermediary development on productivity. The third section explains how aggregate efficiency can be measured and analyzed. The fourth section presents data and variables. The fifth section displays results while the last section concludes.

2 The theoretical relationship between financial development and efficiency

This section presents the channels through which financial intermediary development may influence efficiency. Although it is usually assumed that the relationship is positive, a couple of counterarguments suggest that a negative influence cannot be ruled out.

All the arguments for a positive impact of financial intermediary development on efficiency rest on the role of the financial system to ease information, enforcement, and transaction costs in financing decisions and transactions. Levine (2005) thus considers the financial system's four main functions to reduce these costs. Accordingly, financial development allows the financial system to exert those functions more efficiently. However, several theoretical explanations for the link between financial development and growth hinge on the accumulation of physical capital, which would be favored by financial development. As the focus of the present paper is efficiency, we do not pay attention to the effects of these functions on capital accumulation. Moreover, we focus on financial intermediaries, and therefore do not comment upon the role of financial markets.

The first function of the financial system is to produce *ex ante* information about possible investments, and to allow a better allocation of capital. Financial intermediary development can improve productivity by this channel, as banks may reduce the costs of the evaluation of investment projects before the lending decision, and therefore improve allocation of capital. Indeed, several papers have underlined the reduction of the costs of acquiring and processing information (e.g. Boyd and Prescott, 1986). Furthermore, financial intermediaries may promote technological innovation by identifying borrowers with the best chances of successfully launching innovations.

The second function of the financial system is to monitor firms and to exert corporate governance. The reasoning is straightforward. By increasing the control of firm managers, financial intermediaries raise the pressure to perform and consequently increase their productivity. That pressure is beneficial because of the moral hazard problem in the management of firms, which results from the conflicts of interest between firms' managers and owners. The argument is notably based on the binding nature of debt. A loan contract with a financial intermediary reduces the "free cash-flow" at the disposal of managers (Jensen, 1986). Indeed, debt implies interest payment obligations that managers must satisfy, under the threat of bankruptcy. Grossman and Hart (1982) also argue that debt financing provides managers with greater incentives to perform, as they aim to avoid the personal costs of bankruptcy.

The financial system's third function is the pooling of savings. Financial intermediaries can thus help improve firms' productivity, by reducing information costs for savers, as well as transaction costs associated with the mobilization of savings from different economic agents. Therefore, financial intermediaries are useful to improve resource allocation, and also favor technological innovation.

The last function of the financial system consists in easing the exchange of goods and services. Financial development increases media of exchange and consequently facilitates the exchange of goods and services. According to Adam Smith's argument, this extension facilitates specialization, which is the main force behind productivity improvements.

A wide range of arguments, therefore, explain why financial intermediary development should raise productivity. These arguments are however qualified by a few counterarguments that emphasize the aftermath of financial liberalization. Namely, financial liberalization is likely to increase the probability of financial crises, and thus hamper growth. Rajan (1994) notably argues that bankers' incentives are affected by financial liberalization in such a way that it results in credit expansion and then in a greater volatility of output growth. In a closely related model, Dell-Aricia and Marquez (2006) show how financial liberalization in emerging countries can lead to a greater volatility of credit and a lower output growth.

Empirical elements on developing countries support these theoretical arguments. While De Gregorio and Guidotti (1995) observe a positive relationship between growth and financial development with a sample of 100 developed and developing countries between 1960 and 1985, they also point out that this relationship becomes negative when the investigation is restricted to Latin American countries. This finding is interpreted as the consequence of negative effects of financial liberalization during the 70s and the 80s in these countries.

Furthermore, Ranciere and Loayza (2005) analyze the short and the long-term impacts of financial development on growth with a sample of 75 countries during the period 1960-2000. They conclude that the effects of financial development depend on perspective, as a positive long-term relationship between both variables coexists with a negative short-term relationship. They also point out the effects of financial liberalization in developing countries to explain this negative impact, this interpretation being supported by the observation that negative short-term effects are only significant in financially fragile countries.

Overall, the literature provides several arguments explaining why financial intermediary development favors productivity, while the negative effects of financial liberalization qualify this positive impact. It is therefore of utmost interest to discover which effect dominates. We discuss our investigation in the next section.

3 Methodology

This section is devoted to the presentation of the econometric techniques used to investigate the relationship between financial intermediary development and efficiency. In the first subsection, we explain how we measure aggregate efficiency. The second subsection develops the dynamic panel GMM techniques.

3.1 Measuring efficiency

Our first task is to measure macroeconomic efficiency. We focus specifically on technical efficiency, which measures how close a country's production is to its optimal production, using the same bundle of inputs. We resort to the stochastic frontier approach to estimate technical efficiency, a method developed by Aigner et al. (1977) and applied at the aggregate level by Adkins et al. (2002) and Méon and Weill (2005) among others.

As mentioned above, an alternative technique based on linear programming tools, DEA, can also be applied and has been used by Arestis et al. (2006) to estimate macroeconomic efficiency. However, when comparing the macroeconomic efficiency measures obtained with the stochastic frontier approach and DEA, Weill (2006) concludes in favor of the robustness of efficiency measures to the choice of the frontier technique.

A production frontier is estimated with the stochastic frontier approach, providing a benchmark for each country regardless of its inputs. Then, the efficiency score is computed by comparing the optimal output per worker with the effective output per worker.

