

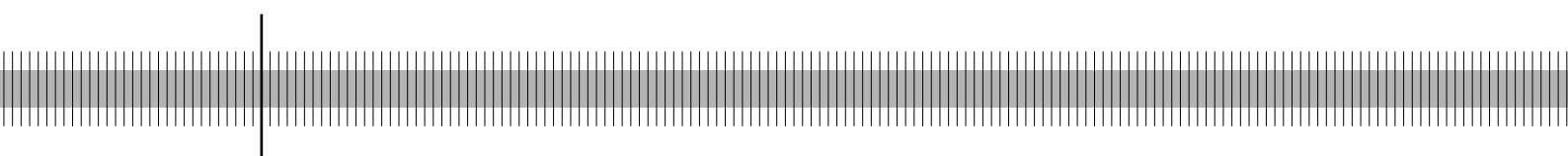
Finance and growth in a bank-based economy: is it quantity or quality that matters?

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Discussion Paper
Series 2: Banking and Financial Studies
No 02/2006

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ISBN 3-86558-145-5 (Printversion)

ISBN 3-86558-146-3 (Internetversion)

Abstract

With this paper we seek to contribute to the literature on the relation between finance and growth. We argue that most studies in the field fail to measure the quality of financial intermediation but rather resort to using proxies on the size of financial systems. Moreover, cross-country comparisons suffer from the disadvantage that systematic differences between markedly different economies may drive the result that finance matters. To circumvent these two problems we examine the importance of the quality of banks' financial intermediation in the regions of one economy only: Germany. To approximate the quality of financial intermediation we use cost efficiency estimates derived with stochastic frontier analysis. We find that the quantity of supplied credit is indeed insignificant when a measure of intermediation quality is included. In turn, the efficiency of intermediation is robust, also after excluding banks likely to operate in multiple regions and distinguishing between different banking pillars active in Germany.

Keywords: Finance-growth nexus, financial intermediation, regional growth

JEL: G21, G28, O4, R11

Non-technical summary

Already in 1911, Joseph Schumpeter advocated that a well-developed financial system improves the allocation of financial capital. Intermediaries help to identify the most profitable investment projects, thereby improving productivity and, ultimately, economic welfare. Since the early 1990's, empirical evidence in support of what is known today as the finance-growth nexus is increasingly available.

But the empirical evidence suffers from two important caveats. First, most studies employ the *volume* of bank credit relative to national income to grasp financial development. In contrast, we hypothesize that it is especially the *quality* of financial institutions that matters for economic growth. Second, the majority of studies is of a cross-country nature. But the required assumption of a homogeneous production technology across markedly different economies may be overly heroic.

Our suggestions in this paper are twofold. First, we use an alternative measure derived from individual bank data to approximate the quality of financial intermediation: cost efficiency. Second, we analyze the regions of one economy only: Germany.

With regard to the former, we argue that well-developed banks successfully minimize non-random deviations from optimal costs due to poor in- and output choices. Cost inefficiency grasps poor information gathering skills *ex ante* and *ex post* the funding of projects as far as less able banks incur higher costs in the longer run, for example due to higher write-offs of loans that eventually default due to poor selection and monitoring of the creditor. Regarding the latter suggestion, we ensure with our regional choice that structural differences known to influence growth, such as legal and cultural standards, are homogeneous. More specifically, we use data on 97 economic planning regions in Germany between 1994 and 2003.

Our main results can be summarized as follows. First, we find that cost efficiency, averaged across all universal banking groups per region, has a significant and positive influence on growth. An increasing ability to channel financial funds from savers to depositors efficiently fosters economic growth.

Second, for this sample the traditionally used volume of credit variable is insignificant. Apparently, an expansion of loan volumes has per se no significant impact on growth.

Third, the positive relation between efficiency and growth is robust after excluding all nationally active banks, which are likely to operate beyond their region of residence. Hence, the relevance of quality and the insignificance of sheer volume remains valid.

Fourth, the distinction between public and private banks highlights the heterogeneity of German banking. While both groups' efficiency continue to exhibit a positive influence on growth, we can only find a significant average efficiency effect for private banks. Possibly, the role of public banks is too different across Germany's regions to obtain a statistically significant effect for the entirety of Germany. Most importantly we conclude that to promote growth it is the quality of financial intermediation that requires attention rather than a mere expansion of loan volumes.

Nichttechnische Zusammenfassung

Bereits 1911 argumentierte Joseph Schumpeter, dass ein gut entwickeltes Bankensystem die effiziente Allokation von Finanzmitteln fördert. Die bessere Auswahl profitabler Investitionsprojekte durch Intermediäre trägt zur Steigerung der Produktivität bei und führt zu positiven Wohlfahrtseffekten. Zunehmend vorhandene empirische Evidenz bestätigt diesen Zusammenhang.

Diese empirischen Studien leiden jedoch unter zwei Schwächen. Zum einen wird der Entwicklungsstand eines Finanzsystems oftmals durch das aggregierte Kreditvolumen gemessen. Es ist jedoch vielmehr die Qualität der Intermediationstätigkeit, welche einen Wachstumseffekt hat. Zum anderen handelt es sich meist um internationale Studien. Länderübergreifende Studien erfordern jedoch die sehr restriktive Annahme einer identischen Produktionsfunktion für alle Volkswirtschaften.

In diesem Beitrag werden diese beiden Schwächen vermieden. Zum einen nutzen wir ein Maß für die Qualität erbrachter Finanzdienstleistungen: bankspezifische Kosteneffizienz. Zum anderen analysieren wir die Regionen innerhalb einer Ökonomie: Deutschland.

Wir vermuten einerseits, dass gut entwickelte regionale Bankensysteme erfolgreich Kostenabweichungen vom Optimum minimieren. Kosteneffizienz erfasst die Fähigkeit zur Auflösung von Informationsasymmetrien vor und nach der Projektfinanzierung insofern, als dass weniger effiziente Banken langfristig systematisch höhere Kosten, z. B. auf Grund von Abschreibung schlecht selektierter und kontrollierter Kredite, haben. Durch die Wahl lokaler Regionen stellen wir sicher, dass wichtige Faktoren, wie z.B. Rechtsprechung und kulturelle Werte, zwischen analysierten Räumen hinreichend homogen sind und damit die Annahme einer identischen Produktionsfunktion weitestgehend gewährleistet ist. Konkret nutzen wir hier die 97 Raumordnungsregionen (ROR) in Deutschland für den Zeitraum von 1994 bis 2003.

Unsere Ergebnisse lassen sich wie folgt zusammenfassen: Erstens zeigt sich, dass die über alle Bankengruppen gemittelte Kosteneffizienz je ROR einen positiv signifikanten Einfluß auf das regionale Wachstum hat. Eine höhere Qualität angebotener Finanzdienstleistungen steigert das Wirtschaftswachstum.

Zweitens finden wir für unsere Stichprobe, dass das üblicherweise spezifizierete Maß Kreditvolumen nicht signifikant ist. Anscheinend hat eine schlichte Erhöhung der Kreditvergabe keinen Einfluss auf das lokale Wirtschaftswachstum.

Drittens, unsere Ergebnisse werden auch nach Ausschluss aller national aktiven, und somit nicht einer ROR eindeutig zurechenbaren, Banken bestätigt. Dies untermauert die Bedeutung unseres Qualitätsmaßes.

Viertens zeigt die Unterscheidung zwischen Volumen- und Qualitätseffekten für lokale nichtöffentliche Banken, dass die Qualität einen positiv signifikanten Einfluß auf das Wachstum hat, während der Volumeneffekt signifikant negativ ist. Für öffentliche Banken können wir dagegen keine entsprechenden signifikanten Einflüsse feststellen. Möglicherweise ist die Rolle öffentlicher Banken in den Regionen Deutschlands zu unterschiedlich, um einen statistisch signifikanten Effekt für das gesamte Land zu identifizieren. Unser wichtigstes Ergebnis ist jedoch die Bestätigung, dass in der Tat die Qualität von Finanzdienstleistungen für wirtschaftliches Wachstum von Bedeutung ist.

