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The Role of Financial Development in Economic Growth: A Meta-Analysis

Master Thesis

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Prague, July 31, 2012 Petra Valíčková

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Master Thesis Proposal

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Proposed Topic:

The Role of Financial Development in Economic Growth: A Meta-Analysis

Topic Characteristics:

The aim of this diploma thesis is to provide a summary, an evaluation and an analysis of the existing econometric evidence on the effect of financial market development on economic growth. Many researchers have tried to give an answer to a seemingly simple question: Does financial market development affect economic growth? Consequently many empirical studies have been written on this subject; however, their results are mixed. Thus, the relationship is ambiguous, which is supported both by the theory and empirical research. Even though the vast majority of empirical studies speak in favor of the importance of financial market development for economic growth (among others a strong impact of financial market development on long run growth can be found for example in Rajan and Zingales (1998)), a non-negligible part of studies show that financial development does not cause economic growth, an example can be found in a work of Favara (2007), or that the correlation can be even negative, as in Gregorio and Guidotti (1995). In this respect, I will focus on the above-mentioned variation among studies and try to explain it by a meta-analysis approach. The studies may differ in methodology used, time span, data sets, specification etc., and some of these might be important determinants in clarifying the ambiguity in results.

Hypotheses:

1. There exist a positive and significant relationship between financial market development and economic growth
2. The methodology used, time span, data sets or different specification may clarify the ambiguity in results.
3. There is a bias in results caused by the preference for publishing both statistically significant results and with a positive effect of finance on economic growth.
4. Clarification of this controversial area of research, and help to estimate the true effect underlying the effect of financial development on economic growth.

Methodology:

In this study I will apply meta-regression analysis on the evidence of financial market development on economic growth in order to explain the variation in results. The meta-analysis was firstly applied in medicine by Karl Pearson in 1904 (O'Rourke, 2007) as a way of dealing with small sample sizes. Consequently meta-analysis was extensively used to summarize and evaluate the empirical results from different studies on the underlying topic. An example of meta-analysis can be found e.g. Stanley and Jarrel (1989), which was the first application of this approach in economics, or more recently in Babetskii and Campos (2007) who examined the effect of reforms on economic growth or Horváthová (2010) who focuses on the impact of environmental performance on economic growth. A narrative literature review in the field of financial development and growth was studied by Levine (2004). Nevertheless, the advantages of meta-analysis which can be understood as quantitative literature review over classical literature review lie in the fact that meta-analysis provide a more systematic approach to combine the empirical results and thus increases the explanatory power, as well as it enables to identify possible publication bias if it is the case (Stanley (2001)).

Outline:

1. An Introduction to the Finance and Growth Nexus
    a. Theoretical and Empirical Overview
2. Metodology Used
    a. Meta-Regression Analysis
    b. Publication Bias
3. Empirical Analysis
    a. Description of the Data
    b. Regression Model
    c. Discussion of the Results
4. Sensitivity Checks
5. Conclusions

Core Bibliography:

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Contents

Abstrakt

Tato práce se zabývá meta-analýzou nashromážděné empirické evidence o vztahu mezi finanční rozvinutostí a ekonomickým růstem. Doposud byly napsány stovky studií snažící se vysvětlit roli finančního systému v růstu ekonomik, výsledky jsou ale nejednoznačné. Tento závěr je podpořený jak teorií, tak empirickým výzkumem v této oblasti. Ve snaze pochopit tento nejednoznačný vztah bylo napsáno několik studií nabízející přehled literatury. Nicméně autoři těchto literárních přehledů často studie k zařazení do přehledu vybírají subjektivně. Proto i výsledky těchto kvalitativních přehledů literatury jsou postaveny jen na omezené informaci. Navíc, vzhledem k povaze těchto analýz nemohou systematicky zhodnotit, které faktory ovlivňují heterogenitu daného efektu, popřípadě zda jsou výsledky ovlivněny snahou o publikování pouze pozitivních a statisticky signifikantních výsledků. V tomto ohledu je hlavním zaměřením naší práce zkoumání toho, jaká je úloha finanční rozvinutosti v ekonomickém růstu a snaha systematicky vysvětlit, které faktory způsobují nejednotnost v odhadnutých výsledcích.

Za tímto účelem jsme shromáždili množství dostupných studií analyzujících vztah mezi finanční rozvinutostí a ekonomickým růstem. Přesněji řečeno, naše analýza bere v úvahu data z 67 empirických studií s celkově 1334 odhady vlivu finanční rozvinutosti na ekonomický růst. Pro kvantitativní analýzu těchto dat jsme použili meta-analytické techniky umožňující zhodnotit, zda autoři dílčích studií publikují převážně pozitivní a statisticky signifikantní výsledky, dále kvantifikovat opravdový vztah mezi finanční rozvinutostí a ekonomickým růstem a v neposlední řadě jsme použili regresní analýzu umožňující objasnit heterogenitu výsledků dílčích studií.

Naše výsledky ukazují, že tato oblast empirického zkoumání není ovlivněna publikační selekcí. Navíc ukazujeme, že mezi finanční rozvinutostí a ekonomickým růstem existuje pozitivní a středně silný vztah. Dle naší analýzy heterogenita publikovaných výsledků vyplývá nejen z metodologických návrhů studií, ale i z reálných faktorů. Konkrétně, efekt finanční rozvinutosti na ekonomický růst je odlišný pro různé části světa či různá desetiletí. Použití ekonometrických metod nezohledňujících endogeneitu vede k nadhodnocení zkoumaného efektu. Konečně, struktura finančního sektoru dané země má vliv na sílu tohoto efektu – poměrně větší zastoupení akciových trhů na úkor bank vede k posílení efektu finanční rozvinutosti na ekonomický růst.

Abstract

This diploma thesis presents a meta-analysis of the accumulated empirical evidence on the relationship between financial development and economic growth. So far, hundreds of studies have been written on the role of financial systems in economic growth; however, their results are ambiguous. This is supported both by theory and empirical research. In order to shed some light on the underlying relationship, narrative literature surveys have been conducted. Nevertheless, the authors of these surveys select representative studies for inclusion subjectively and thus build their results on only a limited set of information. Moreover, due to the nature of their analyses, they cannot systematically assess which factors influence the heterogeneity in reported findings or whether the results are driven by the desire to produce only positive and statistically significant results. Thus, the main focus of our work lies in investigating what the role of financial development in economic growth is, adjusted for possible publication selection, and to systematically explain the heterogeneity behind reported results.

For this analysis a pool of available studies investigating the underlying relationship was collected. More specifically, our analysis takes into account data from 67 empirical studies with 1334 estimates of the effect of financial development on economic growth. In order to quantitatively analyze this dataset we apply standard meta-regression techniques, ranging from a test of funnel asymmetry and a test of the true effect adjusted for possible publication bias to multivariate meta-regression analysis in order to obtain more profound understanding of what determines the effect size estimates in primary studies.

Our results indicate that this area of research is not affected by publication selection and that there is an authentic link between financial development and economic growth. The evidence also suggests that heterogeneity in reported findings arises not only from research design of studies examining this effect but stems also from real factors. More specifically, the effect of financial development on economic growth varies across regions and time periods; using an estimation technique that does not address endogeneity (OLS) inflates the estimated effect size. Lastly, the structure of a country's financial sector is found to matter as stock market oriented systems tend to be more conductive to economic growth compared to bank oriented systems.

Introduction

Economic growth is a topic of major importance for all economies, which is why the determinants of economic growth rate have been studied thoroughly during the last decades. Even small changes in countries' annual growth rates can translate into large differences in attained levels of economic activity over larger periods of time. Hence, it is in each policymaker's interest to understand what factors influence output dynamics.

Speaking of economic theory, the most well-known model to investigate output dynamics is the Solow model awarded with a Nobel Prize. In the Solow model, once an economy attains its equilibrium level of output, growth rates of population and technology are the sole determinants of output growth. As countries are heterogeneous in more than just these two aspects, it is not surprising that the Solow model is able to explain only a fraction of growth rate differences across countries.

With passage of time, models incorporating other promising determinants of economic growth were built. Patience influencing consumers' propensity to save, human capital accumulation, growth rates and levels of technological progress are examples of such determinants. One determinant, however, is largely omitted from theoretical models due to its complex nature – the level of a country's financial development. As with any other determinant, once true causality and direction of the effect of financial development on economic growth are understood, economic policy can be shaped in a way so as to approach the desired level of economic growth more efficiently. Thereby poor countries can catch up faster with the developed ones and developed countries can enjoy a more stable economic growth.

The need to understand the role of financial systems in economic growth has become even more pronounced with the advent of recent global financial crises – the 2007 crisis in the United States or the earlier financial crises in South East Asia and Latin America.

An absence of (equation-type) models that consider financial development as an input factor leaves us with only theoretical arguments on what impact developed financial systems have on the economy as a whole. In this respect, so far no consensus was reached and the issue is still heavily debated among economists. Different economists attribute different importance to the role of financial factors in economic

growth, while some economists regard financial factors completely irrelevant for real growth.

In the current literature three different streams of thought related to this issue can be identified. The first group of economists does not attribute the financial systems with any important role in stimulating or supporting economic growth. For example, the Nobel Laureate Robert Lucas (1988, p. 6) argues that economists "*badly over-stress*" the role of finance in economic growth. Odedokun (1996, p. 120) provides a contrasting view and argues that "*The importance of the financial sector in an economy can hardly be over-emphasized.*" This view would be in accordance with the second line of research, which is currently the prevalent one and can be traced back to Walter Bagehot (1873) and Joseph Schumpeter (1911). These scholars contend that financial system development is crucially important for economic growth and that under-developed financial systems retard economic growth. Lastly, the third line of thought worth discussing follows Robinson (1952) and is based on the idea that financial development simply follows economic growth.

While the last line implies no effect of financial development on economic growth, some theorists propose an effect completely different from the ones mentioned above, i.e. negative. Keynes (1936) argues that speculative activities inherent in stock markets can have destabilizing effect on the economy, implying higher risk of economic downturns with more developed financial systems. Empirical investigations confirming of this negative effect of financial development on economic growth include e.g. Gregorio & Guidotti (1995) or Andersen & Tarp (2003). Minsky (1991) goes even further and suggests that instability inherent in financial systems will finally and naturally create conditions for crises and thus have devastating effects on real economy. One can argue that higher financial system instability is a result of insufficient regulation and thus bad regulation instead of financial development per se is the driver of economic downturn. However, regulatory bodies are typically one step behind financial intermediaries (banks, insurance companies, etc.) in terms of financial innovations and thus increased economic instability is most likely to remain a valid threat regardless of regulators' efforts.

As intuition behind each view is solid, the clash of above mentioned theoretical views can be interpreted as uncertainty in whether the positive effect stemming from better allocation of excess funds to deficient agents is larger than the negative effect related to higher financial system instability.

The last paragraphs demonstrated that neither economic models nor economic theories can give us a definite answer whether financial development is significantly beneficial or detrimental to economic growth. Hence, we can rely on empirical assessments of this effect only. Thus, in this thesis we will focus on the available evidence on the relationship between financial development and economic growth with the aim to gain further understanding of the underlying effect. Further insight into this area of research is gained by employing meta-analysis techniques into this highly unresolved area of research.