Once each country's efficiency is assessed, its relationship with financial development must be measured. We resort to a two-stage approach: efficiency scores are estimated in a first stage, and then regressed on the relevant set of explanatory variables in a second stage.

The stochastic frontier approach needs the specification of the production frontier. A Cobb-Douglas functional form is assumed for the production frontier, following its common specification in the empirical works on growth and macroeconomic efficiency. Furthermore, Hall and Jones (1999) observe in their estimation of aggregate productivity that results obtained with a Cobb-Douglas production function are very similar to those obtained when the production function is not restricted to that specification. We assume constant returns-to-scale because, as Moroney and Lovell (1997, p. 1086) observe, "at the economy-wide level, constant returns-to-scale is virtually compelling". The production frontier is then as follows:

$$\ln(Y/L)_{it} = \alpha_0 + \alpha_1 \ln(K/L)_{it} + \alpha_2 \ln(H/L)_{it} + \varepsilon_{it} \quad (1)$$

where i indexes countries and t stands for years of observation. (Y/L), (K/L), (H/L) are respectively output per worker, capital per worker, and human capital per worker.

Stochastic frontier approach assumes that the error term of the production frontier, (ε_{it}), is the sum of two independent random variables: a random disturbance, v_i, and an inefficiency term u_i. More precisely, v_i is a two-sided component representing random disturbances, reflecting luck or measurement errors. It is assumed to have a normal distribution. The term u_i is a one-sided component capturing technical inefficiencies. In accordance with the literature, we assume a half-normal distribution for the inefficiency term. We use the Frontier software version 4.1 by Coelli (1996) to perform the maximum likelihood estimation of the stochastic frontier model. We then estimate a production frontier for each year of the period.

3.2 The dynamic GMM estimators

In a previous study of the relationship between financial development and macroeconomic efficiency, Méon and Weill (2006) used a pooled model to estimate the model's parameters. However this method fails to take into account the dynamic aspects of this relationship and may thus present some omitted variables problems. Moreover, this estimator does not adress the potential problem of endogeneity of one or more of the explanatory variables. The dynamic aspect of the relationship between financial development and macroeconomic efficiency is captured through the inclusion of lagged efficiency amongst the regressors. We thus consider the following model:

$$Y_{i,t} = \alpha Y_{i,t-1} + \beta' X_{i,t} + \eta_i + \varepsilon_{i,t} \qquad i = 1, \ldots, N, t = 1, \ldots, T \tag{2}$$

where Y_t denotes financial development, X_{it} is a set of explanatory variables consisting of the financial development measure and control variables, η_i is a country specific effect and ε_{it} is the error term. The country specific effect is introduced in order to allow some heterogeneity in the means of the Y_{it} and is treated here as stochastic. We assume in the remainder of this section that the error term is not serially correlated.

Apart from the possible endogeneity of the explanatory variables X_{it} there is an obvious endogeneity problem due to the joint presence of a country specific effect and lagged efficiency in the regressors. A workaround to this problem is to consider the model in differences instead, thereby eliminating the country specific effect:

$$\nabla Y_t = \alpha \nabla Y_{t-1} + \beta' \nabla X_{i,t} + \nabla \varepsilon_{i,t}, \tag{3}$$

where ∇ is the difference operator, that is for a given variable x_t, $\nabla x_t = x_t - x_{t-1}$. However, OLS application still leads to inconsistent estimators since, now, the error term $\nabla \varepsilon_{i,t}$ is correlated with the differenced lagged dependant variable ∇Y_{t-1}.

Under the additional assumption that the explanatory variables X_{it} are predetermined[1], we can use prior observations of these variables as instruments to obtain a consistent estimator. Anderson and Hsiao (1981) present a 2SLS estimator based on these predetermination conditions when $T \geq 3$. If the number of periods is greater than 3, the model is overidentified. In such a case, Arellano and Bond (1991) propose to use all the instruments available

[1] That is, the current values of explanatory variables are uncorrelated with the future shocks.

and to estimate the model using the Generalized Method of Moments with the following moment conditions:

$$\begin{aligned} &E(Y_{i,s}\nabla\varepsilon_{i,t}) = 0, \qquad s = 1, \ldots, T-2, \\ &E(X_{i,s}\nabla\varepsilon_{i,t}) = 0, \qquad s = 1, \ldots, T-2. \end{aligned} \tag{4}$$

The estimator based on conditions (4) is obtained by making the matrix quadratic form:

$$\left(\frac{1}{N}\sum_{i=1}^{N} Z_i^T \nabla\varepsilon_i\right) W_N \left(\frac{1}{N}\sum_{i=1}^{N} \nabla\varepsilon_i^T Z_i\right). \tag{5}$$

where Z_i is the matrix of instruments, as close to zero as possible.

The corresponding GMM estimator is referred to as the GMM difference estimator. Different choices for the weight matrix W_N in equation (5) provide different estimators for the parameters of the model. Arellano and Bond (1991) propose to proceed in two steps. In a first step, the errors are assumed to be independant and homoskedastic. The residuals of the first step estimation are then used to compute the variance matrix of the errors.

A shortcoming of the difference estimator is that it has been shown to perform poorly in the presence of near unit root (see e.g. Blundell and Bond, 1998). These authors suggest using a so-called *system estimator* that combines moment conditions on the first differenced equation with those on the level equation (2). Namely, moments conditions on the level equation rest on the assumption that the country-specific effect is uncorrelated with past *differences* of the right hand side variables. Specifically, the system GMM estimation relies on the following additional conditions:

$$\begin{aligned} &E(\nabla Y_{i,t-1}(\eta_i + \varepsilon_{i,t})) = 0, \\ &E(\nabla X_{i,t-1}(\eta_i + \varepsilon_{i,t})) = 0. \end{aligned} \tag{6}$$

Only the most recent differences are used as instruments in order to avoid redundancy with conditions (4) (Arellano and Bover, 1995).