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Finance and Growth in a Bank-Based Economy: Is it Quantity or Quality that Matters?¹

1 Introduction

The notion that a sound financial system fosters economic growth has already been advocated by Schumpeter (1934, 1939). Since the seminal empirical work by King and Levine (1993), the question if and to what extent financial development spurs economic growth experienced a renaissance. Numerous studies test Schumpeter's early hypotheses.² Given the available evidence, only few economists doubt that finance matters for growth today.

But in our view most studies suffer from two major shortcomings. First, in a Schumpeterian world it is the *quality* rather than the *quantity* of financial intermediation that influences economic growth. However, most studies specify proxies of financial systems' size, for example the credit to GDP ratio. Second, most studies are of a cross-country nature, frequently sampling very different economies like the U.S. on the one hand and Thailand on the other. Then, significant financial indicators may partly be driven by excessively heterogeneous samples.³

We address these problems in the following manner. First, we grasp the quality of intermediation by using microeconomic technical efficiency measures derived at the bank-level to assess banks' abilities to convert inputs into financial products and services. Second, we seek to reduce potential sample bias by focusing on the regions of one industrialized country only, namely Germany. Thereby, we ensure that many environmental factors identified as significant are fairly homogeneous in our sample. We hypothesize that in Germany's fragmented three-pillar system of private and public banks the quality of financial intermediation is not only different

¹m.koetter@rug.nl (M. Koetter) and michael.wedow@bundesbank.de (M. Wedow). This paper represents the authors' personal opinions and does not reflect the views of the Deutsche Bundesbank. We are grateful to participants of the research center's seminar series at the Deutsche Bundesbank, in particular Julia von Borstel, Jörg Döpke, Hannah S. Hempell, Heinz Herrmann, Frank Heid, Thilo Liebig, Fred Ramb and Stéphanie Stolz, for most valuable input. The feedback of our colleagues Jaap Bos, Jörg Breitung, Claudia Buch, Jim Kolari, Clemens Kool, Thorsten Nessi Nestmann, Steven Ongena, Katharina Raabe and Beatrice Weder di Mauro has also been of utmost help to us, too. Furthermore, we are indebted to seminar participants at the XIV Tor Vergata Conference on Banking and Finance, especially Ifthekar Hassan and Paul Wachtel. Comments by the Research Council of the Deutsche Bundesbank, in particular those of Bronwyn Hall and Martin Hellwig have been most helpful to us. Finally, we would like to thank seminar participants of the GBSA workshop held at the University of Frankfurt and the Institute of Economics & Econometrics Seminar series at the University of Groningen. The feedback received from Franklin Allen, Andreas Hackethal, Jan Jacobs, Robert Lensink and Jan Pieter Krahen is highly appreciated. All remaining errors are, of course, our own.

²For example, Rajan and Zingales (1998), Beck and Levine (2002) and Berger et al. (2004). Review studies are Levine (2004), Thiel (2001) and Dolar and Meh (2001).

³To some extent this is merely an omitted variable bias if factors influencing growth are not controlled for. For example, La Porta et al. (1998) show that the legal system and Garretsen et al. (2004) that cultural differences influence growth. However, beyond this potential omitted variable problem we may also face the conceptual problem entailed in the assumption of a homogeneous production function between, say, developed and less developed countries.

across regions but also of significant importance to promote growth.⁴ Our study adds to the only two analyses that we are aware of that also seek to distinguish between the quality and the quantity of financial intermediation, namely Lucchetti et al. (2001) and Berger et al. (2004).

In this paper, we concentrate throughout on banks only. We do not investigate the relative merits of banks versus markets or other intermediaries for two reasons. First, increasingly many scholars discard the view that banks and markets are substitutes (Merton and Bodie, 2004). Empirical evidence indicates that both markets and institutions are integral parts of a financial system that complement each other (Levine, 2002; Beck and Levine, 2002). Second, Germany is a role-model of a bank-based system. Koetter et al. (2004) and Hackethal (2004) examine inasmuch the German economy depends on banks, markets and other intermediaries to channel funds from savers to investors. Their results confirm conventional wisdom: German banks were, still are and likely remain to be of paramount importance in Germany's financial system for the foreseeable future.

We structure the paper as follows. In section 2, we discuss the literature that links finance and growth theoretically and empirically. In section 3, we introduce our growth specification, the methodology to derive the quality of financial intermediation by banks and the data used. In section 4 we present and discuss our results. We conclude in section 5.

2 Financial Development and Growth

The question if and how financial development influences real economic growth is at the very heart of the finance-growth literature. Both the available evidence and remaining open issues are numerous and have been reviewed by Levine (2004) recently. Here, we focus on two issues. The link between finance and growth on the one hand and the available empirical evidence on the other.

2.1 Theoretical Considerations

The importance of finance for real economic growth is not without debate. On the one hand, Robinson (1952) argues that financial services are provided as a reaction to the demand by corporate firms. In her view, finance follows entrepreneurial activity.⁵ Similarly, Lucas (1988) regards finance an overvalued explanatory factor in growth theory. On the other hand, economists like Gurley and Shaw (1955), Gerschenkron (1963), Goldsmith (1969) and McKinnon (1973) find that neglecting financial development severely limits our understanding of economic growth.

Along the lines of the latter scholars there are two channels through which financial development can influence growth. The first is Hicksian in nature and emphasizes the enhanced accumulation of capital through higher savings (Hicks, 1969). The second represents a Schumpetrian point of view and centers on the improved ability of

⁴Private banks are commercials and cooperatives and savings banks constitute the public sector.

⁵This point is also known as the reverse causality critique (Boyd and Smith, 1996).

the financial sector to increase technological progress through an efficient selection, funding and monitoring of projects (Schumpeter, 1934, 1939).

We use a simplistic growth model in the vein of Pagano (1993) to illustrate these effects: the AK-model.⁶ Y_t denotes aggregate output at time t , which is generated with one production factor only, namely capital K_t .⁷ A is a positive constant that reflects the current level of technology. The production function is

$$Y_t = AK_t. \quad (1)$$

Here, the marginal product of capital equals total factor productivity A . Output can only be consumed or saved so that $Y = C + S$. We assume that the capital stock depreciates at a constant rate δ . Investment equals the difference in capital stocks in two subsequent periods, K_t and K_{t+1} :

$$I_t = K_{t+1} - (1 - \delta)K_t. \quad (2)$$

We assume next that the financial goods market is in equilibrium so that aggregate savings S equal aggregate investment I .⁸

$$I_t = \eta S_t. \quad (3)$$

The factor η is $0 \leq \eta \leq 1$ and captures the ability of the financial sector to intermediate funds. Only a fraction of savings is converted into investments because we assume that frictions exist when channelling funds from surplus to deficit units. High values of η indicate that only little resources are wasted.

From equation (1) we know that the growth rate of output $g = \frac{Y_{t+1}}{Y_t} - 1$ depends on the development of K . In the steady state, both capital and output grow at the same rate. Rewriting the investment expression in equation (2) yields:

$$\eta s A K_t = K_{t+1} - (1 - \delta)K_t. \quad (4)$$

Rearranging terms and noting that $\frac{Y_{t+1}}{Y_t} - 1 = \frac{K_{t+1}}{K_t} - 1$ holds in the steady state, we suppress subscripts and write the growth rate g as:

$$g = \eta s A - \delta. \quad (5)$$

Equation (5) illustrates how financial development can influence growth: via a larger fraction of income that is saved, s ; via enhancing total factor productivity, A ; and via an improved quality of intermediation, η , by reducing the fraction of savings "lost in transition". The former effect relates more to the Hicksian view that better developed financial systems are those that channel higher quantities from savers

⁶The AK model can easily be extended e.g. for multiple production factors or population growth. For our illustrative purposes we prefer here a model as simple as possible.

⁷Here, K represents capital in a broad sense and also augments human capital (Chapter 4, Barro and Sala-i Martin (1995)).