This thesis is organized in the following way. In Section 1, we provide the reader with a motivation of our work. The current state of research in the financial development – economic growth nexus is briefly discussed. We follow by a short critique of the existing research in this area and propose some remedies. Section 2 provides deeper information on different theoretical views related to the finance-growth relationship. Special attention is devoted to the rationale why financial systems may be important in enhancing the growth prospects of the real economy. In Section 3, we follow by providing empirical evidence on the financial development - economic growth nexus. We continue by concepts and measurement techniques of financial development to allow for discerning the finance-growth relationship quantitatively. In Section 4, we provide a brief introduction to the field of meta-regression analysis, discuss data in this thesis and summarize the underlying effect reported in empirical studies. Tests for publication bias are provided. In Section 5, we carry out a meta-regression analysis in order to explicitly model the heterogeneity of reported sizes of the finance-growth effect. Section 6 contains a discussion of our results, followed by conclusion.

1. Motivation

As previously stated, the underlying relationship between financial development and economic growth remains unclear in theory and thus only empirical studies can help us understand this matter. Several narrative literature reviews were conducted focusing on financial development and economic growth, e.g. Levine (1997), Levine (2005) or more recently Ang (2008). In general, narrative literature reviews can without a doubt serve as useful tools for providing a survey of existing literature on the underlying topic. Given the abundance of empirical literature on the link between finance and growth they help to shed some light on this subject or give one a general idea. However, narrative literature reviews are likely to suffer from several shortcomings as highlighted by e.g. Stanley (2001). One of these shortcomings may arise when authors of literature reviews err on the side of not including all studies on a particular subject. Some studies can be judged by the authors as either misspecified, not in accordance with the desired theory or authors' personal views. This can lead to a truncated sample of studies being selected for the review. As a consequence some narrative reviews can lead to different conclusions despite examining the same topic, as highlighted by Borenstein (2009). In this respect, Stanley (2001) argues that meta-analysis (MA) provides a more systematic approach to combine all the empirical results and thus increases general understating of the matter. Moreover, meta-analysis enables to identify possible publication bias if present. These reasons lead us to employ a meta-analysis for the investigation of the financial development - economic growth nexus.

So far there has been only one meta-analysis written on the topic at hand. Quantitatively summarizing 20 studies and investigating the effect of financial development in economic growth, Asongu (2011) concluded that contrary to mainstream literature the positive link is not supported by recent empirical studies. However, several shortcomings of Asongu's meta-analysis can be identified. In this respect, the objective of this thesis is to improve upon the meta-analysis of Asongu's by using more up-to-date meta-analysis techniques as well as include all the relevant empirical literature in order to properly examine whether financial development enhances economic growth. By means of meta-analysis not only publication bias in this area shall be examined but also the true effect driving this relationship shall be estimated. Lastly, the heterogeneity among effect sizes from empirical studies will be explicitly explained.

2. Theory behind Financial Systems and Growth

Economic theory states that the emergence of financial markets and institutions can be attributed to the existence of information and transaction costs. The financial system then provides a mechanism to minimize the information and transaction costs (so called market frictions). If information was perfect and in the absence of transaction costs (as in Arrow-Debreu model) there would be no need for financial markets and intermediaries to arise. However, the existence of market frictions inherent in current world implies the necessity for financial markets and intermediaries. Following Levine (1997) and Levine (2005) the primary functions of financial systems can be classified into the following five basic categories: financial systems may improve allocation of resources, mobilize savings, facilitate the exchange of goods and services, reduce risk and exert corporate control. Schumpeter (1911) argued that these services provided by financial intermediaries are essential for technological innovation and economic development.

These five functions may affect economic growth via two recognized channels: capital accumulation channel and technological innovation channel (sometimes referred to as total factor productivity channel or Solow residual). In growth models based on capital accumulation, financial systems can promote growth by enhancing the rate of capital formation, either by increasing the saving rate or by improving the allocation of savings among deficient individuals and potential investors. For example, Allen & Gale (2001) argue that financial systems are crucial to the allocation of resources in a modern economy. On the other hand, the total factor productivity channel emphasizes the ability of financial sector to alter the rate of technological innovation. These two traditional channels through which financial system fosters growth can be further extended.

Another channel was pointed out by Coricelli (2008) who contends that financial sector can serve as a shock absorber in periods of adverse economic shocks. Coricelli's premise is that during good times, firms rely on sources of finance alternative to the banking sector of the country, mainly trade credits and retained earnings. Thus, availability of outside finance does not seem to be a binding constraint for firms' expansion in good times. However, such inside forms of financing increase the likelihood of chain effects, i.e. a negative shock to a company can be transmitted to its trading partners. The occurrence of such chain effects induces the breakdown of both

credit chains and production chains, resulting in sudden and sharp output falls. In such a situation the banking sector comes to aid by providing loans to temporarily illiquid companies, thus preventing a negative shock to one company spread to the rest of them. To investigate the existence of this channel between financial development and economic growth, Coricelli studied the impact of financial development on the magnitude of output falls in both developed and emerging countries from 1963 through 2003. His results indicate that countries with more developed financial sectors display output falls well below the average, when negative shocks occur.

The short-term importance of this channel is clear. Moreover, recent studies (e.g. Cerra & Saxena 2008) demonstrate that the implications of sharp output falls are long-lasting as they are accompanied by future low economic growth rates. Thus, according to this view, building deep, liquid and internationally integrated financial markets is of principal importance and a way how to avoid sharp and persistent falls in output. This implication is even more pronounced for emerging markets where the level of financial development tends to be lower and thus these countries suffer on average from higher output contractions as shown by Coricelli, which further hinders their long-term catch-up process.

The figure on the following page depicts the theoretical view of how the presence of market frictions motivates the emergence of stock markets and financial intermediaries and how the existence of financial system supports economic growth.

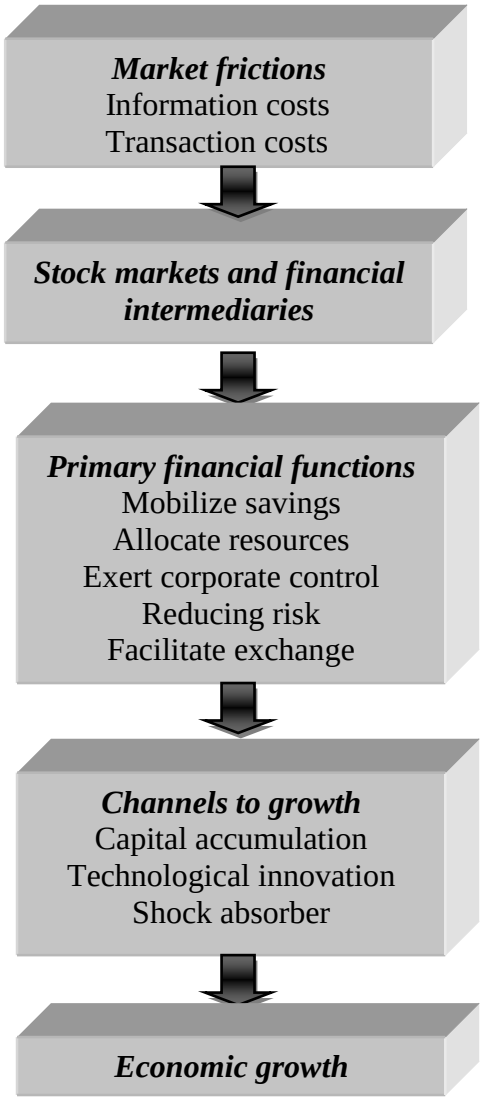

Figure 1: A theoretical Approach to Finance and Economic Growth
Source: Levine (1997) and Coricelli (2008).

The remainder of this chapter studies how specific market frictions motivate the emergence of stock markets and financial intermediaries and the contribution of solving for these frictions (through the five basic financial functions) to economic growth.

2.1. Functions of Financial Systems

In this section, we provide an overview of functions provided by financial intermediaries and stock markets, which are at least theoretically tied to enhancing the growth process. This section builds on Levine (1997) and Levine (2005).

2.1.1. Acquiring Information and Allocating Resources

Without the existence of stock markets and financial institutions it would be costly for individual savers to evaluate investment projects. Levine (1997) demonstrates how financial intermediaries may acquire information about investment projects more effectively than individuals and thereby improve resource allocation and foster growth. With the existence of fixed costs associated with evaluating the subject's ability to repay, it is more advantageous for a group of individuals to approach financial intermediaries to economize on the costs of acquiring and processing information about investments.[1] This ability to acquire and process information may have important growth implications since capital will be invested in most promising projects and thus lead to more efficient allocation of scarce capital as argued by Greenwood & Jovanovic (1990).

In addition, financial intermediaries may also promote the rate of technological innovation by identifying entrepreneurs with the best chances of introducing innovative goods and production technologies. Stock markets can also substantially reduce costs associated with acquiring information about firms. As asset prices are available at any time and instantly, economic agents do not have to undertake the costly process of acquiring information, thus leading to improved allocation of resources and corresponding implications for economic growth.

2.1.2. Exercising Corporate Control

Another role of stock markets and financial institutions is the ability to reduce costs related to monitoring of investment projects. Moreover, they help to address the principal-agent problem by aligning the interests of managers and owners.

[1] Bagehot (1873) explains that good ability of financial system in England in the mid-1800s to identify and fund profitable projects (i.e. good information acquisition and resource allocation) strongly contributed to the economic success of the country.

Levine (1997) supports this view by an illustrative example. Consider a situation when it is costly for outside investors to verify project returns and borrowers are likely to mispresent the project return or to use the funds on other project than formally claimed. Under this condition of high verification costs, which prevents the lender from monitoring the project, the lender will not be willing to invest in the project due to the inability to properly and reliably determine project returns. This situation will result in an inadequate level of investments.

Hence, the existence of verification costs motivates financial development as financial intermediaries can specialize on project verifications/appraisals and thus save due to economies of scale and higher efficiency. The monitoring costs are substantially reduced, as the borrower is monitored only from the side of intermediary and not from the side of all outsider investors who engaged their money in the project.

Overall, more efficient corporate control tends to improve capital accumulation and exerts a positive link on economic growth.

2.1.3. Mobilizing Savings

Financial markets and financial intermediaries perform an important role in mobilizing savings from individual agents who have access to free funds to deficient agents with good investment opportunities. Without this aggregate availability of funds many investment opportunities would be constrained, since they may require a high injection of capital (Sirri & Tufano 1995). Bagehot (1873) argued that in mid-1800s the main difference between England and poorer countries was that the financial system in England was capable to mobilize savings for very large projects. Finally, as pointed out by Bagehot (1873) these aggregate savings do not come only from national resources. Thus in general, with higher availability of funds, more investment projects can be realized, hence improving the resource allocation and economic development.

2.1.4. Facilitating the Exchange of Goods and Services

Stock market development may also lower transaction costs, promote specialization and technological innovation. Transaction costs are lowered as the financial system provides ways of clearing and settling payments to facilitate the exchange of goods and services. These elements were in the centre of attention of Adam

Smith's Wealth of Nations (1976) where Adam Smith argued that greater specialization is the principal factor essential for productivity improvements. Smith also indicated that well-functioning banks were crucial for economic development as they can lower transaction costs and promotes specialization.

2.1.5. Reducing Risk

Traditional finance theory suggests that investors can invest in portfolios of stocks or investment projects and thus diversify and lower their exposure to risk. This is even more pronounced in internationally integrated markets. This ability of financial systems to provide risk diversification can enhance long-run economic growth rates (Obsfeld 1994). In addition, savers would also be reluctant to engage their capital in long-term and potentially higher return projects since there might be situations in which they will need their resources immediately. However, with liquid stock markets and short-term or demand deposit accounts, investors are able to withdraw their money quickly, thus even investments in long-term projects can be realized. Moreover, with insurance companies, uncertainty and involved financial risk can be further mitigated.