Now, as stressed above, the GMM estimator rests on the assumption of absence of serial correlation in the error term $\varepsilon_{i,t}$. This assumption can be ascertained by testing the absence of second order autocorrelation in the differenced error-term (which should, by construction, present first order serial correlation). Also, it is necessary to check the validity of the instruments, that is, that they are uncorrelated with the error term, but have a strong correlation with the RHS variables. Indeed, weak instruments can lead to large finite sample bias in the estimation. The validity of instruments can be confirmed using a Sargan test of overidentifying restrictions.

Our data cover a period of five consecutive years for 41 countries. Thus, the number of cross-sectional units remains quite small for the application of the GMM system estimator.

Now, it has been shown (see e.g. Arellano and Bond, 1991) that asymptotic standard errors are biased downwards for the two-step estimator. This problem is particularly crucial when the number of instruments is equal or larger than those of cross section units. Thus, following Beck and Levine (2004), we adressed this problem by performing estimations with one control variable at a time. Also, we consider here the results from the one-step estimation. If the estimated coefficient is less efficient than in the two-step procedure, statistical inference based on the first step results is more reliable considering our sample properties.

4 Data and variables

Macroeconomic data for the estimation of the production frontier are the same as in Easterly and Levine (2001), and come from the Growth Development Network database of the World Bank. Output is measured in purchasing power parity dollars. Capital was computed by Easterly and Levine (2001) using aggregate investment thanks to a perpetual inventory method, where a year's capital stock is equal to the previous year's capital stock plus investment in that year minus depreciation. Labor is measured as the number of workers. Human capital is proxied by the total number of years of schooling in the working-age population over 15 years old. It is taken from Barro and Lee (2000) education dataset and comes from the Economic Growth Resources website.

Financial intermediary development is evaluated using the three canonical measures of financial intermediary development that have repeatedly been used in the literature since King and Levine (1993). Namely, we use the ratio of the volume of credit to private enterprises to GDP (*PrivateCredit*). That ratio measures the extent to which credit is allocated to private firms, as opposed to government or state-owned firms. Consequently, it is a measure of the financial sector size, which isolates credit issued to the private sector. Furthermore, this measure considers who benefits from the credit.

We then use the ratio of liquid liabilities to GDP as a second measure of financial development (*LiquidLiabilities*). This ratio equals currency plus demand and interest-bearing liabilities of banks and non-bank financial intermediaries divided by GDP. It is therefore also a measure of the overall size of the financial sector, also known as financial depth. Unlike the variable *PrivateCredit*, this indicator takes into account the provision of services by financial intermediaries. Levine et al. (2000) however mentioned some shortcomings of this indicator. It is indeed an imperfect indicator of the quantity of services provided by financial intermediaries, as it involves double counting of deposits by including deposits by one financial intermediary in another. Furthermore, this indicator does not provide information on the ability of the financial sector to reduce the costs of transactions and to acquire information.

Finally, we also measure the role of commercial banks versus central banks in financing the economy, with our third ratio (*CommercialCentralBank*), which is defined as the ratio of commercial banks assets divided by the sum of commercial banks and central banks assets. It is expected to be positively linked with efficiency, as commercial banks are more likely to identify profitable investments, to monitor their customers, and to provide good-quality services. Consequently, it is a measure of financial intermediary development taking into account who grants credit.

Two remarks must be made on the three measures of financial intermediary development. *PrivateCredit* and *LiquidLiabilities* measure different dimensions of the size of the financial sector. *PrivateCredit* and *CommercialCentralBank* are linked with the importance of the private sector in the economy. Namely, while this point is obvious for *PrivateCredit*, it can also be made for *CommercialCentralBank* because the relative importance of commercial banks is a proxy for the role of private banks in the banking industry. All data on financial development are taken from Beck et al. (2000) dataset.

Three control variables are also included, which are standard in the finance and growth literature (e.g. Beck and Levine, 2004; Rioja and Valev, 2004). *TradeOpenness* is the ratio of trade to GDP, which proxies openness to trade. *InflationRate* denotes the truncated inflation rate. Namely, as it can take extreme values, we used the logarithm of that variable added to unity so as to limit the influence of such observations. *GovernmentSize* measures the ratio of government expenditures to GDP. Data on inflation and government expenditures are taken from Beck et al. (2000) dataset.

We estimate our model on a five year period between 1991 and 1995. The countries in the sample are both developed and developing, as can be shown in the list of countries displayed in table 5. All in all, we ended up with a balanced sample of 41 countries. Although a balanced sample is not required by the applied techniques, it is preferable since it prevents an influence of the composition of the country sample on the efficiency scores. Indeed, we estimate one efficiency frontier for each year to allow the technology changes over time. Therefore, as efficiency scores are relative measures of performance, an unbalanced sample could lead to some variations in efficiency scores owing only to the modification of the country sample.

Descriptive statistics on variables are presented in table 1.