⁸Note that this reflects the assumption of a small, closed economy.

to investors. In contrast, the latter two effects resemble the Schumpeterian train of thought. Better intermediaries help to reduce slack in the financial system and foster capital productivity through investing in more profitable projects.

The Hicksian as well as the Schumpeterian notion entail that better developed financial systems imply lower transaction and information costs. Levine (2004) distinguishes five ways how banks accomplish these reductions:⁹ (i) information collection, (ii) project monitoring, (iii) risk management, (iv) channelling savings and (v) facilitate transactions of goods and services.

First, consider information collection. If it is costly to gather information when making investment decisions, studies in the vein of Allen (1990) show that financial intermediaries help to economize on search cost and thereby foster aggregate saving. According to Morales (2003), information gathering leads to learning effects. This implies that financial intermediaries are better suited to spot entrepreneurs with the highest potential to innovate on products, services and processes.

Second, consider monitoring. Better developed financial systems aid equity and debt holders of firms to scrutinize managers as to ensure that the latter act in the best interest of the former. If information asymmetries exist, managers may exploit free-rider considerations of investors in financial markets when individual investors rely on each other to conduct costly monitoring activities.¹⁰ The seminal model by Diamond (1984) illuminates how banks act as delegated monitors on behalf of investors, thereby solving the free-rider problem. De la Fuente and Marin (1996) find that banks help to enhance productivity as they are particularly suited to monitor opaque, and hence information cost intensive, innovative projects. In the vein of Schumpeter's constructive destruction argument, Bencivenga and Smith (1993) provide a model where banks ration credit in order to select the most profitable investments, which raises capital productivity.

Third, consider risk management. Better developed financial systems help savers and investors in three ways to enhance risk management: cross-sectional diversification, intertemporal diversification, and liquidity provision. The first issue follows straight from finance theory. Greenwood and Jovanovic (1990) argue that intermediaries foster productivity thanks to their ability to select profitable investments and to assemble portfolios that ameliorate project-specific shocks. While it may be too costly for an individual investor to diversify, Acemoglu and Zilibotti (1997) show how intermediaries facilitate the funding of more risky but innovative projects. The second issue highlights intertemporal risk-sharing (Allen and Gale, 1997). Especially in Germany's corporate culture of long-term relations between borrowers, lenders and owners (Elsas and Krahen, 2004) financial intermediaries may commit to a long-run perspective and help both savers and investors to prevent premature divestiture. The third issue refers to liquidity risk. The more difficulties savers have to convert real assets into means of exchange, the less inclined they are to give up the direct control of their savings. This implies that either financial markets (Bencivenga et al., 1995), intermediaries (Diamond and Dybvig, 1983) or a mixture of the

⁹Note again that we focus here on banks. Obviously, all of these functions may be fulfilled by markets or non-bank financial intermediaries, too. For a complete review of the relative merits we refer to Levine (2004).

¹⁰Shleifer and Vishny (1997) review studies investigating the relation between corporate governance and firms' investment choices.

two (Fecht et al., 2005) can help to insure savers against liquidity shocks, thereby fostering investment in longer-run, illiquid and relatively risky projects.

Fourth, consider the collection and channelling of savings. Many projects require large, indivisible funding. Collecting funds from a multitude of investors is expensive for an individual project owner. Financial intermediaries can spread these fixed costs if they execute this collection function for many savers and investors (Sirri and Tufano, 1995). This increases aggregate savings and investment by matching different denominations between the two.

Fifth, consider the facilitation of exchanging goods and services. Financial development helps to establish an accepted medium of exchange. This reduces transaction and information costs since these are high if non-standardized goods have to be evaluated on a case-by-case basis in barter economies. According to Greenwood and Smith (1996), this allows for a higher number of transactions, which is necessary if an economy increasingly specializes. They argue that higher specialization favors productivity gains and thereby promotes growth.

In sum, all five functions of financial intermediaries affect growth via the volume of savings and the allocation of capital to productive investments. Additionally, we introduced a factor η which captures the amount of savings that is lost during the intermediation process. We regard the former effect primarily as a quantity effect that financial development has on growth. In contrast, we regard the latter two effects as a joint quality effect of the sector's ability to channel financial resources efficiently to those investment projects that maximize return. Let us turn next to the empirical evidence as how to measure financial development.

2.2 Empirical Evidence

Empirical analyses in the growth literature rarely specify the AK model used previously to illustrate the relation between finance and growth. Most studies analyze if and how fast per capita income y converges to its steady state. Barro and Sala-i Martin (1995) show that the average growth rate of per capita output depends on the initial level of per capita output, Y_0 .¹¹ On this basis, Lucchetti et al. (2001) denote what they call the reference model of the finance-growth literature as

$$\Delta y = \beta_1 y_0 + \beta_2 fd + \beta_3 x + \epsilon, \quad (6)$$

where lower case letters indicate the log of a variable, FD denotes a proxy of financial development, x is a vector of additional control variables and ϵ is a random error term. In equation (6), Δy depicts the growth rate of per capita GDP. To our knowledge none of the studies on Germany's economic growth considers the financial sector in the analysis (Niebuhr, 2001; Dreger and Kosfeld, 2003; Kosfeld et al., 2005). This neglect is surprising because, to put it in terms of Levine (2004), the evidence in support of a positive relation between financial development and growth is remarkably robust across a whole range of alternative empirical methodologies.

¹¹See the discussion in chapters 11 and 12, in particular their equation (11.1).

With respect to the international evidence, the seminal contribution in the finance-growth literature is King and Levine (1993). Their empirical specification of the growth model is based on a single cross-sectional analysis under the assumption of identical aggregate production functions as depicted in equation (6). Their proxy for financial development FD equals liquid liabilities of the financial industry relative to gross domestic product (GDP).¹² Hence, King and Levine (1993) gauge primarily the quantity effect of financial development. Additionally, they acknowledge the importance of human capital accumulation, population growth, trade or government expenditure and specify according covariates to enter x . For 77 countries during the period 1960 and 1989 and three alternative measures of economic growth¹³ they find significant and large relations between financial development and growth.

Many empirical studies of the growth-finance nexus (Demetriades and Hussein, 1996; Da Rin and Hellmann, 2002) proxy FD by a variation of these initially suggested measures. Levine et al. (2000) extend earlier analyses regarding estimation techniques and data coverage. Their results confirm earlier findings: a significant and strong influence of financial development on growth. They conclude that the evidence on the importance of finance for growth is robust.

The available evidence is criticized by Lucchetti et al. (2001) primarily for the choice of proxies of financial development. They stress two issues. First, the volume of credit intermediated is only an indirect measure of the Schumpeter argument that better developed financial systems enjoy less frictions in the intermediation process and foster additionally the rate of return through better project selection and monitoring. Secondly, absolute measures of credit volume are subject to simultaneity problems, initially pointed out by Robinson (1952), to a much larger extent than a relative measure of the quality with which banks perform their intermediation task. In a nutshell, credit *volume* may simply be positively correlated with growth because in an expanding economy firms increase their demand for financial funds. Lucchetti et al. (2001) find indeed that both the quantity of credit and the quality of banks as measured by cost efficiency have significant influence on regional growth, respectively. The only additional study that we are aware of that also distinguishes more explicitly between the quantity and quality effect of financial development is Berger et al. (2004). For a sample of 49 nations they do find a positive and significantly different effect of bank efficiency on growth during 1993 and 2000. In sum, both studies suggest that the alternative channels as to how financial development matters for growth should be separated: quantity versus quality.

A second critique of most international evidence is related to the cross-country nature of these studies. Failure to account for systematic differences across countries leads to biased results. Intuitively, comparing growth rates and the volume of cumulative loans to GDP between developed and less-developed countries may yield spurious results (Rioja and Valev, 2004). While the identification of additional control variables is an important progress in the finance-growth literature, an alternative strategy is to compare regions with reasonably akin economic structures.

¹²King and Levine (1993) construct two additional proxies: credit supplied by central versus commercial banks and funds lend to the private and the public sector. These two measures provide additional information about the sources and directions of financial funds.