2.2. Skepticism over Financial systems and Growth

In the previous subsection, we presented a list of services provided by the financial system which should enhance financial development. However, the definite positive association between finance and growth is subject to debate. Here, we present some skepticism over the benefits provided by financial development to economic growth.

While some researchers do not attribute any important role to financial systems in the growth process, some economists even argue that financial systems can have adverse effects on the real economy. The rationale behind this view is that the financial sector may give rise to financial crises and thus destabilize the real economy. This view is supported by Keynes (1936) who argued that speculative activities inherent in stock markets have destabilizing effect on economic performance. Likewise, Kindleberger (1978) contends that psychological factors stimulate excessive speculative behavior which leads to excessive asset prices (asset price bubbles). A snap in confidence (panic) will cause the asset price bubble to finally burst and will induce an

economic crisis. Furthermore, Minsky (1991) in his Financial Instability Hypothesis expressed a view that financial markets naturally become fragile. This provides conditions for an occurrence of a financial crisis caused by excessive accumulation of debt exceeding the speculative borrower's ability to pay back. This spreads out in the economy, leading to an economic recession. Minsky's theory of financial instability gained popularity with the subprime mortgage crisis (see McCulley 2009).

All the above mentioned links between financial systems and economic downturns can rather be caused by inefficient regulation. However, as more developed financial systems are more difficult to efficiently regulate, we cannot disregard these channels between finance and economic downturns as consequences of market failures ineffectively addressed by regulatory bodies. Instead, regulation that is insufficient to some degree can be considered "inherent" to financial systems.

Lastly, taking into account that financial systems can have a supporting as well as a destabilizing effect on the economy, the question is whether the benefits resulting from financial development outweigh the negative consequences of possible financial market failures.

3. Evidence on Finance and Growth

After having established the possible theoretical links between financial systems development and economic growth, this section provides a brief discussion of the accumulated empirical evidence on this topic. Empirical literature on financial development and economic growth focuses on either the role of financial system in the economic growth process or examining the causal relationship between these two variables, specifically the existence and direction of causal relationship. With advances in econometric techniques, some of the most recent empirical studies consider both issues simultaneously.[2] These recent studies first test for the direction of causality and if the causality follows from financial development to economic growth, the role of financial development in economic growth is quantified.

The majority of empirical studies on one hand shows that financial development is correlated with subsequent economic growth and on the other hand provides evidence on the causal impact of financial development on economic growth. However, a more profound examination of the large body of literature indicates that this prevailing effect cannot be generalized as there is a large variety of empirical findings on both of these issues derived from a diverse set of studies using different estimation techniques, specifications or data characteristics. Throughout this thesis, we will focus on studies examining whether higher levels of financial development are associated with higher economic growth rates, i.e. we do not investigate the existence and direction of causality.

To our knowledge the first empirical study written on this subject goes back to Goldsmith (1969). Goldsmith examined data on 35 countries spanning from 1860 through 1963. The author's results can be summarized as follows: "*periods of more rapid economic growth have been accompanied, though not without exception, by an above-average rate of financial development*" (Goldsmith 1969, p. 48).[3] Nevertheless, apart from a few pioneering works, empirical studies on this subject emerge mainly after the influential work of King & Levine (1993). Using data for 80 countries over the period 1960 to 1989, King & Levine (1993, p. 719) found a "*significant and robust*

[2] For correlation between financial development and economic growth, see for example King & Levine (1993) or Rajan & Zingales (1998) and for evidence on causality refer, for example, to Levine et al. (2000), which is the first study on this subject considering the endogeneity of financial development, or Christopoulos & Tsionas (2004).

[3] However, as pointed out by Levine & Renelt (1992), the weekness of Godsmith's work is that he did not account for other important variables potentially influencing economic growth, such as education, international trade and political and macroeconomic stability.

relationship between the level of financial development and both the current and future rate of economic growth." The authors regress the average annual GDP growth over the time span 1960 to 1989 on the initial value of financial sector development in 1960. Based on this regression, the authors conclude that "*the link between growth and financial development is not just a contemporaneous association… Finance does not only follow growth; finance seems importantly to lead economic growth"* (King & Levine 1993, p 730). In their work, other factors associated with long-run GDP growth rates, such as initial income, trade, human capital or macroeconomic and political stability, were systematically controlled for.

While the aforementioned study uses initial values of financial development variables to control for the potential endogeneity problem, this may still remain an issue (see Manning 2003). At the same time this approach does not address the potential endogeneity of other control variables. Levine et al. (2000), Beck et al. (2000), Rousseau & Wachtel (2000) and Beck & Levine (2004) confirm the importance of financial development in economic growth, and at the same time improve upon earlier work by controlling for both simultaneity bias, omitted variables and unobserved country specific effects.

For instance, Levine et al. (2000) and Beck et al. (2000) deal with the issue of potential simultaneity by employing cross-sectional instrumental variable estimator and a GMM[4] dynamic panel estimator, respectively. When the cross-sectional instrumental variable estimator is used, countries' legal origins are used as instruments for financial intermediary development. While the problem of endogeneity of financial development is likely addressed,[5] this approach overlooks the time series variability of the data and does not deal with omitted variable bias. Moreover, due to cross-sectional nature of the data, the results are just an average effect of financial development on the real economy. In this respect, the GMM dynamic panel estimator provides a better solution to the problem of endogeneity.

The GMM estimator, proposed by Arellano & Bond (1991) and introduced to the financial development – economic growth related empirical literature by

[4] Generalized Method of Moments

[5] However, Manning (2003) discusses circumstances under which this does not hold. Moreover, it is worth noting that the cross-sectional IV estimator where countries' legal origins are used as instrumental variable (IV) for financial intermediny development deals with the issue of endogeneity of financial development, however, it does not address the potential endogeneity of other controlling variables.

Levine (1998), Levine (1999), Rousseau & Wachtel (2000) and Levine et al. (2000),[6] simultaneously addresses the issue of endogeneity and omitted variable bias, as well as enables to take into account the time variability in the data. Following these works, the GMM panel estimators have been increasingly used in the finance-growth literature.

To cite but a few, Levine et al. (2000) for the first time in the finance-growth literature employed the GMM system estimator, developed by Arellano & Bover (1995). The study was based on a panel dataset of 74 countries, with data spanning from 1960 to 1995 and averaged over seven five-year periods. Levine et al. (2000, p. 53) concludes that *"the exogenous component of financial intermediary development exerts a large, positive impact on economic growth."* These results are confirmed by Beck & Levine (2004), who apply system panel estimator and find that financial development exerts not only statistically but also economically significant impact on economic growth. To sum up, their results confirm the importance of financial development in fostering economic growth prospects and this result is not due to potential biases created by simultaneity or unobserved country specific effects, i.e. shortcomings, that earlier works and their results may have been subject to.

Studies discussed so far focused exclusively on the development of financial intermediaries and their importance to economic growth. However, more recently, the empirical literature does not limit itself to the banking sector but with the development of stock markets the analysis expands to examine the linkage between stock market development and economic growth. The role of stock market development in economic growth was firstly studied by Atje & Jovanovic (1993). These authors, using cross-sectional data for 40 countries averaged over the period 1980 – 1988, found a "*large effect*" of stock market development defined as the total value of traded shares to GDP on subsequent economic growth (Atje & Jovanovic 1993, p. 636). Conversely, the effect of financial intermediaries' development was found insignificant to affect the growth rate of real economy.[7]

Levine & Zervos (1998) were the first to simultaneously examine the effect of both the stock market and financial intermediaries on economic growth. They used cross-country data averaged over the period 1976 – 1993 and several measures of stock

[6] While Levine (1998) and Levine (1999) employ the GMM difference estimator on cross-sectional data, Rousseau & Wachtel (2000) and Levine et al. (2000) employ the GMM estimator on panel data, thus taking into account the time variability of the data set at hand.

[7] For clarity, the effects of stock market and financial intermediaries on economic growth were studied separately by running two different regressions.

market development while controlling for bank development. Both stock market and financial intermediary indicators are included in the same regression in order to see whether they are additive in nature. As the coefficients related to the indicators of both stock market development and financial intermediaries' development are found positive and significant, Levine & Zervos (1998, p.537-8) conclude that "*stock markets provide different services from banks*" and these are "*robustly correlated with current and future economic growth.*"

Beck & Levine (2004) expand the analysis of stock markets' role in economic growth by examining the time variability of data. They employed GMM system estimator to a panel data set of 40 countries over the period 1976 – 1998. In line with previous research they found that both stock market and bank development are jointly significant and thus contribute to the growth process. As highlighted by the authors, this is not due to endogeneity or country specific effects which were systematically controlled for in the regressions. Other authors investigating the role of financial markets in the growth process include Liu & Hsu (2006), Minier (2003), and Naceur & Ghazouani (2007), to cite but a few.

However, not all studies report a positive link. Among others, Ram (1999) examined data for 95 countries over the period 1960 - 1989 and concluded that the association between financial development and growth of real GDP per capita is weakly negative or negligible. Next, Andersen and Tarp (2003, p. 202) report that the positive growth effect of financial development which holds for the broad panel of 71 countries studied by Levine et al. (2000) becomes "*at best insignificant during 1960–95, and at worst, it is negative*" when the sample is restricted to countries from Sub-Saharan Africa and Latin America. Thus, Andersen & Tarp (2003) by splitting the sample into different region groups showed that huge heterogeneity across regions imply that financial development is not always positively related to growth and that different regional patterns may emerge. Similarly, De Gregorio & Guidotti (1995) found that the impact of financial development on growth is negative for a panel of Latin American countries.

Last but not least, some researchers argue that the strong positive association between financial development and economic growth established by studies using data from the period 1960 – 1989 weakens when more recent data are used (e.g. Rousseau & Wachtel 2011). Splitting the data into two periods, 1960 – 1989 and 1990 - 2004, the authors found that while the coefficients are significant and positive for the first period, they are mostly negative and insignificant for the second period.

Finally, some empirical results suggest that the effect of financial development is not monotonic and that some threshold effects may exist (Rioja & Valev 2004) or that there are other factors which may affect the growth effect of financial development (Rousseau & Wachtel 2002; Deidda & Fattouh 2002). Specifically, Rioja & Valev (2004) argue that the growth effect of the financial system differs with the degree of financial development. Examining a panel data set of 74 countries over the period 1961 – 1995 and dividing these countries into three categories, their results suggest that a strong positive impact of financial development on economic growth holds only after a certain threshold of financial development is achieved. Besides, this effect is lessened for countries with highly developed financial systems. For countries which find themselves at low levels of financial development, this effect is ambiguous.

Rousseau & Wachtel (2002) argue that the strength of the relationship between financial development and economic growth is contingent on the rate of inflation. They estimate a threshold level of inflation (between 13-25 percent) above which financial development no longer increases economic growth. Similar findings are obtained in Rousseau & Yilmazkuday (2009) and Giedeman & Compton (2009). Last but not least, Deidda & Fattouh (2002) argue that the growth effect of financial development increases with the level of economic development. The authors argue that in initial stages of economic development the growth effect of financial development is ambiguous while in later stages of development process it becomes significantly positive. To sum up, the results of aforementioned studies speak in favor of examining different countries or regions separately as a non-linear relationship between financial development and economic growth could lead to inconsistent results if heterogeneous countries are pooled together in one regression.