Table 1: Descriptive statistics

Variable	Mean	Std Dev.	Minimum	Maximum
Y/L	10.3655	14.0173	0.0701	49.5210
K/L	33.2830	47.8574	0.1810	190.4666
H/L	0.0102	0.0047	0.0008	0.0186
Efficiency	0.8055	0.1150	0.4020	0.9990
TradeOpenness	66.5992	29.9559	17.7000	194.8800
InflationRate	0.1377	0.1445	-0.0640	0.7242
GovernmentSize	0.1627	0.0762	0.0539	0.4903
PrivateCredit	0.4537	0.3782	0.0236	1.6323
LiquidLiabilities	0.4629	0.2589	0.0351	1.4050
Commercial-Central Bank	0.8024	0.1840	0.0543	0.9946

Y/L, K/L, H/L are respectively output per worker, physical capital per worker, human capital per worker. Efficiency is the technical efficiency score in percentage.

The table presents the descriptive statistics for the means by country. Y/L, K/L, H/L, are respectively output per worker, physical capital per worker, and human capital per worker. *TradeOpenness* denotes a dummy variable, while *InflationRate* is the logarithm of the inflation rate in percentage plus unity.

5 Results

Table 2: Results with PrivateCredit

	Model I	Model II	Model III
Constant	0.618*** (0.000)	0.798*** (0.000)	0.689*** (0.000)
Finance	0.291** (0.025)	0.125* (0.065)	0.258*** (0.008)
TradeOpenness	0.001 (0.565)		
InflationRate		−0.360** (0.049)	
GovernmentSize			−0.004 (0.994)
Sargan Test[1]	20.58 (0.716)	57.00*** (0.000)	28.29 (0.294)
AR1 Test	−3.209*** (0.001)	−3.896*** (0.000)	−3.013*** (0.003)
AR2 Test	1.394 (0.163)	1.002 (0.316)	1.609 (0.108)

*, **, *** indicate significance at the 10%, 5% and 1% level.

[1] The null corresponds to the absence of correlation between instruments and the residuals.

This section presents the results of our estimations[2]. Tables 2 to 4 display the one-step estimation results for our three measures of financial development, using Blundell and Bond (1998) so-called system estimator along with

[2]Our results were obtained by using the Ox version of DPD (Doornik et al., 1999)

Table 3: Results with LiquidLiabilities

	Model I	Model II	Model III
Constant	0.585^{***} (0.000)	0.823^{***} (0.000)	0.823^{***} (0.000)
Finance	0.253 (0.149)	0.068 (0.432)	0.307^{**} (0.031)
TradeOpenness	0.001 (0.434)		
InflationRate		-0.359^{**} (0.022)	
GovernmentSize			-0.985^{**} (0.043)
Sargan Test[1]	21.25 (0.678)	64.92^{***} (0.000)	19.45 (0.775)
AR1 Test	-2.844^{***} (0.004)	-4.072^{***} (0.000)	-3.104^{***} (0.002)
AR2 Test	1.476 (0.140)	1.031 (0.302)	2.175^{**} (0.030)

*, **, *** indicate significance at the 10%, 5% and 1% level.

[1] The null corresponds to the absence of correlation between instruments and the residuals.

the Sargan and AR tests statistics. We performed three estimations for each financial intermediary development variable, each estimation using one control variable at a time in order to keep the number of instruments relatively small with respect to the number of cross-section units.

We observe a positive coefficient for all three financial intermediary development measures in all estimations. This is a major finding as it supports the view that financial intermediary development fosters macroeconomic efficiency. However, the significance of the coefficients generally differs according to the chosen control variable.

Table 4: Results with Commercial-Central Bank

	Model I	Model II	Model III
Constant	0.499^{***} (0.000)	0.713^{***} (0.000)	0.788^{***} (0.000)
Finance	0.248 (0.148)	0.175 (0.216)	0.233^{**} (0.031)
TradeOpenness	0.002 (0.129)		
InflationRate		-0.350^{**} (0.048)	
GovernmentSize			-1.042^{*} (0.080)
Sargan Test[1]	29.94 (0.226)	63.56^{***} (0.000)	27.34 (0.339)
AR1 Test	-3.210^{***} (0.001)	-3.670^{***} (0.000)	-3.208^{***} (0.001)
AR2 Test	0.670 (0.503)	0.560 (0.576)	0.345 (0.730)

*, **, *** indicate significance at the 10%, 5% and 1% level.

[1] The null corresponds to the absence of correlation between instruments and the residuals.

The significant impact of *PrivateCredit* is very robust as it is observed in all three estimations. Nonetheless, in the estimation with the control variable *InflationRate*, the Sargan test rejects the validity of instruments at the 10 percent significance level. It must however be stressed that this diagnosis of the Sargan test is observed for all estimations using *InflationRate* as the control variable, which suggests that this variable presents some statistical shortcomings to be used as an instrument. The positive influence of the variables *LiquidLiabilities* and *CommercialCentralBank* is only significant when *GovernmentSize* is the control variable.

Therefore, our main finding is the positive role of financial intermediary development on macroeconomic efficiency. Consequently, we show that the share of credit devoted to private sector tends to be the most robust dimension of financial intermediary development, favoring macroeconomic efficiency.