¹³Mean rate of real GDP per capita growth, mean rate of per capita capital stock growth and total productivity growth.

One of the few studies embarking on this train of thought is Jayaratne and Strahan (1996). They examine the relation between branching deregulation in the U.S. and its impact on state growth. They find that deregulation improved the quality of lending, measured by individual banks' shares of non-performing loans, thereby fostering capital accumulation. With regard to European evidence we are only aware of Italian studies. Besides Lucchetti et al. (2001), Guiso and Zingales (2002) use survey data on loan applicants' success to receive a loan as a proxy for financial development. They find that higher financial development fosters entrepreneurial activity, enhances competition in the non-financial sector and results in higher corporate growth. These studies suggest that after eliminating a range of reasons for systematic differences between regions it is the quality of financial intermediation that spurs growth.

In sum, theory suggests that well-developed banks should spur growth via a quantity and a quality effect. However, the empirical literature did not yet address the issue as how to measure these two different channels more directly. We turn next to our methodology as how to measure regional growth in Germany.

3 Methodology

Our primary concern in this paper is perfectly in line with one agenda point for future research in Levine (2004): The necessity to develop better proxies for financial development. We begin with our specification of a growth model and subsequently discuss the measurement of bank efficiency as a proxy for intermediation quality.

3.1 Growth Specification

A crucial assumption of cross-sectional growth studies in the vein of equation (6) is that production functions are supposed to be homogeneous across analyzed regions. In our view, it is most likely that such an assumption is overly heroic due to unobserved country-specific effects.¹⁴ While using alternative samples of more homogeneous regions within one country partly alleviates the problem, Islam (1995) suggests to approach the problem more directly. He advocates the use of panel estimators to relax the restrictive assumption of homogeneous production functions across regions. This approach avoids the bias of estimated coefficients when omitting unobservable region-specific effects if these are correlated with the error. Furthermore, Levine (2004) notes that cross-sectional estimation of mean growth rates neglects the information contained in the time variation and forgoes additional degrees of freedom, which are available when exploiting longitudinal data. Therefore, we use in this study panel data and estimation techniques.

Another decisive advantage of a panel approach relates to potential simultaneity problems of financial development indicators and growth. The use of endogenous regressors leads to estimations that suffer from inconsistency and bias, which requires the specification of suited instrument variables. Levine et al. (2000) stress that panel data enables us to control for endogenous explanatory variables insofar as dynamic

¹⁴This issue relates to our second concern: excessive heterogeneity in the data.

panel data estimators in the vein of Arellano and Bond (1991) have been developed to address the potential simultaneity bias directly. They exploit the information contained in panel data by choosing lagged level variables as instruments as to solve the issue. Moreover, they allow us to explicitly test the validity of chosen instruments.

We follow Islam (1995) and Levine et al. (2000) and specify the reduced form of a growth model in levels as a dynamic panel model. The regression equation is:

$$y_{i,t} = \alpha y_{i,t-1} + \beta fd_{i,t} + \gamma x_{i,t} + \mu_i + \epsilon_{i,t}. \quad (7)$$

As previously, all variables in lower cases are denoted in logarithms. We amend time indicators t and in addition, FD contains now two measures: the volume FD^V and the quality of financial development FD^Q . The former resembles the well-known specification of bank credit volume relative to GDP in the finance-growth literature. We deal with the measurement of the latter below in section 3.2. We specify a vector of further control variables, x , to contain human capital HC and the growth rate of the working population ETG . μ_i is an unobserved region-specific effect and ϵ represents the error term, where the latter is $\epsilon_{i,t} \sim \text{iid}(0, \sigma_\epsilon^2)$, independent of each other and among themselves.

Equation (7) cannot be estimated directly because the lagged endogenous variable is correlated with the unobserved group effects μ_i . Thus, we have to eliminate the latter. To this end the Arellano-Bond estimator transforms equation (7) by taking first differences to yield:¹⁵

$$\Delta y_{i,t} = \alpha \Delta y_{i,t-1} + \beta \Delta fd_{i,t} + \gamma \Delta x_{i,t} + \Delta \epsilon_{i,t}. \quad (8)$$

The implementation of equation (8) is not straightforward because the differenced error term and lagged dependent variable, $E[\Delta y_{i,t-1}, \Delta \epsilon_{i,t}] \neq 0$, are now correlated by construction. Under the assumption that the $\epsilon_{i,t}$ are not autocorrelated, Arellano and Bond (1991) suggest to employ lagged levels as instruments for $\Delta y_{i,t-1}$. The Arellano-Bond estimator is formulated as a GMM estimator with the moment conditions given by

$$E[W_i' \Delta \epsilon_i] = 0, \quad (9)$$

where W_i' denotes a matrix of instruments. If the lagged difference of the dependent variable can be instrumented sensibly with its own lagged levels, equation (9) holds and we can reject the presence of a correlation between differenced error terms and instruments.

In addition to the correlation problem of $y_{i,t}$ prevalent by construction of the difference estimator, we have to address the concern that our explanatory variables FD^V and FD^Q are potentially also correlated with the error due to reverse causality. In principle, any measure of financial development is potentially endogeneous.

¹⁵Note, that taking first differences does not affect estimated coefficients as these are identical in equations (7) and (8). We report below estimated coefficients with variable labels in levels according to equation (7).

Especially the volume of credit may well be explained by expanding economic activity rather than vice versa. Thus, we have to identify suitable instruments for FD^V and FD^Q .¹⁶

The appropriateness of the chosen instruments can be validated by a test on the validity of the moment restrictions. The Sargan test for overidentifying restrictions represents such a test on the moment conditions formulated in equation (9) with the null-hypothesis H_0 that moment conditions are not systematically violated.

Specifying financial development as exogenous, predetermined or endogenous variables and using alternative instruments respectively, allows us to test which choice of instruments for financial development is appropriate.¹⁷ Let us turn beforehand to our approach to measure the quality effect of financial development.

3.2 Intermediation Quality

Our approach to devise a measure of intermediation quality is inspired by Lucchetti et al. (2001) and Berger et al. (2004). We approximate the quality of banks to perform their intermediation function by the efficiency of banks to employ resources when generating financial products and services.

The intuition behind this proxy unfolds as follows. We regard the main task of a bank to channel funds from savers to investors, to allocate them to the most profitable projects and to act as a delegated monitor after investment. Therefore, we consider in line with Sealey and Lindley (1977) the monetary volume intermediated as output O . When conducting their intermediation function, we assume that banks minimize cost, C . This requires them to use input quantities, Q , such as labor and deposits, in optimal proportions to produce a portfolio of outputs, for example interbank versus corporate loans. Under the assumption that banks are price-takers in factor markets, optimal input proportions depend on relative input prices, P . Bank inefficiency arises when managers employ simply too much input quantities and/or allocate them in wrong proportions.

Let us illustrate the link between efficiency and the quality of financial services provided with an example. If banks are better developed, we would expect that they hire the optimal amount of risk managers and credit officers given their choice of a loan portfolio to supply and respective wages. Assume that a bank granted relatively many corporate loans, which we assume to be on average more risky compared to interbank loans. Consider now a management that hires too few (or not appropriately trained) credit officers to monitor these exposures and also too few risk managers to price the loan during the negotiations prior to lending appropriately. This may save the bank labor costs in the short run. But if the bank consistently

¹⁶If explanatory variables are correlated with past *and* contemporaneous errors $E[X_{i,t}, \epsilon_{i,s}] \neq 0$ for $s \leq t$, we refer to the variable as endogenous. Then, using first differences requires us to use levels lagged by two periods or more as instruments. In contrast, predetermined variables are contemporaneously *uncorrelated* with the errors $E[X_{i,t}, \epsilon_{i,s}] \neq 0$ for $s < t$ and present realizations depend only on past shocks. Thus, it suffices to instrument predetermined variables with their levels lagged by one period.