3.1. Empirical Studies Used

All of the above mentioned studies are only an illustrations, since many empirical studies examining whether higher levels of financial development are associated with higher economic growth have been written.[8] The high number of these studies documents that the link between finance and growth is not only a long-debated issue, but is of principal interest among economists and researchers. These studies use data for various countries and time periods and can be further categorized into pure

[8] For a more detailed survey of empirical studies see for example Ang (2008).

cross-country studies, time series studies and panel data studies depending on the nature of data used.

Regardless of data used, all such studies use a variant of the classical growth regression to assess the link between financial development and economic growth. A general classical growth model augmented for financial development can be written as follows:

$$G_{it} = \alpha + \beta F_{it} + X'_{it}\gamma + \delta_t + \eta_i + \epsilon_{it}, \quad (1)$$

where i and t denote country and time period subscripts, respectively; G stands for some measure of economic development (in this case, GDP growth rate or per capita GDP growth rate, measured either in real or nominal terms); F represents a measure of financial development (usually some measure of the size or activity of financial intermediaries or some measure of stock market development); X is a vector of control variables to account for other factors considered important in the growth process (e.g. initial income, education, international trade or macroeconomic and political stability); δ_t captures a common time specific effect (unexplained part which is specific to time period but has the same effect in all countries); η_i is the unobserved country specific effect which is time invariant; and ε is the unobserved error term with its usual properties. Finally, the estimated coefficient related to financial development, β from equation (1), is the regression parameter of interest. However, it should be noted that these regression coefficients related to financial development obtained from different studies are not directly comparable and some adjustments must be undertaken, which will be further discussed in Section 4.2.

As discussed above, the earliest studies on the finance-growth nexus and on economic growth in general were of cross-country nature and used a large sample of countries with only one observation for each country. Usually, this observation contained an average of economic growth, financial development and other variables over several decades. However, there is some skepticism among researchers regarding cross-country regressions (Arestis & Demetriades 1997; Ram 1999). As in broad cross-country regressions different countries are treated as homogenous entities, the unobserved country specific effect is part of the error term. Due to this oversight estimates are likely to be biased. Other drawback is that observations are averaged over

long periods and the time dimension of the data is not taken into account in estimations. In the field of financial development and economic growth this issue was pointed out for example by Levine & Zervos (1998), Beck et al. (2000) or more recently by Ang (2008) in his literature review of this topic. Last but not least, cross sectional studies are subject to potential endogeneity problems and do not satisfactorily address the question of causality (Arestis & Demetriades 1997). Finally, the results can only shed some light on average effect across studies under consideration and thus cannot be meaningfully used for policy recommendations.

Having the shortcomings of cross-country regressions in mind, some researchers suggest focusing more on simple time series analysis which takes into account country specific aspects (Ang 2008; Arestis & Demetriades 1997; Ram 1999). Arestis & Demetriades (1997) point to the differences in causality patterns across countries which can be assessed by time series analysis. However, this is likely to be difficult due to data limitations of many countries. This drawback of time series studies is more pronounced for developing countries where data availability is even worse.

In this respect, the use of panel datasets seems more appropriate. Panel studies ameliorate the econometric shortcomings of pure cross-section studies by the ability to exploit both the time-series and cross-sectional variation (allows for country-specific differences) in the data. These econometric techniques are nevertheless subject to some shortcomings too (see Ang 2008). In addition, different panel approaches are employed (as discussed in Section 5.1), ranging from standard panel data techniques such as fixed and random effects model to GMM estimators.

3.2. Measuring Financial Development and Economic Growth

"*Defining appropriate proxies for the degree of financial development is, indeed, one of the challenges faced by empirical researchers***"** Edwards (1996, p. 21)**.**

Different authors use various measures of financial development in their empirical studies of finance and economic growth. However, as it is evident from the introductory citation this presents a real challenge for empirical research. Financial Development Report 2011 published by the World Economic Forum defines financial development as "*the factors, policies, and institutions that lead to effective financial*

intermediation and markets, as well as deep and broad access to capital and financial services" (WEF 2011, p. 13). This definition thus gives major importance to well-functioning and effective financial intermediation/markets and by no means states that financial development is related to quantitative measures of financial development only. Levine (1999, p. 11) remarks that an ideal measure of financial development would capture "*the ability of the financial system to research firms and identify profitable ventures, exert corporate control, manage risk, mobilize savings, and ease transactions.*" That is, the ability of financial intermediaries and stock markets to provide primary financial functions, as discussed in detail in Section 2. Nevertheless, this theoretical ideal is unrealistic as these characteristics would be extremely difficult to measure for a single country and even more difficult across different countries. For this reason, various proxies for the development of financial system are used, focusing either on the development of financial intermediaries or stock markets.

The Database of Financial Development and Structure 2009 of the World Bank distinguished among various measures of financial development according to the size, activity, efficiency and stability of financial intermediaries and stock markets. We select and focus here only on those indicators which are most frequently applied in empirical literature of financial development and economic growth.[9]

The most commonly used indicators of financial intermediary development are financial depth, bank ratio and financial activity. Financial depth, defined as the ratio of liquid liabilities of the financial system to GDP, refers to the size of financial sector. Various measures of financial sector depth are employed with regard to different measures of money supply, so called monetary aggregates. Some authors use M2 to GDP ratio (e. g. Giedeman & Compton 2009; Anwar & Cooray 2012) while other authors use M3 to GDP ratio (e.g. Dawson 2008; Hassan et al. 2011b or Huang & Lin 2009). The use of financial depth as an indicator of financial development relies on the assumption that the size of financial sector is positively associated with the provision and quality of financial services (King & Levine 1993). Hence, the use of a broader monetary aggregate M3 to GDP is driven by the fact that M2 to GDP ratio may not appropriately capture the development of financial system in countries where money is used as a store of value (Yu et al. 2012). Or, in order to eliminate the pure transaction aspect of narrower monetary aggregates and thus more appropriately capture

[9] For other measures of financial development as well as for the statistics on the size, activity, efficiency and stability of financial intermediaries and stock markets refer to Beck et al. (2010).

the activities of financial intermediaries some authors employ M3 – M1 to GDP ratio (e.g. Yilmazkuday 2011; Rousseau & Wachtel 2002). However, financial depth is only a quantitative measure of financial development which does not control for the quality of provided financial services. In addition, financial depth also includes deposits in banks by other financial intermediaries raising problem of double counting (Levine 1997).

The second proxy used to measure financial development is bank ratio, defined as the ratio of bank credit divided by a sum of bank credit and central bank domestic assets. This indicator was firstly applied in the work by King & Levine (1993). Bank ratio appraises the importance of commercial banks versus central bank in allocating excess resources in the economy. Higher value of this indicator implies better financial development since commercial banks are more likely to provide better primary financial functions than central banks (King & Levine 1993). However, as Levine (1997) points out there are some weaknesses associated with the implementation of this measure, as financial institutions other than banks provide financial functions too. Moreover, bank ratio does not capture to whom the financial system is allocating credit (King & Levine 1993), nor does it assess how well commercial banks perform in mobilizing savings, allocating resources, exercising corporate control or reducing risk.

The third proxy used to measure the development of financial intermediaries is financial activity. Several measures of financial activity are used: private domestic credit provided by deposit money banks to GDP (employed by e.g. Beck & Levine 2004 or Cole et al. 2008); private domestic credit provided by deposit money banks and other financial institutions to GDP (hereafter private credit, employed e.g. by Andersen & Tarp 2003 or De Gregorio & Guidotti 1995); and the ratio of credit allocated to private enterprises to total domestic credit (hereafter private credit/domestic credit, employed by King & Levine 1993 or Rousseau & Wachtel 2011, to cite but a few). These measures provide a better indicator of the size and quality of services provided by financial system as they focus on credit issued to the private sector (Levine et al. 2000). However, neither private credit nor financial depth can adequately assess the effectiveness of the financial intermediaries to ameliorate market frictions and channel funds to the most productive uses (Levine et al. 2000).

As discussed in Section 3, the beginning of research in this area focused entirely on banks and thus only indicators of financial intermediaries' development were used. However, with the development of stock markets and since the pioneering work of

Atje & Jovanovic (1993) more attention is paid to stock markets and their role in enhancing the growth process. In this respect, indicators of stock market development are increasingly used. The most commonly employed measures of stock market development in empirical literature under question are market capitalization ratio (e.g. employed in Chakraborty 2010; Shen & Lee 2006; Yu et al. 2012), stock market activity (Manning 2003; Tang 2006 or Shen et al. 2011) and turnover ratio (e.g. Beck & Levine 2004; Yay & Oktayer 2009 or Liu & Hsu 2006). Stock market capitalization refers to the overall size of stock market and is defined as the total value of listed shares relative to the size of real economy (GDP). Other measures of stock market development refer to the liquidity of these markets. Stock market activity equals the total value of traded shares relative to GDP and the turnover ratio is defined as the total value of traded shares relative to total value of listed shares.

Alternative measures of financial system development identified in empirical studies include for example an aggregate measure of overall stock market development (Naceur & Ghazouani 2007) which takes into account market size, market liquidity as well as integration with world capital markets); a share of resources a society devotes to running its financial system (Graff 2003), ratio of deposit money bank assets to GDP (Bangake & Eggoh 2011) or financial allocation efficiency defined as bank credit to bank deposits.

The above mentioned variation indicates that there is little consensus among researchers on the most appropriate measure of financial development. In this respect, researchers most commonly use several measures of financial development rather than a single indicator in order to provide more robust results across different specifications. It is also worth noting that none of the measures can meaningfully capture the overall financial development of a particular country which is associated with both financial intermediaries' development and stock markets development, as the first group of indicators identified above focuses entirely on the bank side of financial system development whereas the second group focuses on the stock market development. This is likely to vary across countries as some countries rely more on banking sector (e.g. Germany or Japan), whereas other countries rely more on stock markets (Anglo-Saxon countries) in channeling funds to the most productive use. Also Beck et al. (2009) finds a trend towards market based financial systems, indicating that the relative importance of stock markets is increasing over time and thus more attention should be

given to indicators explicitly incorporating some measure of stock market development when examining the finance-growth nexus.

As none of the above identified measures of financial development can meaningfully capture the overall financial development, they only serve as proxy variables for financial development of a particular country and each of them is associated with several shortcomings as discussed above. Lastly, the selection of financial development indicators in empirical research is largely driven by data availability.

An initiative to provide a meaningful measure of financial development capturing at once different characteristics of countries was conducted by the World Economic Forum, which since 2008 publishes on a yearly basis the Financial Development Report containing an aggregate financial development index for a number of countries around the world. This aggregate index emphasizes the importance of the development of financial system as a whole as well as the interdependence of its parts. The index is based on seven pillars related to institutional and business environment, financial stability, banking and non-banking financial services, financial markets and access to financial services. It follows that the achievement of well-developed financial system is rather complex and many factors must be taken into account when formulating appropriate government policies with respect to financial development. Considering this aggregate measure of financial development, it is apparent that financial development is a broader concept and the development of financial intermediaries and stock markets is only a subset of it.

Regarding the measures of economic growth or economic development in general identified in the empirical studies of finance and growth, researchers most frequently use GDP growth or per capita GDP growth measured either in real or nominal terms. Other possible growth indicators sometimes used are the rate of capital accumulation per capita or improvements in economic efficiency (used for example in the pioneering work of King & Levine 1993) or human capital development.[10] However, as the focus of the present study is classical growth regressions, only studies using the former measures of economic performance are considered.