Our results are in accordance with both former empirical studies on this issue. Arestis et al. (2006) observe a positive and significant impact of financial intermediary development, measured either with *PrivateCredit* or with *LiquidLiabilities* on macroeconomic efficiency. Méon and Weill (2006) also support the positive influence of financial intermediary development on macroeconomic efficiency. They point out some differences similar to those in our analysis between the three tested measures of financial intermediary development. Indeed, while the impact is significant for the variables *PrivateCredit* and *CommercialCentralBank*, it is not significant for the variable *LiquidLiabilities*. These differentiated findings can be put into parallel with ours, as we conclude that the positive role of *PrivateCredit* is more robust than that of *LiquidLiabilities* and also *CommercialCentralBank*. Therefore, unlike these both papers, we address potential endogeneity in the data with the application of dynamic panel GMM techniques, and thus confirm the findings of these papers.

The analysis of the control variables shows significant coefficients in accordance with the intuition. Namely, *InflationRate* has a significantly negative impact on macroeconomic efficiency, which can be explained by inflation-induced distorsions. An increase in *GovernmentSize* significantly hampers macroeconomic efficiency, which was also observed by Delorme et al. (1999) in their analysis of the impact of governement expenditures on macroeconomic efficiency. This may be explained by some crowding-out phenomena.

Both results were are also observed by Rioja and Valev (2004).

6 Concluding remarks

This paper provides new empirical evidence on the finance-growth nexus by investigating the role of financial intermediary development on macroeconomic efficiency. Since empirical observations show that cross-country differences in income mainly result from differences in productivity, it is of utmost interest to know whether financial intemediary development influences macroeconomic efficiency. Our results support the view that financial intermediary development fosters macroeconomic efficiency after controlling for potential endogeneity. As a consequence, we provide evidence that cross-country differences in financial intermediary development explain cross-country differences in efficiency. The comparison of the findings obtained with the three financial intermediary development measures shows that the credit granted to private sector to GDP is the most robust measure of financial intermediary development positively related to macroeconomic efficiency.

The normative implications of our findings are straightforward. They support policies favoring financial intermediary development, particularly the enhancement of the credit granted to the private sector. This work can be extended in various ways. The role of the development of financial markets, both alone and with financial intermediary development, on macroeconomic efficiency could also be investigated in the line of the works from Levine and Zervos (1998) and Beck and Levine (2004) on their impact on growth. Therefore this study opens avenues for further research.

References

Adkins, C., Moomaw, R. and Savvides, A. (2002), 'Institutions, freedom, and technical efficiency', *Southern Economic Journal* **69**(1), 92–108.

Aigner, D., Lovell, C. and Schmidt, P. (1977), 'Formulation and estimation of stochastic frontier production function models', *Journal of Econometrics* **6**, 21–37.

Anderson, T. and Hsiao, C. (1981), 'Estimation of dynamics models with error components', *Journal of the American Statistical Association* **76**, 589–606.

Arellano, M. and Bond, S. (1991), 'Some tests of specification for panel data: Monte carlo evidence and an application to employment equations', *Review of Economic Studies* **58**(2), 277–297.

Arellano, M. and Bover, O. (1995), 'Another look at the instrumental-variable estimation of error-components', *Journal of Econometrics* **68**(1), 29–52.

Arestis, P., Chortareas, G. and Desli, E. (2006), 'Financial development and productive efficiency in oecd countries: An exploratory analysis', *Manchester School* **74**(4), 417–440.

Barro, R. and Lee, J. (2000), 'International data on educational attainment updates and implications', *Oxford Economic Papers* **53**(3), 541–563.

Beck, T., Demirgüc-Kunt, A. and Levine, R. (2000), 'A new database on financial development and structure', *World Bank Economic Review* **14**, 597–605.

Beck, T. and Levine, R. (2004), 'Stock markets, banks, and growth: Panel evidence', *Journal of Banking and Finance* **28**(3), 423–442.

Blundell, R. and Bond, S. (1998), 'Initial conditions and moment restrictions in dynamic panel data models', *Journal of Econometrics* **87**(1), 115–143.

Boyd, J. and Prescott, E. (1986), 'Financial intermediary - coalitions', *Journal of Economic Theory* **38**(2), 211–232.

Caselli, F. (2005), Accounting for cross-country income differences, *in* P. Aghion and S. Durlauf, eds, 'Handbook of Economic Growth', Vol. 1 of *Handbook of Economic Growth*, Elsevier, chapter 9, pp. 679–741.

Coelli, T. (1996), 'A guide to frontier 4.1: a computer program for stochastic production and cost function estimation', *Centre for Efficiency and Productivity Analysis* (96/07).

De Gregorio, J. and Guidotti, P. (1995), 'Financial development and economic growth', *World Development* **23**(3), 433–448.

Dell-Aricia, G. and Marquez, R. (2006), 'Lending booms and lending standards', *Journal of Finance* **61**(5), 2511–2546.

Delorme, C., Thompson, H. and Warren, R. (1999), 'Public infrastructure and private productivity: A stochastic-frontier approach', *Journal of Macroeconomics* **21**(3), 563–576.

Doornik, J. A., Arellano, M. and Bond, S. (1999), 'Panel data estimation using dpd for ox'. mimeo.
*www.doornik.com/download/dpd.pdf

Easterly, W. and Levine, R. (2001), 'It's not factor accumulation: Stylized facts and growth models', *World Bank Economic Review* **15**(2), 177–219.

Färe, R., Grosskopf, S., Norris, M. and Zhang, Z. (1994), 'Productivity growth, technical progress and efficiency changes in industrial countries', *American Economic Review* **84**(1), 66–83.

Grossman, S. J. and Hart, O. D. (1982), Corporate financial structure and managerial incentives, *in* J. McCall, ed., 'The Economics of Information and Uncertainty', University of Chicago Press, Chicago.