¹⁷Note, however, that this tests cannot rule out the conceptual question of reverse causality. Ultimately, the decision to specify GDP to depend on financial development can only be rooted in theory.

underprices riskier loans, subsequent defaults will result in write-offs of bad loans, thereby increasing cost and ultimately leading to inefficiency.¹⁸ As a second example, banks may simply employ too much of an input. Spending on buildings and other fixed assets may be too high if managers negotiate rents poorly or if they are more interested in prestigious offices. Such a bank is then identified as inefficient compared to the industry.¹⁹

We estimate cost efficiency with stochastic frontier analysis. A bank produces three outputs: interbank and commercial loans, O_1 and O_2 , respectively, and securities, O_3 . To this end, it demands three inputs subject to given prices, P , and the technology constraint, $T(O, Q, Z)$, which also contains equity, Z . A bank employs fixed assets, Q_1 , labor, Q_2 , and borrowed funds, Q_3 . We account for technological change with a time trend t (Baltagi and Griffin, 1988). We specify the cost frontier using the translog functional form and write the reduced form as:²⁰

$$\begin{aligned}
\ln C_{kt} = & \alpha_k + \sum_{i=1}^3 \alpha_i \ln W_{ikt} + \sum_{m=1}^3 \beta_m \ln O_{mkt} + \delta_0 \ln Z_{kt} \\
& + \frac{1}{2} \sum_{i=1}^3 \sum_{j=1}^3 \alpha_{ij} \ln W_{ikt} \ln W_{jkt} + \sum_{i=1}^3 \sum_{m=1}^3 \gamma_{im} \ln W_{ikt} \ln O_{mkt} \\
& + \frac{1}{2} \sum_{m=1}^3 \sum_{n=1}^3 \beta_{mn} \ln O_{mkt} \ln O_{nkt} + \frac{1}{2} \delta_1 (\ln Z_{kt})^2 \\
& + \sum_{i=1}^3 \omega_i \ln W_{ikt} \ln Z_{kt} + \sum_{m=1}^3 \zeta_m \ln O_{mkt} \ln Z_{kt} + \eta_0 t + \frac{1}{2} \eta_1 (t)^2 \\
& + \sum_{i=1}^3 \kappa_i \ln W_{ikt} t + \sum_{m=1}^3 \tau_m \ln O_{mkt} t + u_{kt} + v_{kt}.
\end{aligned} \tag{10}$$

In any year t , a bank k can deviate from optimal cost due to random noise, v_{kt} , or inefficient use of in- and outputs, u_{kt} . To distinguish these two effects, we specify a composed total error, ε_{kt} . For a cost frontier, inefficiency leads to above frontier costs. Therefore, the total error is $\varepsilon_{kt} = u_{kt} + v_{kt}$. The random error term v_{kt} is assumed iid with $v_{kt} \sim N(0, \sigma_v^2)$ and independent of the explanatory variables. The inefficiency term is iid with $u_{kt} \sim N|(0, \sigma_u^2)|$ and independent of the v_{kt} . It is drawn from a non-negative distribution truncated at zero.²¹

In contrast to Lucchetti et al. (2001) and Berger et al. (2004), we follow Greene (2005) and use a bank-specific fixed effects stochastic frontier model with time-variant inefficiency to estimate the parameters in equation (10). This is important because Bos et al. (2005) show that systematic differences across banks that are

¹⁸Alternatively, if the bank consistently overprices, it will lose the business to competitors. This would imply comparatively high labor cost in relation to relatively small volumes of funds and, thus, high inefficiency, too.

¹⁹See Hughes et al. (2003) for evidence on bank manager's desire to build empires.

²⁰We impose the necessary homogeneity and symmetry restrictions as in Lang and Welzel (1999).

²¹Note that inefficiency can vary over time but is not further specified to follow any particular trend over time.

not due to inefficiency must be accounted for in efficiency analyses. Such systematic differences are likely to exist even within one economy only, let alone in cross-country studies like that of Berger et al. (2004).

Non-random differences of banks' costs that are not due to inefficiency are here captured by the bank-specific fixed effect, α_k .²² Subsequently, we obtain bank-specific efficiency measures with the method suggested by Jondrow et al. (1982). We use the conditional distribution of u given ε and a point estimator of technical efficiency is given by $E(u_k|\varepsilon_k)$, i.e. the mean of u_k given ε_k . Cost efficiency (FD^Q) is calculated as $[\exp(-u_{kt})]$ and equals one for a fully efficient bank. Likewise, FD^Q of 0.9 implies that a bank could have produced an identical output vector with 90 percent of actually incurred cost.

We argue that our FD^Q measure enjoys three major advantages compared to the traditional approaches in the finance-growth literature. First, it is a much more direct measure of resources wasted during the intermediation process due to suboptimal allocation and use of input factors in the vein of Leibenstein (1966). It therefore resembles the η component of financial development mentioned in Pagano (1993) much closer compared to the intermediated credit volume employed traditionally.

Second, we estimate a long-run cost frontier, which covers operational costs inclusive of those costs arising from writing off non-performing loans. Deviations from optimal costs therefore capture the long-run (dis-)ability of bankers to fulfil their intermediation task efficiently. We argue that this holistic assessment of bank performance captures the ability to gather information both ex ante and ex post more appropriately compared to a proxy of the volume intermediated. This is because systematic and sustained failure to optimize the production process in light of these core functions of successful bankers, will result in higher than industry cost. Hence, we think that our FD^Q measure also captures the influence of financial development on A to a better extent compared to the sheer size of the financial industry.

Third, the relative ability to convert inputs into outputs is less prone to critique regarding reverse causality. In section 3.1 we pointed out that cross-sectional estimation fails to distinguish whether large volumes of bank credit, that is bank size, cause economic growth or rather result from it. While the use of instruments in our dynamic panel model alleviates the problem, FD^Q enjoys the conceptual advantage that it is a *relative* measure. More specifically, we assume that the transformation technology $T(\cdot)$ is identical for all banks operating in Germany. At the same time, we account simultaneously through α_k for systematic differences across banks, such as size or banking sector. Our quality proxy of financial development, FD^Q , is therefore independent of the credit volume of an individual bank because the efficiency of a bank does not depend on how much output it produces but rather how well it does so. It therefore seems reasonable to assume that the sustained ability of individual banks to exploit its resources given the available technology as efficient as possible does not depend per se on whether the economy is contracting or expanding. Intuitively, the performance of bankers to minimize costs when supplying financial services should foster growth independent of the question whether the intermediated volume is small or large.

As noted earlier in our growth specification, the Arellano-Bond estimator allows

²²The α_k 's are allowed to be correlated with O_{kt} , W_{kt} and Z_{kt} (Greene, 2005).

us to test the validity of our empirical specification in the light of the potential endogeneity of the financial development indicators more formally below. Before turning to our results, we briefly discuss our data sources and defined variables.

3.3 Data and Variables

Growth Macroeconomic data per district ("*Kreis*") are obtained from State and Federal Statistical Offices, respectively.²³ These data are available on an annual basis between 1994 and 2003. The Federal Office for Building and Regional Planning ("*Bundesbehörde für Bauwesen und Raumordnung*") provided us with a key to map these political regions, namely districts, to economic planning regions ("*Raumordnungsregionen, ROR*") in Germany. The latter consist of multiple districts and represent the office's taxonomy. It is based on economic interdependencies as approximated by commuters within economic agglomeration areas.²⁴ Niebuhr (2001) argues that the use of economic planning regions is significantly superior due to their definition by economic criteria compared to political regions provided by the statistical offices.²⁵ Our data comprise all 97 ROR in Germany and we use GDP per worker, Y , as dependent variable.²⁶

Financial development We use balance sheet and profit and loss account data for all private and public banks that reported to the Bundesbank between 1993 and 2004. As noted earlier, we measure the quantity of financial development FD^V as the amount of loans and securities over GDP. The quality of financial intermediation FD^Q is approximated by cost efficiency, measured with stochastic frontier analysis. After estimating FD^Q for each bank in every year, we allocate bank-specific variables to their respective ROR via the location of the head office of the bank. Given the *de jure* principle of regional demarcation of German public banks as well as the *de facto* regionally limited range of activity of small commercial and virtually all cooperative banks, bank specific indicators should accurately describe both quality and quantity of financial intermediation within a respective ROR. We conduct two plausibility checks regarding the defensibility of this approach. First, we use data on the large credit register of the Bundesbank ("*Millionenkreditevidenz*") to obtain the percentage share of loans larger than 1.5 million Euros granted within the regions ("*Ortsnummer*") classified by the Bundesbank. While not identical to ROR this classification provides the closest alternative.²⁷ On average, local savings and cooperative banks grant 80 percent of their loan portfolio to customers within the Bundesbank regions. Even for commercial banks the local lending share is still at around 30 percent. This supports our approach to allocate banks on the basis of their head quarters. As a second check we use available information on bank branches to

²³These regions resemble the NUTS 3 level of the data assembled by Eurostat.