[10]The relationship between human capital development and financial development was examined for example by Outreville (1999).

4. Methodology

4.1. Introduction into Meta-Regression Analysis

"*Have you ever wondered why there is so much variation among the reported empirical results of economic research?*" (Stanley and Jarell 1989, p. 299).

Meta-analysis can be understood as quantitative literature review. In other words it is a way how to systematically and transparently summarize regression results from primary studies.[11] As the introductory quotation suggests, there is a large variation among empirical results present in research. Regression results across studies differ in magnitude, sign of the effect or significance of regression coefficients, for which reason it is impossible to arrive at a definite understanding of the investigated relationship. For example, the debate present here is whether the regression coefficient β on financial development from equation (1) is significantly different from zero and if yes what the coefficient sign is. First attempts to derive a definite conclusion regarding the relationship between financial development and economic growth were literature surveys by Levine (1997), Levine (2005) or Ang (2008). A drawback of literature reviews is the lack of objective rules determining which studies should be included into the review. As a result, different literature reviews on the same topic can arrive at different conclusion (see Borenstein 2009) due to different choice of primary studies by each author. Meta-analysis serves the same goal as literature reviews. However, the advantages of meta-analyses over classical literature reviews lie in the fact that meta-analyses provide a more systematic approach to combining all empirical results on a particular issue, allows to explicitly model the heterogeneity of results in primary studies and thus improve the general understanding of the matter. Moreover, it enables researchers to identify possible publication bias if that is the case (Stanley 2001). Thus, meta-analysis approach is not only employed to quantitatively examine the empirical results, but is useful to assess the degree of publication bias heavily present in empirical research and to find out the true effect driving the particular relationship.

Meta-analysis was firstly applied in medicine by Karl Pearson in 1904 as a way of dealing with small sample sizes (O'Rourke 2007).[12] Consequently, meta-analysis was

[11] By primary studies we mean studies that empirically investigate the financial development – economic growth relationship and are included into meta-analysis.
[12] For a thorough introduction into the field of meta-analysis see Card (2011) or Borenstein et al. (2009).

used to summarize and evaluate the empirical results from different studies on the underlying topic. Nowadays meta-analysis is extensively applied in different fields of research, including economics. The first application of this approach in economics is credited to T. D. Stanley and S. B. Jarrel (Stanley & Jarrel 1989). More recent examples of meta-analysis can be found in the work of Rusnak et al. (2011) on monetary policy transmission, Horvathova (2010) examining the link between environmental and financial performance of companies or Havranek & Irsova (2010) concentrating on the spillover effect of foreign direct investments. In the economic growth literature, this technique is now extensively used as well. A meta-regression analysis was for instance applied to quantitatively assess the impact of economic reforms, economic freedom, democracy, foreign aid or the effect of institutions on economic growth.[13]

Meta-analysis can be divided into several steps. The first step includes identifying the whole body of relevant empirical literature on a particular topic. This usually includes searches in several databases. These studies, referred to as primary studies, are the cornerstone of every meta-analysis as they will provide the researcher with bases from which data for analysis are derived. The second step aims to identify in what respect the primary studies vary. Studies may differ in specification or estimation characteristics or cover different data in their estimation, thus leading to different results. The third step is thus to carefully go through every single study and in addition to retrieving comparable effect sizes, study characteristics stated in the second step are coded for each study. This step provides a researcher conducting a MA on a particular topic with a dataset for subsequent analysis. The final step is to investigate quantitatively data as well as the sources of heterogeneity among effect sizes in a particular area of interest by employing meta-analysis techniques. All these steps are conducted in the present meta-analysis as well as further discussed below.

[13]See Babetskii & Campos 2007; Doucouliagos & Ulubasoglu 2006; Doucouliagos & Ulubasoglu 2008; Doucouliagos & Paldam 2008; Efendic et al. 2009.

4.2. Data Used in the Meta-Analysis

The focus of this meta-analysis lies in studies examining the correlation between financial development and economic growth. That is, classical growth regressions augmented for the level of financial development in the variant of equation (1) are in the centre of our attention. In this view, the inclusion of all relevant studies is an appropriate starting point. In this respect, the present thesis builds on an extensive literature search with the aim to include most empirical studies written on this topic.

The rules related to search for primary studies set in this analysis are as follows.[14] All empirical studies mentioned in the recent literature review of Ang (2008) as well as all studies used in a meta-analysis similar to ours by Asongu (2011) were considered.[15] Moreover, an additional search in Scopus database was conducted. For the inquiry: "Financial Development" and "Economic Growth" the Scopus database returned 451 records as of April 10, 2012. Studies added to the database after this date were not included in the present meta-analysis. Studies identified in Scopus database were screened and their abstracts were reviewed. Any study indicating some chance of examining an empirical effect of finance and growth was selected.[16] Overall, a literature search of the aforementioned two reviews and a search in Scopus database provided us with 274 unique studies.

Owing to the high number of available studies to potentially include an empirical estimate on the finance-growth nexus and thus to be included in the meta-analysis, we opted for an additional criterion. We split the sample of 274 studies into two groups, studies whose titles or abstract showed any potential to examine the finance-growth nexus in at least one country from the Asian continent (overall 221 studies), and studies that focused exclusively on other regions (together 53 studies). In this thesis, we

[14] Card (2011) notes that in this regard, meta-analysis in not objective since the criteria are determined subjectively. However, he remarks as well that the choice of primary studies to be included in any meta-analysis is transparent.

[15] These two studies together yielded 67 studies.

[16] Also studies examining regional financial development and economic growth are not subject of this meta-analysis and thus were not included in further analyses. In the same vein, we excluded studies that analyze the effect of financial liberalization or international financial integration on economic growth. As these studies are not compatible with studies analyzing the effect of financial development on economic growth. This is in spite of the fact that lack of financial liberalization or integration with international financial systems can be an important obstacle to financial development.

focused on the former group of studies with the aim to extend the sample to all studies in the future.[17]

All of the 224 remaining studies were consequently examined to identify all studies that use a variant of the classical growth model as in equation (1). In addition, we applied the following inclusion criteria. Following Doucouliagos & Stanley (2008) who showed that the inclusion of working papers does not mitigate publication bias (more on this in the following chapter), our focus is only on published studies (thus working or conference papers, dissertation theses, etc. are excluded from analysis). Furthermore, only studies reporting an empirical estimate of the effect of financial development on economic growth and studies reporting the estimates' precision (standard errors, t-statistics or p-values) were included in the meta-analysis, as these statistics are an integral input for conducting a meta-analysis. As discussed above, different measures of economic development are used in the growth literature. However, we consider only studies where the dependent variable in the growth equation is the growth rate of GDP or GDP per capita in real or nominal terms. In this respect, studies examining the effect of financial development on the level of economic activity were not included.

In order to truly capture all the relevant studies, some authors of meta-analyses perform backward and forward searches of literature. A backward search of literature refers to the process of identifying any study cited in the previously identified literature that might be relevant for the meta-analysis. On the other hand, a forward search refers to the attempt to trace studies which cite the studies that were identified for potential inclusion in meta-analysis. However, due to the large number of studies identified in our search we did not proceed in either of these directions as our inclusion criteria have already yielded a reasonable number of studies.[18] After the elimination of 154 studies which did not fulfill at least one of the above mentioned inclusion criteria, we were left with 67 unique studies which constitute the primary data source for this meta-analysis. These studies are presented in Table 1.[19]

[17] Thus, studies focusing for example exclusively on the Sub-Saharan region (e. g. Agbetsiafa 2004 or Ahmed 2010), Latin American region (Bittencourt 2012 or Blanco 2009), Europe (Zagorchev et al. 2011; Mero 2004) or Australia (Thangavelu & Ang 2004) were not considered.

[18] Thus we stop our search here as this is according to our opinion a reasonable equilibrium point of the trade-off between the inclusion of more studies and cost resulting from searching additional databases.

[19] For the list of excluded studies as well as the reason for their exclusion refer to the enclosed excel spreadsheet.

Table 1: List of Primary Studies Used in Met-Analysis

Al-Malkawi & Abdullah (2011)	Hassan et al. (2011b)	Minier (2003)
Andersen (2003)	Huang & Lin (2009)	Moshirian & Wu (2012)
Andersen & Tarp (2003)	Huang et al. (2010)	Naceur & Ghazouani (2007)
Anwar & Cooray (2012)	Hwang et al. (2010)	Odedokun (1996)
Anwar & Sun (2011)	Chakraborty (2010)	Ram (1999)
Apergis et al. (2007)	Jalilian & Kirkpatrick (2005)	Rioja & Valev (2004)
Atje & Jovanovic (1993)	Jeanneney & Kpodar (2006)	Rousseau & Wachtel (2000)
Bangake & Eggoh (2011)	Ketteni et al. (2007)	Rousseau & Wachtel (2002)
Beck & Levine (2004)	King & Levine (1993)	Rousseau & Wachtel (2011)
Beck et al. (2000)	Lartey (2010)	Rousseau & Yilmazkuday (2009)
Benhabib & Spiegel (2000)	Lartey & Farka (2011)	Saci et al. (2009)
Cole et al. (2008)	Leitao (2010)	Seetanah et al. (2009)
Compton & Giedeman (2011)	Lensink (2001)	Shen & Lee (2006)
Dawson (2003)	Levine (1998)	Shen et al. (2011)
Dawson (2008)	Levine (1999)	Tang (2006)
De Gregorio & Guidotti (1995)	Levine & Zervos (1998)	Tsangarides (2002)
Deidda & Fattouh (2002)	Levine et al. (2000)	Wang (1999)
Djalilov & Piesse (2011)	Liu & Hsu (2006)	Yao (2010)
Ergungor (2008)	Loayza & Ranciere (2006)	Yay & Oktayer (2009)
Giedeman & Compton (2009)	Lu & Yao (2009)	Yilmazkuday (2011)
Graff (2003)	Manning (2003)	Yu et al. (2012)
Hao (2006)	Masten et al. (2008)	
Hassan et al. (2011a)	McCaig & Stengos (2005)	

When all the primary studies included in meta-analysis are selected, we have to decide whether to include all reported estimates or just a best set of estimates from each study.[20] Some authors opt for the best set as they include only the preferred estimate(s) (for instance Havranek 2010; Efendic et al. 2011) whereas others include all reported estimates in order to avoid bias which may arise by subjectively selecting the "best" estimate (e.g. Havranek et al. 2012). More recently, it seems a common practice to select all estimates and then perform the analysis for both the best set and all set (e.g. Doucouliagos & Ulubasoglu 2006; Doucouliagos & Ulubasoglu 2008; Doucouliagos & Paldam 2008). This can increase the reliability of achieved results if they are close across different specifications. We follow (Havranek et al. 2012) and include all reported coefficients on the relationship between financial development and economic growth, as authors of primary studies usually estimate and report several

[20] The best set of estimates usually refers to the preffered regression result of the authors of primary studies. When this cannot be inferred from the primary study at hand, the selection of best estimate is subject to the subjective selection of authors performing the meta-analysis. On the other hand, the all set refers to the entire available pool of regression results presented in these studies regardless of the preferred estimate of the authors.

regressions to test whether the results are robust to different specifications of financial development indicators, countries included in the sample or to alterations in the conditioning variable set that account for other factors that may contribute to economic growth.