Hall, R. and Jones, C. (1999), 'Why do some countries produce so much more output per worker than others?', *Quarterly Journal of Economics* **114**(1), 83–116.

Jensen, M. (1986), 'Agency costs of free cash flow, corporate finance, and takeovers', *American Economic Review* **76**(2), 323–329.

King, R. and Levine, R. (1993), 'Finance and growth: Schumpeter might be right', *Quarterly Journal of Economics* **108**(3), 717–737.

Levine, R. (2005), Finance and growth: Theory and evidence, *in* P. Aghion and S. Durlauf, eds, 'Handbook of Economic Growth', Vol. 1 of *Handbook of Economic Growth*, Elsevier, chapter 12, pp. 865–934.

Levine, R., Loayza, N. and Beck, T. (2000), 'Financial intermediation and growth: Causality and causes', *Journal of Monetary Economics* **46**(1), 31–77.

Levine, R. and Zervos, S. (1998), 'Stock markets, banks, and growth', *American Economic Review* **88**(3), 537–558.

Méon, P.-G. and Weill, L. (2005), 'Does better governance foster efficiency? an aggregate frontier analysis', *Economics of Governance* **6**(1), 75–90.

Méon, P.-G. and Weill, L. (2006), Does financial intermediation matter for macroeconomic performance ?, Working Papers DULBEA, Research Series 06-13.RS, Université Libre de Bruxelles, Department of Applied Economics (DULBEA).

Moroney, J. and Lovell, C. (1997), 'The relative efficiencies of market and planned economies', *Southern Economic Journal* **63**(4), 1084–1093.

Rajan, R. (1994), 'Why bank credit policies fluctuate: A theory and some evidence', *Quarterly Journal of Economics* **109**(2), 399–442.

Ranciere, R. and Loayza, N. (2005), Financial development, financial fragility, and growth, imf Working Papers 05/170, International Monetary Fund.

Rioja, F. and Valev, N. (2004), 'Does one size fit all? a reexamination of the finance and growth relationship', *Journal of Development Economics* **74**(2), 429–447.

Weill, L. (2006), 'On the consistency of aggregate production frontiers', *European Journal of Operational Research* **172**(1), 326–333.

Appendix

Table 5: Countries List

Algeria	Israel	Sri Lanka
Australia	Italy	Sweden
Bolivia	Jamaica	Switzerland
Cameroon	Jordania	Thailand
Canada	Kenya	Trinidad and Tobago
Chile	Korea	Tunisia
Colombia	Malawi	Turky
Costa Rica	Malaysia	United States
Denmark	Mali	Uruguay
Dominican Republic	Mauritius	Venezuela
Ecuador	Mexico	
Egypt	Netherlands	
El Salvador	New Zealand	
Finland	Norway	
Ghana	Pakistan	
Guatemala	Paraguay	
Honduras	Philippines	
India	Senegal	
Indonesia	Sierra Leone	
Ireland	South Africa	

PAPIERS

Laboratoire de Recherche en Gestion & Economie
(LARGE)

D.R. n° 1 "Bertrand Oligopoly with decreasing returns to scale", J. Thépot, décembre 1993

D.R. n° 2 "Sur quelques méthodes d'estimation directe de la structure par terme des taux d'intérêt", P. Roger - N. Rossiensky, janvier 1994

D.R. n° 3 "Towards a Monopoly Theory in a Managerial Perspective", J. Thépot, mai 1993

D.R. n° 4 "Bounded Rationality in Microeconomics", J. Thépot, mai 1993

D.R. n° 5 "Apprentissage Théorique et Expérience Professionnelle", J. Thépot, décembre 1993

D.R. n° 6 "Stratégic Consumers in a Duable-Goods Monopoly", J. Thépot, avril 1994

D.R. n° 7 "Vendre ou louer ; un apport de la théorie des jeux", J. Thépot, avril 1994

D.R. n° 8 "Default Risk Insurance and Incomplete Markets", Ph. Artzner - FF. Delbaen, juin 1994

D.R. n° 9 "Les actions à réinvestissement optionnel du dividende", C. Marie-Jeanne - P. Roger, janvier 1995

D.R. n° 10 "Forme optimale des contrats d'assurance en présence de coûts administratifs pour l'assureur", S. Spaeter, février 1995

D.R. n° 11 "Une procédure de codage numérique des articles", J. Jeunet, février 1995

D.R. n° 12 Stabilité d'un diagnostic concurrentiel fondé sur une approche markovienne du comportement de rachat du consommateur", N. Schall, octobre 1995

D.R. n° 13 "A direct proof of the coase conjecture", J. Thépot, octobre 1995

D.R. n° 14 "Invitation à la stratégie", J. Thépot, décembre 1995

D.R. n° 15 "Charity and economic efficiency", J. Thépot, mai 1996

D.R. n° 16 "Princing anomalies in financial markets and non linear pricing rules", P. Roger, mars 1996

D.R. n° 17 "Non linéarité des coûts de l'assureur, comportement de prudence de l'assuré et contrats optimaux", S. Spaeter, avril 1996

D.R. n° 18 "La valeur ajoutée d'un partage de risque et l'optimum de Pareto : une note", L. Eeckhoudt - P. Roger, juin 1996

D.R. n° 19 "Evaluation of Lot-Sizing Techniques : A robustess and Cost Effectiveness Analysis", J. Jeunet, mars 1996