²⁴We also employed data on the district and state level to check our estimations for robustness. While results are qualitatively similar, we consider our choice of RORs superior to other regions in order to minimize spatial correlations and poor asymptotic properties of our estimator for small cross-sections.

²⁵An alternative regional dimension to analyze growth in Germany are labor market regions as in Kosfeld et al. (2005) and German Council of Economic Advisors (2004).

²⁶Alternatively, we checked the robustness of our results using gross value added per worker. Furthermore, we also checked dependent variables per capita.

²⁷German banks have to report each loan beyond the mentioned size to the Bundesbank indicating the debtor and his geographical location.

examine the regional activities of banks. Only very few banks maintain networks in more than one ROR. In fact, the branch network of savings and cooperative banks is highly concentrated within their respective ROR. While 93 percent of all cooperative banks' branches are located within the ROR of the head office, the branch network of saving banks is even more concentrated with 97 percent of all branches located within the same ROR. Despite these supporting indications we still consider national banks undertaking their business across ROR to present a difficulty since a precise allocation of their activities remains impractical. This is also confirmed by the branch distribution of nationally active banks. The share of branches within the same ROR of large commercial banks, small commercial banks and *Landesbanken* is 5, 31 and 45 percent, respectively. Therefore, we estimate below our preferred specification also after excluding all nationally active banks.²⁸

Controls To control for the accumulation of human capital, HC , we use the ratio of student enrollment in the upper secondary school relative to total students. As in King and Levine (1993) we consider capital depreciation δ to be constant at 5 percent and we specify population growth as the change of the employed population. We define the joint variable as ETG in our estimated regressions.²⁹ Finally, we amend control variables for the structure of local banking markets. In our results section we present estimations that use either the mean market share per ROR or the local Hirschman-Herfindahl-Index as proxies for competition. Variable descriptions, sources and summary statistics are depicted in table 5 in the appendix.

4 Results

Specification Choices We consider two specification choices most important when estimating the growth model as presented in equation (7). First, we need to investigate if our quality and quantity measures of financial development should be specified as exogenous, predetermined or endogenous variables. Clearly, the differentiation of a variable as endogenous or predetermined should be model driven. The approach pursued here is to let the Sargan test validate whether the imposed moment conditions determined by the choice of instruments are systematically violated when our measures of financial development are specified as endogenous, predetermined or exogenous.³⁰ Second, we are concerned with potential problems due to serial correlation and an adequate lag-structure of level variables used as instruments for our lagged endogenous variable $y_{i,t-1}$.

Consider first the Sargan test, which provides a mean to test the appropriateness of specified instruments for the lagged dependent and especially financial development indicators (Arellano and Bond (1991)). If it is true that financial development merely results from an increased demand for financial funds in an expanding economy, the specification of FD^V and/or FD^Q as exogenous variables yields biased and inconsistent estimates due to their contemporaneous correlation with the error term.

²⁸These are large commercial banks, *Landesbanken* and central cooperative banks.

²⁹In analogy to the specification of GDP per capita we also employed population growth here as well. We also checked the robustness of our results for alternative values for δ , ranging in increments of 50 basis points between 2.5 to 7.5 percent. By and large, results were not qualitatively affected.

³⁰See footnote 16 for the choice of instruments for predetermined and endogenous variables.

Table 1: Comparison of Specification Choices

Quality	Quantity		
	<i>Sargan [chi2]:</i>	Exogenous	Predetermined
Exogenous	56.01**	87,44	82,99
	(0.01)	(0.22)	(0.14)
Predetermined	88,83	95.61	95,28
	(0.19)	(0.96)	(0.89)
Endogenous	82,9	94,2	93,35
	(0.14)	(0.9)	(0.79)
<hr/>			
<i>Sargan [df.]:</i>	Exogenous	Predetermined	Endogenous
Exogenous	35	78	70
Predetermined	78	121	113
Endogenous	70	113	105
<hr/>			
<i>AR2 [z-value]:</i>	Exogenous	Predetermined	Endogenous
Exogenous	-1,28	-1,3	-1,42
	(0.20)	(0.19)	(0.15)
Predetermined	-1,27	-1,26	-1,38
	(0.20)	(0.21)	(0.17)
Endogenous	(-1.22)	-1,27	-1,39
	(0.22)	(0.21)	(0.16)

Notes: p-values in brackets.

***, **, * denotes significance at the 1, 5, 10 percent level.

This would be indicated by the Sargan test since equation (9) is no longer fulfilled. We may treat financial development alternatively as predetermined or endogenous variables which implies the use of alternative lagged levels instruments. If such a specification fulfills the notion that the expected correlation between contemporaneous errors and instruments is not systematically different from zero, we interpret the effect of financial development due to its direct effect on growth. In the predetermined case, an acceptance of the H_0 under the Sargan test indicates that financial development is at least contemporaneously uncorrelated with the error term.

We therefore estimate the baseline model in equation (7) using the two-step GMM estimator.³¹ Consider the nine respective Sargan test statistics in table 1 that represent all possible combinations as how to specify the quality and the quantity of financial intermediation, respectively.³² In the upper panel of table 1 we depict the three possible specification choices of FD^V in columns and the respective options for FD^Q in rows.

In the upper left cell of table 1 we depict the case to simultaneously specify

³¹In terms of table 5 the employed variables are: Y_1 , FD^Q , FD^V , HC and ETG .

³²Arellano and Bond (1991) show that the one-step Sargan test over-rejects in the presence of heteroscedasticity and therefore formulate a consistent two-step estimator. However, Arellano and Bond (1991) also note that standard errors of individual coefficients from the two-step estimator suffer from a downward bias. Therefore, we focus here only on test statistics based on the two-step estimator as these are suited for specification choices. We report coefficients subsequently on the basis of one-step estimates to draw inference.

both indicators of financial development as exogenous variables. The according Sargan statistic rejects this specifications on the basis of a systematic violation of the moment conditions. This specification indicates that financial development is not independent of growth.

Regarding the remaining options as how to specify these indicators, our results indicate across the whole range, that at least one of the two variables needs to be instrumented. Notably, it is statistically irrelevant which of the two is chosen. Also note that it is statistically permissible to specify one or both indicators either as predetermined or as endogenous variable. For any combination, the Sargan test is insignificant and does not reject the set of instruments chosen.

Our prime conclusion regarding this result is to acknowledge that the use of estimators using suitable instruments is necessary. Inference from analyses that fail to instrument financial development indicators of either kind must be treated with great care.³³

Another conclusion of this result is that econometric guidance alone does not provide a clear-cut picture. We therefore motivate our specification choice based on our view that the relative nature of our FD^Q measure supports the notion of strict exogeneity. In contrast, on grounds of potentially higher demand for financial funds as a consequence of higher growth, we regard the FD^V effect of financial development at least as predetermined. Henceforth, reported results therefore instrument FD^V as a predetermined and include FD^Q as exogenous variable.³⁴

To ease, however, a comparison to the most frequently encountered approaches in the literature consider table 2. We present coefficient estimates for two estimations. In the first column we specify both FD^V and FD^Q as exogenous variables, the second depicts our preferred baseline specification where only the former is instrumented. The results indicate that our measure of the quality of financial development is not affected by choosing to instrument both proxies as predetermined variables.³⁵

Second, we consider briefly the issue of serial correlation. As discussed in section 3.1, taking first differences and rewriting equation (7) implies that the error term $\Delta\epsilon_t$ suffers from serial correlation by construction, which is unproblematic given our difference estimator.³⁶ However, we must not observe any autocorrelation of higher order as to avoid inconsistent and biased estimates. For all possible combinations of FD^Q and FD^V discussed above, the bottom panel in table 1 reports according test statistics and p-values. The results provide evidence that second-order autocorrelation does not present a problem.