Once the primary studies are selected and the estimates of interest established, it is important to identify in what respect these studies differ. For this reason, they were thoroughly examined to identify all potentially relevant study characteristics that may have influenced the reported results and thus help to provide an answer to the introductory quotation of (Stanley & Jarell 1989, p. 299) from previous the section. As we could see in the part devoted to empirical evidence and measures of financial development, the studies differ considerably in measures employed for financial development and estimation characteristics, as well as countries and the data span considered. These differences will be discussed in detail in Section 5.

Hereafter, the codification process may start. For each reported regression result we recorded the coefficient on financial development, the precision of this estimate (it`s standard error, p-value or t-statistics) and other study characteristics discussed in detail in Section 5. Our 67 studies on the relationship between financial development and economic growth yielded 1334 estimates of the effect between these variables. This provided us with a unique data set for subsequent analysis. The majority of primary studies provide multiple regression results usually as a result of employing different model specifications. The highest number of estimates was derived from Shen & Lee (2006) with 152 estimates, Odedokun (1996) with 142 point estimates, followed by Compton & Giedeman (2011) with 96 estimates, Rousseau & Wachtel (2011) with 80 estimates, Shen et al. (2011) with 72 estimates and by Beck & Levine (2005) and by Tang (2006) with 54 point estimates each. On the other hand, studies of Hwang et al. (2010), Jeanneney & Kpodar (2006), and Wang (1999) contained only one usable estimate. The oldest studies in this sample go back to King & Levine (1993) and Atje & Jovanovic (1993) while the most recent studies are works of Anwar & Cooray (2012), Moshirian & Wu (2012) and Yu et al. (2012).

In order to meaningfully compare the results from various studies, standardized effect sizes need to be derived from each study examining the finance-growth nexus. Authors engaged in meta-analytic reviews in economics usually use elasticities or partial correlation coefficients (henceforth PCC) as standardized effect sizes. These effects can be compared across studies. In this study partial correlation coefficients were

used which is a common practice among meta-analysts of the growth literature (see Doucouliagos 2005, Doucouliagos & Ulubasoglu 2006, Doucouliagos & Ulubasoglu 2008; Efendic et al. 2009). Even though studies in our dataset do not report the partial correlation coefficients between the two variables under consideration, it can be computed from reported regression output. Partial correlation coefficients can be simply derived from the t-statistics of reported regression output and residual degrees of freedom as follows (Greene, 2008)

$$PCC_{ij} = \frac{t_{ij}}{\sqrt{t_{ij}^2 + res.df_{ij}}} \tag{2}$$

where PCC_{ij} denotes the partial correlation coefficient from i^{th} regression estimate of the j^{th} study; t is the associated t-statistics and $res.df$ is the corresponding degrees of freedom of the t-statistics. The sign of the partial correlation coefficient is the same as the sign of the coefficient β related to financial development from equation (1).

The partial correlation coefficient will provide us with a measure of the impact of financial development on economic development holding other factors constant. Simple correlations cannot be used in this manner as different studies control for different determinants of economic growth (for the most important and commonly used determinants of economic growth refer to Levine & Renelt 2002). Partial correlation coefficients take this specification difference into consideration and thus provide a standardized measure.

After computing partial correlation coefficients from primary studies, these standardized effect sizes can be both meaningfully compared across our pool of studies and compared to other partial correlation coefficients in the growth literature. Thus, it would be interesting to examine the partial correlation coefficients identified in the empirical literature examining the finance and growth nexus to those examining, for example, the economic freedom or foreign aid-growth relationship to see which factors are more important in the growth process.

The standard error of each partial correlation coefficient needs to be computed in order to employ meta-regression analysis (MRA) techniques. The standard error of each partial correlation coefficient can be derived employing the following formula (Fisher 1954)

$$SEpcc_{ij} = \frac{PCC_{ij}}{t_{ij}} \tag{3}$$

where $SEpcc_{ij}$ stands for the standard error of partial correlation coefficient PCC_{ij} and t_{ij} is again the t-statistics from i^{th} regression of the j^{th} study.

4.3. Empirical Effect Established by Literature

The presented pool of 67 studies provides us with 1334 estimates of the impact of financial development on economic growth. Of the 1334 estimates 638 are positive and statistically significant, 446 are positive but insignificant, 128 are negative and significant and lastly 122 are negative but insignificant at the 5% level of significance. This indicates a widespread distribution of effect sizes, which supports the view of a lacking consensus of the effect of financial development on economic growth.

From these estimates a mean-effect size can be derived. However, as partial correlation coefficients are not normally distributed, we follow a commonly used convention and use the Fisher z-transformation of partial correlation coefficients to get a normal distribution of effect sizes

$$Zpcc_{ij} = 0.5 \ln\left(\frac{1 + PCC_{ij}}{1 - PCC_{ij}}\right) \tag{4}$$

This enables the construction of normal confidence intervals.[21] These z-transformed effect sizes are used for computations and then transformed back to PCCs for reporting. Table 2 presents summary statistics for partial correlation coefficients as well as their non-weighted and weighted average.

[21]For details on the use of Fisher transformation and associated computations refer to Card (2011).

Table 2: Descriptive Statistics Related to Published Financial Development and Growth Effects

Observations	
Number of studies	67
Number of estimates	1334
Median	0.14
Averages	
Simple average PCC	0.15 (0.095 to 0.20)
Fixed effect average PCC	0.09 (0.088 to 0.095)
Random effects average PCC	0.14 (0.129 to 0.150)

Notes: Figures in brackets denote 95% confidence intervals.

The non-weighted mean corresponds to a partial correlation coefficient of 0.15 with confidence intervals of 0.1 to 0.2. It is interesting to note that the corresponding 95% confidence interval does not contain zero and thus the effect is positive at 5% level of significance. Following Doucouliagos' (2011) guidelines on the interpretation of partial correlation in economics we can evaluate that financial development has a moderate positive effect on economic growth.[22] This simple average of partial correlation coefficients is, however, associated with several shortcomings. First of all it does not take into account the estimate's precision[23] as each partial correlation coefficient is given the same weight regardless of the sample size from which it is derived resulting in the fact that studies reporting multiple regression coefficients (such as Shen & Lee 2006 with 152 estimates or Odedokun 1996 with 142 point estimates) may drive the overall result. Secondly, it does not consider possible publication selection which can further bias the average effect. Thus, this result can be interpreted as the average role of financial development played in economic growth across countries established by the published empirical literature under question when all estimates are given the same weight.

However, a more appropriate summary statistics which takes into account estimate's precision can be computed by using fixed effect or random effects model described in details for example in Card (2011) or Borenstein et al. (2009). These models are also useful in lessening the publication selection, an issue in empirical

[22] These guidelines are based on a survey of 41 meta-analyses in economics and the distribution of reported partial correlations in these studies. The partial correlation coefficient is considered small if its value lies inside the ±0.07 interval and large if its value lies outside the ±0.33 interval. If the value of partial correlation coefficient is between these two intervals, the effect is regarded based on these guidelines as medium.

[23] Here and throughout the following text, precision refers to the inverse of the standard error of a partial correlation coefficient.

research discussed further in section 4.4. As noted by Stanley (2005, p. 311) "*a simple and obvious way how to lessen publication bias is to use weighted averages that appropriately discount small-sample studies.*" This is based on the assumption that studies with smaller sample sizes may try various model specifications until the desired effect is established (Stanley 2005).

Fixed effect model assumes that the pool of all reported estimates is drawn from the same population. In the fixed effect model, more precise studies are given higher weight. To calculate the fixed effect estimate, each estimate is weighted by the inverse of its variance as follows (Card 2011)

$$\mathrm{W_{ij}} = \frac{1}{\mathrm{SE^2(Zr_{ij})}}, \tag{5}$$

where $\mathrm{SE(Zr_{ij})}$ stands for the standard error of the z-transformed variable from $\mathrm{j^{th}}$ study and $\mathrm{i^{th}}$ estimate. $\mathrm{SE(Zr_{ij})}$ is calculated as follows (Card 2011)

$$\mathrm{SE\left(Zr_{ij}\right)} = \frac{1}{\sqrt{\mathrm{N_{ij}} - 3}}, \tag{6}$$

where N_{ij} is the sample size from which the estimate was derived. Weighted mean effect size can be calculated in the following way (Card 2011)

$$\overline{Zr} = \sum\left[W_{ij} Zr_{ij}\right] / \sum W_{ij}, \tag{7}$$

where $\overline{Zr}$ is the weighted mean effect size and Zr_{ij} is the z-transformed partial correlation coefficient from the $\mathrm{i^{th}}$ regression estimate of the $\mathrm{j^{th}}$ study; W_{ij} is the associated weight.

After applying these formulas, the fixed effect weighted average mean effect size is a partial correlation coefficient of 0.09 with 95% confidence intervals of 0.088 to 0.095. Weighted mean effect size is lower than simple mean effect size. This indicates that when larger studies are given higher weight, the average effect size is decreased. Thus studies with smaller samples report on average higher effect sizes which biases the simple average effect upwards. This can be a sign of "selection for publication" as

studies with small sample sizes need to establish a higher effect in order to offset higher standard errors.

However, we were combining 67 studies with different study design, studies which analyze different countries and regions during different time span. Hence, assuming that there is a common effect of financial development on economic growth that can be described by the mean value despite these differences is quite unrealistic. In this case, random effects model may provide a better summary statistics. Random effects model, in addition to taking into account the precision of estimates, accounts for between study heterogeneity. The random effects partial correlation coefficient takes the value of 0.14 with 95% confidence intervals of 0.129 to 0.15. However, since the random effects model assumes that the underlying differences among effect sizes are random and thus in essence unobservable it is quite limited as well. For this reason we proceed to explicitly model the heterogeneity among effect sizes by means of meta-regression analysis in Section 5.

Stanley et al. (2010) argue that contrary to statistical beliefs discarding 90% of the estimates may actually give a better picture of the true underlying effect net of publication selection. By Monte Carlo simulations Stanley et al. (2009) finds that top 10% of estimates (sorted with respect to precision) has a smaller bias than simple mean, or even fixed effect or random effects model of all reported estimates in the presence of publication selection. In this respect, it is interesting to compute the average effect size from the 10% of most precise estimates from the population of 1334 coefficients (those with precision higher than 30.08). This gives us the value of partial correlation coefficient of 0.06 with a 95% confidence interval of (-0.11; 0.23). That is, the mean value of the most precise estimates is more in line with the weighted average fixed effect value of partial correlation coefficient and substantially lower than the simple mean or random effects weighted average. As zero is contained in the last confidence interval, we cannot infer that the average effect is statistically positive. However, out of 129 most precise estimates, 85 originate from a study of Shen & Lee (2006), hence this last result should be considered with caution.[24]

[24] The reason for such a high percentage of estimates originating from Shen & Lee (2006) is their uncommonly large observation count (for most regressions in the range of 800-1000). As such a large dataset was not observed for any other study, doubt is cast on whether Shen & Lee report reliable observation counts. However, as we have no foolproof way of determining whether their observation counts are correct, we can only presume these observation counts to be correct.

In this section, some of the summary statistics of the reported correlation coefficients on the link between finance and growth were presented. Based on the confidence intervals, the effects are significantly different from zero and positive for three methods of averaging while insignificantly different from zero when the most precise estimates of the finance-growth effect are used. Based on the guidelines provided by Doucouliagos (2011) we can conclude that the financial development has a moderate effect on economic growth. This effect can be directly compared to partial correlation coefficients of, for example, the association between democracy and economic growth. Doucouliagos & Ulubaşoglu (2008) report a fixed effect weighted average partial correlation coefficient of 0.02 related to the effect of democracy on economic growth which is considered a small-sized effect.