D.R. n° 20 "Entry accommodation with idle capacity", J. Thépot, septembre 1996

D.R. n° 21 "Différences culturelles et satisfaction des vendeurs : Une comparaison internationale", E. Vauquois-Mathevet - J.Cl. Usunier, novembre 1996

D.R. n° 22 "Evaluation des obligations convertibles et options d'échange", A. Schmitt - F. Home, décembre 1996

D.R n° 23 "Réduction d'un programme d'optimisation globale des coûts et diminution du temps de calcul, J. Jeunet, décembre 1996

D.R. n° 24 "Incertitude, vérifiabilité et observabilité : Une relecture de la théorie de l'agence", J. Thépot, janvier 1997

D.R. n° 25 "Financement par augmentation de capital avec asymétrie d'information : l'apport du paiement du dividende en actions", C. Marie-Jeanne, février 1997

D.R. n° 26 "Paiement du dividende en actions et théorie du signal", C. Marie-Jeanne, février 1997

D.R. n° 27 "Risk aversion and the bid-ask spread", L. Eeckhoudt - P. Roger, avril 1997

D.R. n° 28 "De l'utilité de la contrainte d'assurance dans les modèles à un risque et à deux risques", S. Spaeter, septembre 1997

D.R. n° 29 "Robustness and cost-effectiveness of lot-sizing techniques under revised demand forecasts", J. Jeunet, juillet 1997

D.R. n° 30 "Efficience du marché et comparaison de produits à l'aide des méthodes d'enveloppe (Data envelopment analysis)", S. Chabi, septembre 1997

D.R. n° 31 "Qualités de la main-d'œuvre et subventions à l'emploi : Approche microéconomique", J. Calaza - P. Roger, février 1998

D.R n° 32 "Probabilité de défaut et spread de taux : Etude empirique du marché français", M. Merli - P. Roger, février 1998

D.R. n° 33 "Confiance et Performance : La thèse de Fukuyama", J.Cl. Usunier - P. Roger, avril 1998

D.R. n° 34 "Measuring the performance of lot-sizing techniques in uncertain environments", J. Jeunet - N. Jonard, janvier 1998

D.R. n° 35 "Mobilité et décison de consommation : premiers résultas dans un cadre monopolistique", Ph. Lapp, octobre 1998

D.R. n° 36 "Impact du paiement du dividende en actions sur le transfert de richesse et la dilution du bénéfice par action", C. Marie-Jeanne, octobre 1998

D.R. n° 37 "Maximum resale-price-maintenance as Nash condition", J. Thépot, novembre 1998

D.R. n° 38 "Properties of bid and ask prices in the rank dependent expected utility model", P. Roger, décembre 1998

D.R. n° 39 "Sur la structure par termes des spreads de défaut des obligations », Maxime Merli / Patrick Roger, septembre 1998

D.R. n° 40 "Le risque de défaut des obligations : un modèle de défaut temporaire de l'émetteur", Maxime Merli, octobre 1998

D.R. n° 41 "The Economics of Doping in Sports", Nicolas Eber / Jacques Thépot, février 1999

D.R. n° 42 "Solving large unconstrained multilevel lot-sizing problems using a hybrid genetic algorithm", Jully Jeunet, mars 1999

D.R n° 43 "Niveau général des taux et spreads de rendement", Maxime Merli, mars 1999

D.R. n° 44 "Doping in Sport and Competition Design", Nicolas Eber / Jacques Thépot, septembre 1999

D.R. n° 45 "Interactions dans les canaux de distribution", Jacques Thépot, novembre 1999

D.R. n° 46 "What sort of balanced scorecard for hospital", Thierry Nobre, novembre 1999

D.R. n° 47 "Le contrôle de gestion dans les PME", Thierry Nobre, mars 2000

D.R. n° 48 ″Stock timing using genetic algorithms", Jerzy Korczak – Patrick Roger, avril 2000

D.R. n° 49 "On the long run risk in stocks : A west-side story", Patrick Roger, mai 2000

D.R. n° 50 "Estimation des coûts de transaction sur un marché gouverné par les ordres : Le cas des composantes du CAC40", Laurent Deville, avril 2001

D.R. n° 51 "Sur une mesure d'efficience relative dans la théorie du portefeuille de Markowitz", Patrick Roger / Maxime Merli, septembre 2001

D.R. n° 52 "Impact de l'introduction du tracker Master Share CAC 40 sur la relation de parité call-put", Laurent Deville, mars 2002

D.R. n° 53 "Market-making, inventories and martingale pricing", Patrick Roger / Christian At / Laurent Flochel, mai 2002

D.R. n° 54 "Tarification au coût complet en concurrence imparfaite", Jean-Luc Netzer / Jacques Thépot, juillet 2002

D.R. n° 55 "Is time-diversification efficient for a loss averse investor ?", Patrick Roger, janvier 2003

D.R. n° 56 "Dégradations de notations du leader et effets de contagion", Maxime Merli / Alain Schatt, avril 2003

D.R. n° 57 "Subjective evaluation, ambiguity and relational contracts", Brigitte Godbillon, juillet 2003

D.R. n° 58 "A View of the European Union as an Evolving Country Portfolio", Pierre-Guillaume Méon / Laurent Weill, juillet 2003

D.R. n° 59 "Can Mergers in Europe Help Banks Hedge Against Macroeconomic Risk ?", Pierre-Guillaume Méon / Laurent Weill, septembre 2003