Variable Choice We consider next alternative dependent variables y and addi-

³³We also estimated the growth specification with alternative estimators, ranging from simple cross-sectional and pooled OLS to fixed effect panel estimators. These robustness checks further underpinned our conclusion that dynamic panel estimators using appropriate instruments are key to the analysis.

³⁴We checked subsequent regressions systematically across all nine specification choices depicted in table 1. Bearing the well-known sensitivity of instrumental GMM for dynamic panels in mind, our results were surprisingly robust.

³⁵We refrain at this stage from interpreting single coefficients in more depth since we concentrate first on our specification choices. Instead, we ask the reader to bear with us for a few more pages until we discuss individual estimates.

³⁶This is confirmed by tests for an AR(1) process which we do not report here.

Table 2: Alternative Instruments for FD

$\ln FD^V$	Predetermined	Predetermined
$\ln FD^Q$	Predetermined	Exogenous
$\ln Y_{i,t-1}$	0.581*** [0.028]	0.605*** [0.032]
$\ln ETG$	-0.018*** [0.005]	-0.020*** [0.005]
$\ln HC$	0.053*** [0.014]	0.064*** [0.015]
$\ln FD^V$	-0.027** [0.013]	-0.009 [0.011]
$\ln FD^Q$	0.085** [0.036]	0.087** [0.041]
Constant	0.006*** [0.001]	0.005*** [0.001]
AR1 [z-value]:	-2.19**	-2.00**
AR2 [z-value]:	-1.47	-1.56

Robust standard errors in brackets

***, **, * denotes significance at the 1, 5, 10 percent level.

tional control variables x in the baseline regression. Table 3 presents results based on the one-step AB estimator with heteroscedasticity robust standard errors. Column (1) contains the baseline regression using GDP per worker as dependent variable. In line with our expectations, the coefficient of FD^Q is significant and positive. An improvement of 1 percent of the quality of financial intermediation furthers economic growth by about 0.09 percent. With regard to FD^V we find that the coefficient is insignificant and negative. This stands in contrast to the evidence presented in the finance-growth literature. The result suggests that merely increasing the amount of bank loans has no significant impact on growth. Potentially, the amount of funds provided by banks to finance investment projects is not in short supply. Then, increasing the volume of potentially available funds for investment exerts per se no growth impetus.³⁷ In contrast, an improvement of the ability to put these available funds to use in the sense of selecting and monitoring investment projects indeed helps to promote growth.

With regard to the control variables, we find that human capital (HC) and the growth of the working population (ETG) exhibit signs in line with expectations and are statistically significant. The former exhibits a positive coefficient, which implies that faster accumulation of know-how feeds economic growth. The latter yields the result that higher population growth leads, *cet. par.*, to reduced income per capita. The result for human capital is in line with previous findings in the literature. However, Kosfeld et al. (2005) fail to detect any effect with regard to the

³⁷Since most banks in Germany are either voluntarily or due to imposed regulation acting in confined regions only, this result may also indicate a lack of possibilities to diversify loan portfolios to customers outside their regions. If, for example, macroeconomic shocks are region-specific, there is little a bank obliged to lend only within it's region can do. Any increase of loan volumes is likely to be channelled to creditors more or less equally suffering from poor economic conditions.

Table 3: Alternative dependent and additional control variables

	(1)	(2)	(3)	(4)
$\ln Y_{i,t-1}$	0.605*** [0.032]	0.595*** [0.033]	0.604*** [0.032]	0.601*** [0.031]
$\ln HC$	0.064*** [0.015]	0.065*** [0.015]	0.065*** [0.015]	0.063*** [0.015]
$\ln FD^V$	-0.009 [0.011]	-0.017 [0.012]	-0.009 [0.012]	-0.017 [0.013]
$\ln FD^Q$	0.087** [0.041]	0.082** [0.040]	0.078** [0.038]	0.076* [0.039]
$\ln ETG$	-0.020*** [0.005]	-0.024*** [0.005]	-0.020*** [0.005]	-0.020*** [0.005]
$\ln HHI$			-0.009 [0.007]	
$\ln MSi$				-0.019 [0.013]
Constant	0.005*** [0.001]	0.005*** [0.001]	0.006*** [0.001]	0.007*** [0.001]
Wald [chi2]:	671.43	602.11	659.6	690.68
Sargan [chi2]:	87.44	88.41	86.41	88.51
Sargan [p-value]:	0.22	0.20	0.24	0.22
AR1 [z-value]:	-2.00**	-2.02**	-2.03**	-2.03**
AR2 [z-value]:	-1.56	-1.67*	-1.55	-1.49

Note: Robust standard errors in brackets. AB One-Step Estimation.

Sargan test from Two-Step Estimator.

***, **, * denotes significance at 1, 5 and 10 percent level.

growth of the working population.³⁸

The results remain qualitatively similar for alternative variables. Column (2) is based on the same regression using gross value added per worker as dependent variable. The coefficients remain largely unchanged while we reject the null hypothesis of no second-order autocorrelation at the 10 percent level. Thus, the results based on gross value added per worker are potentially biased and inconsistent. In column (3) and (4) of table 3 we add further variables about the structure of local banking markets. Column (3) contains the Herfindahl-Hirschman index on the basis of total assets per ROR. The regression in column (4) includes the average market share of banks per ROR. Both measures are proxies for market power. The coefficients for both proxies are insignificant and have no effect on our result for financial development.

Regional versus national banks Next, we analyze if the identified quality effect of financial development is driven by a potential failure to appropriately allocate the activities of national banks to separate regions. While the majority of German banks are small and undertake their business within a limited geographical area, some operate on a nation-wide basis (Koetter et al., 2004).

Local banks comprise primarily savings and cooperative banks but also smaller

³⁸We also run regressions using the growth of the total population and also found a significant and negative impact on growth.

commercial banks. To account for the unavailability of regional income distributions of nationally active banks, we therefore exclude this group when constructing our indicators for financial development. The respective results in column (1) of table 4 indicate the same positive and significant effect of FD^Q and an insignificant effect of FD^V for local banks.³⁹ Consequently, our results are not driven by the inclusion of large banks.

Table 4: Financial development across banking groups

	(1)	(2)	(3)	(4)
$\ln Y_{i,t-1}$	0.584*** [0.027]	0.481*** [0.040]	0.626*** [0.028]	0.544*** [0.049]
$\ln \text{ETG}$	-0.020*** [0.004]	-0.017*** [0.003]	-0.021*** [0.005]	-0.018*** [0.003]
$\ln \text{HC}$	0.052*** [0.016]	0.046*** [0.016]	0.060*** [0.014]	0.047*** [0.014]
$\ln FD_{local}^V$	-0.024 [0.016]			
$\ln FD_{local}^Q$	0.093* [0.050]			
$\ln FD_{pub}^V$		0.007 [0.021]	-0.028 [0.024]	
$\ln FD_{pub}^Q$		0.024 [0.033]	0.065 [0.040]	
$\ln FD_{coop}^V$		-0.076*** [0.026]		-0.040* [0.022]
$\ln FD_{coop}^Q$		0.085*** [0.030]		0.073** [0.032]
Constant	0.006*** [0.001]	0.008*** [0.001]	0.005*** [0.001]	0.006*** [0.001]
Wald [chi2]:	692.99	686.76	758.25	749.39
Sargan [chi2]:	87.12	90.59	83.98	88.23
Sargan [p-value]:	0.22	0.98	0.30	0.20
AR1 [z-value]:	-2.21**	-2.57**	-2.05**	-2.61***
AR2 [z-value]:	-1.75*	-1.42	-1.97**	-1.6

Notes: Robust standard errors in brackets. AB One-Step Estimation.