4.4. Publication Bias

Publication bias, which is sometimes referred to as the file-drawer problem, arises when researchers or publishers have a preference for either publishing results to support a particular direction of theory or to publish only statistically significant results (Stanley 2005). Stanley (2005) names these biases as Type I and Type II bias, respectively. The magnitude and consequence of publication selection in economics was studied by Doucouliagos & Stanley (2008). Given the wide presence of publication selection, Stanley et al. (2010) suggests that estimates selected for reporting should be selected on the ground of precision and not on the basis of statistical significance or particular sign of the effect. However, in reality the opposite is true as empirical research is full of studies being selected on the basis of Type I or Type II bias. This has been shown in several works examining this issue by means of meta-analysis.

Among others, Stanley (2005) points out that price elasticities of demand for water are exaggerated fourfold; Havranek et al. (2012) showed that after correcting for publication bias, the price elasticity of gasoline demand is approximately half of the average published estimate. This indicates that in the absence of bias, the average empirical effect will be lower. Economic growth literature is not an exception, as the presence of publication selection was found in the work of Doucouliagos (2005) where the effect of economic freedom on economic growth was investigated or Doucouliagos & Paldam (2008) who focus on aid effectiveness and economic growth. The presence of publication bias is particularly true when there is little disagreement in

theory (Doucouliagos & Stanley 2008). As a consequence, only estimates supporting the prevailing theoretical view are likely to be published, whereas insignificant results or results showing the opposite effect will be underrepresented.

On the other hand, not every area of research is affected by publication selection. A commonly illustrated example can be found in the work of Doucouliagos & Laroche (2003) who find no evidence of publication selection in studies investigating the union productivity effect. Similarly, Havranek & Irsova (2010) report no evidence of publication bias when investigating spillover effects of foreign direct investment when the whole sample of studies is considered. In the economic growth literature, no sign of publication selection was found in the work of Efendic et al. (2009) on the effect of institutions on macroeconomic performance. Collaborating to the idea of Doucouliagos & Stanley (2008), the democracy-growth literature do not seem to show sign of selectivity bias either (Doucouliagos & Ulubasoglu 2008) as this research area is quite open to contrasting views on the effects of democracy on economic growth.

However, if the selection for desired effect is present in a particular area of research, the estimates will have a skewed or truncated distribution (Doucouliagos & Stanley 2008). Thus, taking the average of coefficients will not shed true light on the effect driving the relationship. Similarly, a meaningful inference will be difficult as the distribution of results may be driven by simply "*analyzing the data*" until researchers "*are satisfied with the results*" (Doucouliagos & Stanley 2008, p. 4). In this respect, it is important to test for the presence of publication selection before any inference is drawn on the effect of financial development on economic growth. As noted by Stanley (2005) one of the advantages of meta-regression methods is the ability to estimate the degree of bias present in particular research and correct for this bias.

Various tests have been suggested to test for the presence of publication bias. The first attempt to model this bias goes back to Card and Krueger (1995). These authors interpret the absence of any positive association between the logarithm of the absolute value of the study's reported t-statistics and the logarithm of the square root of its degrees of freedom as an evidence of publication bias. However, their approach has been challenged by Stanley (2005), who points out that from a simple absence of this relationship publication bias cannot be inferred. Even though it may be the case when the particular area of research is affected by publication selection, such a result can also be driven by a simple non-existence of an overall effect between the variables under

consideration (Stanley 2005).[25] Even though this approach of testing for the presence of publication bias suffers from a significant oversight as discussed above, this test was applied in the first meta-analysis of the finance and growth nexus of Asongu (2011). Since this test is not sufficient for the detection of publication bias, more rigorous techniques need to be applied.

A way how to cope with publication bias is to use some properties of small sample sizes. As studies with smaller samples tend to have larger standard errors, the estimated empirical effect must be higher to achieve the desired significance level. Thus, studies with small sample sizes may resort to re-estimating the model with different estimation techniques, data sets or specification characteristics until the estimates are found significant (Stanley 2005). On the other hand, studies which use more observations will report smaller effects as standard errors are lower with more observations, hence parameter significance is easier to achieve. Hence, "*a simple and obvious way to lessen publication bias is to use weighted averages that appropriately discount small-sample studies*" (Stanley 2005, p. 311).

A typical graphical method to assess publication bias in empirical research is the so called funnel plot (Stanley & Doucouliagos 2010). Funnel plots are commonly used to get some sense of potential publication bias present in empirical research. These graphs display the standardized effect size or effect sizes derived from each study (i.e. elasticities or partial correlation coefficients) on the horizontal axis with estimates' precision on the vertical axes. More precise estimates will be concentrated in the top part of the plot whereas estimates with lower precision will stay at the bottom. Similarly, more precise estimates will be closer to the "true" effect while imprecise estimates will be more spread out. In the absence of publication selection the pattern thus should resemble an inverted funnel.[26]

The funnel plot for all the reported coefficients on financial development is depicted in Figure 2. On the horizontal axis we plot the partial correlation coefficient, PCC_{ij} from ith regression estimate and jth study and the estimate precision on the vertical axis.

[25] For a thorough explanation see Stanley (2005).
[26] The shape of symmetric inverted funnel holds under the assumption that the population of effect sizes is drawn from the same population. As this may not be the case in many areas of empirical research, multivariate meta-regression analysis is required (Stanley et al. 2010).

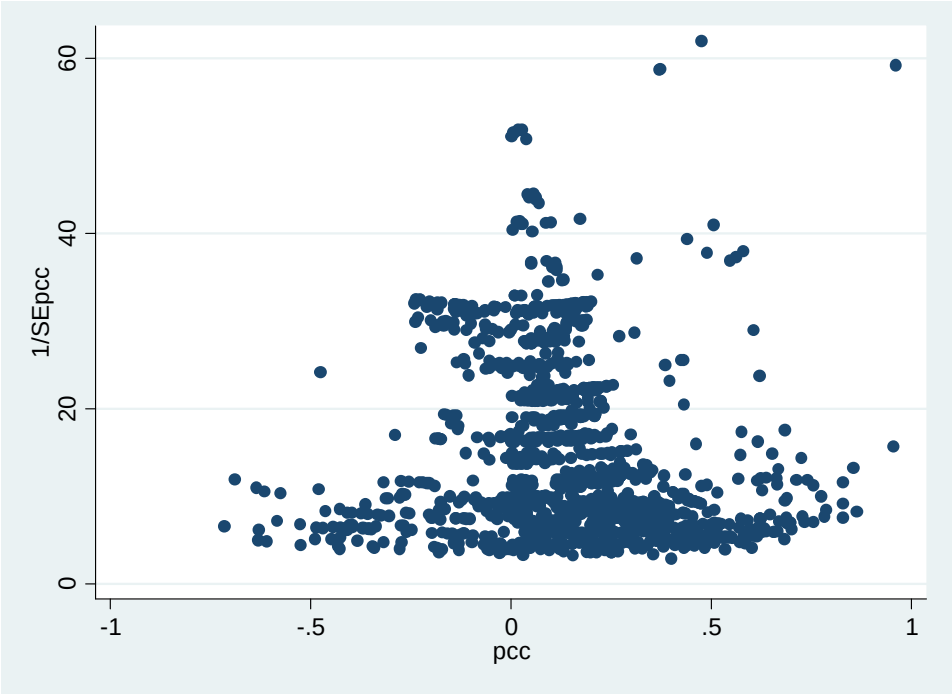

Figure 2: Funnel plot of reported economic growth effects of financial development (n=1334)

Some observations differ considerably in terms of precision or the estimates themselves. To account for extreme values that may affect proper graphical inference (Havranek & Irsova 2010) we control for outliers by taking out observations with t-statistics outside the ±7 interval. Figure 3 depicts the funnel plot after removing the 44 observations with t-statistics lying outside the ±7 interval.

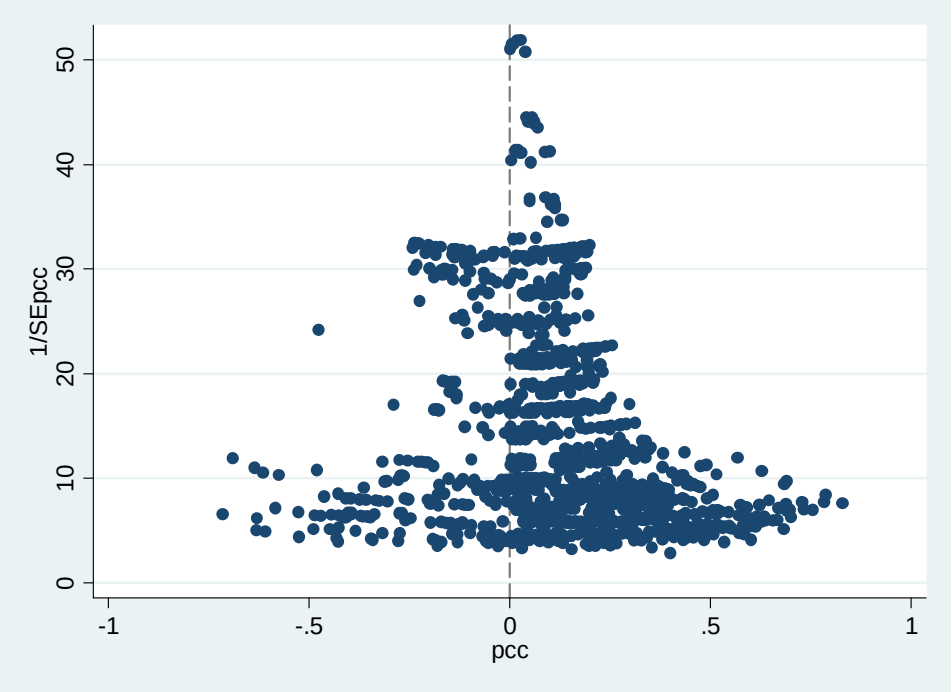

Figure 3: Funnel plot of reported economic growth effects of financial development (n=1290)

Even though the observations in Figure 3 resemble an inverted funnel a visual inspection suggests that some imbalance in reported effect sizes does exist as the right hand side of the funnel is more represented. This may be a sign that positive estimates are preferably selected for publication. However, the most precise estimates (on top of the Figure) are positive or have a value of zero.

In order to properly address the issue of publication bias, more formalized methods must be used. In the absence of publication bias, the estimated empirical effects and their standard errors are uncorrelated (Stanley & Doucouliagos, 2010). This reasoning stems from the fact that small sample sizes tend to have larger standard errors, and thus the estimated effect must be large enough to achieve statistically significant results. A formal test for publication bias follows Stanley & Doucouliagos (2010) in which the standardized effect size is regressed against its standard error:

$$PCC_{ij} = \beta_0 + \beta_1 SEpcc_{ij} + \mu_{ij} \;\; ; \;\; j = 1, \dots, N; i = 1, \dots, S \tag{8}$$

where N is the total number of studies, i is an index for regression estimate in the j^{th} study and each j^{th} study can be comprised of S regression estimates. Then, the coefficient β_1 measures the magnitude of publication bias and β_0 denotes the true effect.