D.R. n° 60 "Monetary policy in the presence of asymmetric wage indexation", Giuseppe Diana / Pierre-Guillaume Méon, juillet 2003

D.R. n° 61 "Concurrence bancaire et taille des conventions de services", Corentine Le Roy, novembre 2003

D.R. n° 62 "Le petit monde du CAC 40", Sylvie Chabi / Jérôme Maati

D.R. n° 63 "Are Athletes Different ? An Experimental Study Based on the Ultimatum Game", Nicolas Eber / Marc Willinger

D.R. n° 64 "Le rôle de l'environnement réglementaire, légal et institutionnel dans la défaillance des banques : Le cas des pays émergents", Christophe Godlewski, janvier 2004

D.R. n° 65 "Etude de la cohérence des ratings de banques avec la probabilité de défaillance bancaire dans les pays émergents", Christophe Godlewski, Mars 2004

D.R. n° 66 "Le comportement des étudiants sur le marché du téléphone mobile : Inertie, captivité ou fidélité ?", Corentine Le Roy, Mai 2004

D.R. n° 67 "Insurance and Financial Hedging of Oil Pollution Risks", André Schmitt / Sandrine Spaeter, September, 2004

D.R. n° 68 "On the Backwardness in Macroeconomic Performance of European Socialist Economies", Laurent Weill, September, 2004

D.R. n° 69 "Majority voting with stochastic preferences : The whims of a committee are smaller than the whims of its members", Pierre-Guillaume Méon, September, 2004

D.R. n° 70 “Modélisation de la prévision de défaillance de la banque : Une application aux banques des pays émergents”, Christophe J. Godlewski, octobre 2004

D.R. n° 71 “Can bankruptcy law discriminate between heterogeneous firms when information is incomplete ? The case of legal sanctions”, Régis Blazy, october 2004

D.R. n° 72 “La performance économique et financière des jeunes entreprises”, Régis Blazy/Bertrand Chopard, octobre 2004

D.R. n° 73 “*Ex Post* Efficiency of bankruptcy procedures : A general normative framework”, Régis Blazy / Bertrand Chopard, novembre 2004

D.R. n° 74 “Full cost pricing and organizational structure”, Jacques Thépot, décembre 2004

D.R. n° 75 “Prices as strategic substitutes in the Hotelling duopoly”, Jacques Thépot, décembre 2004

D.R. n° 76 “Réflexions sur l’extension récente de la statistique de prix et de production à la santé et à l’enseignement”, Damien Broussolle, mars 2005

D. R. n° 77 “Gestion du risque de crédit dans la banque : Information hard, information soft et manipulation ”, Brigitte Godbillon-Camus / Christophe J. Godlewski

D.R. n° 78 “Which Optimal Design For LLDAs”, Marie Pfiffelmann

D.R. n° 79 “Jensen and Meckling 30 years after : A game theoretic view”, Jacques Thépot

D.R. n° 80 “Organisation artistique et dépendance à l’égard des ressources”, Odile Paulus, novembre 2006

D.R. n° 81 “Does collateral help mitigate adverse selection ? A cross-country analysis”, Laurent Weill –Christophe J. Godlewski, novembre 2006

D.R. n° 82 “Why do banks ask for collateral and which ones ?”, Régis Blazy - Laurent Weill, décembre 2006

D.R. n° 83 “The peace of work agreement : The emergence and enforcement of a swiss labour market institution”, D. Broussolle, janvier 2006.

D.R. n° 84 “The new approach to international trade in services in view of services specificities : Economic and regulation issues”, D. Broussolle, septembre 2006.

D.R. n° 85 “Does the consciousness of the disposition effect increase the equity premium” ?, P. Roger, juin 2007

D.R. n° 86 “Les déterminants de la décision de syndication bancaire en France”, Ch. J. Godlewski

D.R. n° 87 “Syndicated loans in emerging markets”, Ch. J. Godlewski / L. Weill, mars 2007

D.R. n° 88 “Hawks and loves in segmented markets : A formal approach to competitive aggressiveness", Claude d'Aspremont / R. Dos Santos Ferreira / J. Thépot, mai 2007

D.R. n° 89 "On the optimality of the full cost pricing", J. Thépot, février 2007

D.R. n° 90 "SME's main bank choice and organizational structure : Evidence from France", H. El Hajj Chehade / L. Vigneron, octobre 2007

D.R n° 91 "How to solve St Petersburg Paradox in Rank-Dependent Models" ?, M. Pfiffelmann, octobre 2007

D.R. n° 92 "Full market opening in the postal services facing the social and territorial cohesion goal in France", D. Broussolle, novembre 2007

D.R. n° 2008-01 A behavioural Approach to financial puzzles, M.H. Broihanne, M. Merli, P. Roger, janvier 2008

D.R. n° 2008-02 What drives the arrangement timetable of bank loan syndication ?, Ch. J. Godlewski, février 2008

D.R. n° 2008-03 Financial intermediation and macroeconomic efficiency, Y. Kuhry, L. Weill, février 2008

D.R. n° 2008-04 The effects of concentration on competition and efficiency : Some evidence from the french audit market, G. Broye, L. Weill, février 2008

D.R. n° 2008-05 Does financial intermediation matter for macroeconomic efficiency?, P.G. Méon, L. Weill, février 2008

D.R. n° 2008-06 Is corruption an efficient grease ?, P.G. Méon, L. Weill, février 2008

D.R. n° 2008-07 Convergence in banking efficiency across european countries, L. Weill, Février 2008.