Sargan tests from AB Two-Step Estimation.

***, **, * denotes significance at 1, 5 and 10 percent level.

Note that specification (1) still incorporates small commercial banks. One may object the assumption that the business of small commercial banks is limited to a geographical area similar to that of public and private banks from the cooperative sector. Since there is no possibility to verify the geographical scope of activity for the group of small commercial banks, we further reduce our sample to construct financial development indicators.

³⁹In addition, we excluded RORs, which host most of such nationally active banks, namely the regions hosting the cities of Frankfurt a.M., Munich and Stuttgart. Results are qualitatively identical and we conclude that our findings are not driven by these regional "banking centers". Intuitively, this is not too surprising if one realizes that even the five largest banks in Germany have together only a very small market share of around 17 percent.

Consider to this end column (2), where we estimate our baseline specification with measures of financial development that are derived for public and cooperative banks only. Because both groups are active in all ROR in all years, we test for asymmetries by including our FD^Q and FD^V variables for each pillar separately. While we still find that the coefficient of FD^Q is positive for both banking groups, it is, however, only statistically discernable from zero for the group of cooperative banks.

One potential explanation is that a change in the efficiency of savings banks has no significant growth impact due to an already higher level compared to other banks. However, our summary statistics for cost efficiency per region indicate no such differences in the data.⁴⁰

Therefore, we are more inclined to hypothesize that it may well be possible that the role of savings banks, or more precisely the relation between their efficiency and local growth, is simply too different in the regions of Germany to yield a common coefficient on FD^Q in table 4 that is statistically significant for the whole of the economy.⁴¹ Note, however, that *statistical* significance need not preclude *economic* significance. Perhaps, the role of public banks is particularly important in less well endowed regions while it is markedly less relevant for growth in already better developed regions of the German economy. This is supported by a test on the equality of the coefficients for efficiency of both pillars which we cannot reject. It is thus possible that savings banks efficiency have a similar impact on local growth.⁴² While we cannot accept such a hypothesis on the basis of our analysis, such a result would be fairly in line with earlier studies distinguishing between developed and less-developed countries on the one hand and private and public banks on the other (Rioja and Valev, 2004; Galindo and Micco, 2004). In our view, therefore, the role of public banks in general and the apparent heterogeneity in German banking requires further research.

Finally we note that the systematic difference of FD^Q for these two banking groups is confirmed in columns (3) and (4). We estimate for each pillar separately and the result for cooperative banks implies that a sheer expansion of financial quantity of cooperative banks is to the detriment of income per worker.⁴³ Clearly, we do not model here whether the volume of cooperative bank loans is supply or demand driven. But what we infer from our results is that larger volumes do not promote growth. Instead, an improvement in the quality of financial intermediation is the variable that indicates a positive effect on income per worker.

⁴⁰Mean efficiency for both banking groups is around 74 % and the standard deviation of efficiency for savings banks even exceeds that of cooperative banks.

⁴¹We check to this end for each ROR the correlation between Y and FD^Q of savings and cooperative banks, respectively. While mean correlations are virtually identical, the standard deviation of correlations for savings is indeed 50 percent larger compared to that of cooperative banks.

⁴²In fact, estimating two regionally separated models (East versus West and regions above versus below median GDP per worker in 1993) yields that savings bank efficiency in poorer regions is indeed significant. While those estimates are available upon request from the authors, we do not depict them here since specification tests do not allow us to draw statistically firm inference.

⁴³As in the case of FD^Q , the coefficient for savings banks points into the same direction but is statistically insignificant.

5 Conclusion

We provide in this paper evidence on the finance-growth nexus for the regions of Germany. Using data for the 97 economic planning regions ("*Raumordnungsregionen, ROR*") and all banks operating in the Republic, we distinguish two different channels of financial development: a Hicksian volume effect FD^V and a quality effect FD^Q of financial development in the vein of Schumpeter. We introduce an improved measure for the latter: microeconomic cost efficiency measured for each bank individually. Our main results are the following five.

First, our evidence supports the notion that the quality of financial intermediation as measured by cost efficiency of individual banks significantly affects growth. A one-percent increase in cost efficiency spurs GDP per worker by 0.09 percent.

Second, the traditional proxy of credit volume to GDP used in most finance-growth studies receives no statistical support for our sample. In most specifications, an expanding amount of bank credit has no significant effect on growth.

Third, we find evidence that both measures of financial development must not be specified simultaneously as exogenous explanatory variable. We find that the use of instrumental variable estimators is necessary. However, by choosing suitable instruments we are able to obtain unbiased and consistent estimates.

Fourth, our results remain robust after excluding those banks from the construction of our financial development indicator that operate nationally and can therefore not be allocated to single regions with complete certainty. Nonetheless, after including FD^Q and FD^V only for local banks from each pillar, it is only the former effect of financial development that affects growth significantly and positively.

Fifth, both the quality and quantity effect is significant for cooperative banks only. In general, the results lead us to conclude that it is not the volume of funds, which is in short supply in Germany's region. In fact, the positive effect of FD^Q on growth suggests that economic expansion requires better but not necessarily more banking.

Two important caveats deserve mention. First, the negative and mostly insignificant coefficient found for lending volume may merely reflect the maturity of the German economy and could actually indicate an excess supply of credit (German Council of Economic Advisors, 2004). However, such inference would require the explicit modelling of the credit market as to determine if the observed level of aggregate loans indeed reflects the equilibrium level or not. Second, the lack of statistical significance of savings banks' efficiency need not imply economic insignificance. Rather, it may merely reflect the need to account more explicitly for potentially alternative roles played by these banks in different stages of economic development across regions at a given point in time.

Here, we remain in line with the existing finance growth literature and deem both issues out of the present paper's scope. But our results indicate that, first, the channels of financial development are conceptually different and, second, this difference can be taken into account by using efficiency as a more explicit proxy for the quality effects financial development has on growth.

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6 Appendix

Table 5: Summary Statistics for Growth and Stochastic Frontier Analysis Variables

Variable	Description	Unit	N	Mean	SD	Source
<i>Growth regression</i>						
Y_1	GDP per worker	€	776	49,016	7,708	FSO/SSO
Y_2	Gross value added per worker	€	776	45,737	7,151	FSO/SSO
FD^Q	Bank loans and securities to GDP	%	776	98.9	125.5	BBK
FD^V	Cost efficiency	%	776	74.3	2.4	BBK
ETG	Growth rate employed	%	776	0.18	1.43	FSO/SSO
$POPG$	Growth rate population	%	776	0.05	0.02	FSO/SSO
HC	Secondary school pupil to total pupil	%	776	22.0	3.9	FSO/SSO
HHI	Hirschman-Herfindahl-Index	Pts	776	151	241	BBK
MS	Mean market share	%	776	6.0	5.0	BBK
I	Change in bank liabilities to GDP	%	776	2.3	10.0	BBK
<i>Stochastic cost frontier</i>						
O_1	Interbank loans	M€	34,188	382	4,440	BBK
O_2	Commercial loans	M€	34,188	757	6,920	BBK
O_3	Securities and bonds	M€	34,188	365	3,900	BBK
W_1	Price of fixed assets	%	34,188	23.2	469.4	BBK
W_2	Price of labor	T€	34,188	51.5	151.4	BBK
W_3	Price of borrowed funds	%	34,188	3.94	25.51	BBK
Z	Equity	M€	34,188	58.4	507.0	BBK
TOC	Total operating cost	M€	34,188	84.0	767.0	BBK

Notes: M€: millions of Euro; T€: thousands of Euro; %: percentages; FSO and SSO: Federal and State Statistical Offices, respectively; BBK: Deutsche Bundesbank.

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