However, as the explanatory variable in (8) is a standard error itself, the above specification is likely to be heteroscedastic. This drawback is in practice addressed by applying weighted least squares such that equation (8) is divided by the standard error of the effect size measure (Stanley 2005)

$$\frac{PCC_{ij}}{SEpcc_{ij}} = t_{ij} = \beta_0 \left(\frac{1}{SEpcc_{ij}}\right) + \beta_1 + \mu_{ij} \left(\frac{1}{SEpcc_{ij}}\right) = \beta_1 + \beta_0 \left(\frac{1}{SEpcc_{ij}}\right) + \nu_{ij} \tag{9}$$

where $SEpcc_{ij}$ is the standard error of partial correlation coefficient PCC_{ij}. After transforming equation (8) the response variable in equation (9) is now the t-statistics of the estimated coefficient β from equation (1). The equation can be interpreted as the funnel asymmetry test (FAT) and therefore a test for the presence of publication bias (Stanley 2005). This model can be estimated by running simple OLS on

(9). However, as we used multiple estimates per study, additional adjustments need to be performed as estimates taken from the same study are likely to be dependent. To control for the potential dependence of estimates taken from one study the mixed-effects multilevel model is commonly employed (Doucouliagos & Stanley 2009; Havranek & Irsova 2010)

$$t_{ij} = \beta_1 + \beta_0 \left(\frac{1}{SEpkk_{ij}}\right) + \alpha_j + \epsilon_{ij}, \quad \alpha_j \mid SEpkk_{ij} \sim N(0, \psi), \quad v_{ij} \mid SE_{ij}, \alpha_j \sim N(0, \theta) \tag{10}$$

The overall error term (ν_{ij}) from
(9) breaks down into two components: study level random effects (α_j), and estimate level disturbances (ϵ_{ij}). The specification (10) is the same as running random effects model in standard panel data analysis. Testing for funnel-asymmetry requires the following test specification (Stanley 2008)

$$\begin{aligned} H_0&: \quad \beta_1 = 0 \\ H_1&: \quad \beta_1 \neq 0 \end{aligned} \tag{11}$$

If the null hypothesis is rejected, asymmetry exists and the sign of the estimate of β_1 indicates the direction of the bias. A non-zero and positive constant term β_1 is indicative of publication selection for larger effects. A negative and statistically significant estimate β_1 would on the other hand indicate that lower estimates are preferably selected for publication. Stanley (2008) by Monte Carlo simulations shows that funnel-asymmetry test (FAT), i.e. testing for a null hypothesis $H_0: \beta_1 = 0$ in equation (10) is valid, even though it has low power in detecting publication selection.[27] On the other hand, testing for "genuine" effect beyond publication bias requires (Stanley 2008)

$$\begin{aligned} H_0&: \quad \beta_0 = 0 \\ H_1&: \quad \beta_0 \neq 0 \end{aligned} \tag{12}$$

[27] Stanley (2008) also notes that all alternative tests for the presence of publication selection such as Hedges` maximum likelihood publication selection estimator or meta-significance testing suffer from the same property.

Testing $H_0: \beta_0 = 0$ in equation (10) is known as precision-effect test (PET). Stanley (2008) examined the properties of PET in simulation results and showed that PET is a powerful method for testing the presence of genuine effect and is quite robust even in smaller samples and regardless of publication selection.

Table 3: Test of the True Effect and Publication Bias

1/SEpcc (Effect)	0.199***(0.018)
Constant (bias)	-0.353 (0.422)
Within-study correlation	0.46
Observations	1334
Studies	67

Notes: Response variable: t-statistics of the estimated coefficient on financial development. Estimated by mixed effects multilevel model. Standard errors in parentheses, *** denote significance at the 1% level.

Table 3 reports the results for FAT (publication bias) and PET (true effect beyond publication bias) from equation (10). In the mixed effects model, the constant term is insignificant, indicating there is no sign of publication selection (do not reject $H_0: \beta_1 = 0$). Thus, contrary to our subjective interpretation of the funnel plot the estimates do not seem to be contaminated by publication selection. Since there is no evidence of publication bias, estimates are distributed randomly around the true effect estimated by β_0. The highly significant estimate β_0 on precision (1/SEpcc) indicates that there is an authentic link between financial development and economic growth. And this link can be interpreted in terms of partial correlation coefficient of 0.2. Following Doucouliagos' (2011) this represents a moderate link between financial development and economic growth. Thus, financial development plays a moderate role in economic growth. Based on the likelihood ratio test the null hypothesis of no between study heterogeneity is rejected at 1% level which supports the validity of using mixed effects multilevel model. However, as noted by Stanley (2008), careful interpretation should be employed when large variation in equation (10) remains. In this respect, we proceed to multivariate meta-regression analysis to estimate and evaluate the systematic dependence of reported results on study characteristics.

5. Meta-Regression Analysis

In many studies on finance and growth, researchers explicitly emphasize that the estimated effect depends heavily on estimation characteristics, proxy measures for financial development, data span or countries included in the estimation (see Beck & Levine 2004; Ang 2008; Yu et al. 2012, among others). In order to see how the results systematically vary across different specification and estimation techniques used, we employ multivariate meta-regression analysis. In addition to controlling for various specification and estimation characteristics, we add other moderator variables that could potentially explain the wide variation in effect sizes found in primary studies.

A moderator variable is a variable that is likely to be important in influencing reported results. These variables are codified during the process of examining primary studies identified in the literature search. Differences in reported results can result either from differences in research design or due to real differences in the finance-growth nexus across countries and time periods. Both differences in research design and across countries and time periods are commonly acknowledged to matter in estimated results and in this respect are appropriately corrected for in meta-analysis in order to shed some light on the variation in reported effect sizes.

We follow Doucouliagos & Stanley (2009) and include the above mentioned moderator variables into (10) as follows

$$t_{ij} = \beta_1 + \beta_0 \left(\frac{1}{SEpcc_{ij}}\right) + \sum_{k=1}^{K} \frac{\gamma_k Z_{ijk}}{SEpcc_{ij}} + \alpha_j + \epsilon_{ij}, k = 1, \dots, K \qquad (13)$$

where Z stands for the set of moderator variables that are assumed to affect the reported estimates, each weighted by $(1/SEpcc_{ij})$; γ_k are coefficients to be estimated and each refers to the impact of the corresponding moderator variable on the underlying effect of financial development on economic growth; K is the total number of moderator variables that are assumed to affect reported estimates on financial development from equation (1); i and j are the usual subscripts. This multivariate MRA enables us to explicitly model the heterogeneity in reported estimates on financial development and economic growth. The set of moderator variables used in this MRA is presented in Table 4. In this meta-analysis, we divide moderator variables into two broad categories:

moderator variables related to differences in research design and those related to real differences across regions and time periods. The reasons for their inclusion are discussed below.

Table 4: Description of Moderator Variables

Variable	Description	Mean	Std. dev.
t-statistic	The t-statistic of the estimated coefficient on financial development; response variable	1.77	3.49
1/SEpkk	Precision of the partial correlation coefficient	14.68	9.91
Data characteristics			
No. of countries	Number of countries included in the estimation	43.13	30.19
No. of time units	Number of time units included in the estimation	11.06	18.69
Sample size	The logarithm of the total number of observations used	4.96	1.27
Length	Number of years in the time unit T	4.96	1.27
Log	DV = 1 if logarithmic transformation is applied	0.58	0.49
Panel	DV = 1 if panel data are used	0.62	0.48
Cross-section	DV = 1 if cross-sectional data are used	0.24	0.43
Time series	DV = 1 if time series data are used	0.13	0.33
Homogeneous	DV = 1 if homogeneous sample of countries is considered	0.34	0.47
Nature of the dependent variable			
Real GDP per capita	DV = 1 if dep. var. in primary regression is growth rate of real GDP per capita	0.72	0.45
GDP per capita	DV = 1 if dep. var. in primary regression is growth rate of GDP per capita	0.08	0.27
GDP	DV = 1 if dep. var. in primary regression is growth rate of GDP	0.14	0.35
Real GDP	DV = 1 if dep. var. in primary regression is growth rate of real GDP	0.06	0.24
Proxy measures for financial development			
Depth	DV = 1 if financial depth is used as an indicator of FD	0.33	0.47
Activity1	DV = 1 if private domestic credit provided by deposit money banks to GDP is used as an indicator of FD	0.14	0.35
Activity2	DV = 1 if private credit is used as an indicator of FD	0.10	0.30
Bank	DV = 1 if bank ratio is used as an indicator of FD	0.06	0.24
Private/dom. credit	DV = 1 if private credit/domestic credit is used as an indicator of FD	0.03	0.17
Market capitalization	DV = 1 if stock market capitalization is used as an indicator of FD	0.06	0.23
Market activity	DV = 1 if stock market activity is used as an indicator of FD	0.07	0.25
Turnover ratio	DV = 1 if turnover ratio is used as an indicator of FD	0.09	0.29
Other	DV = 1 if other indicator of FD is used as an indicator for FD	0.12	0.32
Non-linear	DV = 1 if the coefficient is derived from non-linear specification of financial development	0.22	0.42
Changes	DV = 1 if financial development is measured in changes, rather than levels	0.06	0.23
Joint	DV = 1 if more than one financial development indicator is included in the regression	0.50	0.50

Continued on next page.

Table 4: Description of Moderator Variables (continued)

Variable	Description	Mean	Std. dev.
Estimation characteristics			
OLS	DV = 1 if ordinary least squares estimator is used for estimation	0.42	0.49
IV	DV = 1 if instrumental variables estimator is used for estimation	0.17	0.37
FE	DV = 1 if fixed effects estimator is used for estimation	0.08	0.27
RE	DV = 1 if random effects estimator is used for estimation	0.02	0.13
GMM	DV = 1 if GMM estimator is used for estimation	0.30	0.46
Endogeneity	DV = 1 if the estimation method addresses endogeneity	0.77	1.04
Conditioning variables characteristics			
Regressors	Total number of explanatory variables included in the regression (excluding the constant term)	7.97	3.77
Macro. stability	DV = 1 if the primary study controls for macroeconomic stability in the conditioning data set	0.71	0.45
Pol. stability	DV = 1 if the primary study controls for political stability	0.13	0.34
Trade	DV = 1 if the primary study controls for the effects of trade	0.53	0.50
Initial income	DV = 1 if the primary study controls for the level of initial income	0.71	0.45
Human capital	DV = 1 if the primary study controls for the level of human capital	0.67	0.47
Investment	DV = 1 if the primary study controls for the amount of investments	0.30	0.46
Fin. Crisis	DV = 1 if a dummy variable for some indicators of financial fragility is included in the estimation	0.03	0.17
Time dummy	DV = 1 if time dummies are included in the estimation	0.15	0.35
Publication characteristics			
Impact	The recursive RePEc impact factor of the outlet as of July 2012	0.33	0.42
Publication year	The year of publication (mean is subtracted)	0.00	1.05
Real factors: differences between time periods			
1960s	DV = 1 if data from 1960s used	0.35	0.48
1970s	DV = 1 if data from 1970s used	0.78	0.42
1980s	DV = 1 if data from 1980s used	0.94	0.24
1990s	DV = 1 if data from 1990s used	0.79	0.41
2000s	DV = 1 if data from the twenty first century used	0.50	0.50
Real factors: differences between regions			
East Asia & Pacific	DV = 1 if countries from East Asia and Pacific are included in the sample	0.75	0.43
South Asia	DV = 1 if countries from South Asia are included in the sample	0.70	0.46
Asia	DV = 1 if Asian countries included in the sample	0.70	0.46
Europe	DV = 1 if European countries included in the sample	0.70	0.46
Latin America	DV = 1 if Latin American & Caribbean countries included in the sample	0.75	0.43
MENA	DV = 1 if Middle East & North African countries included in the sample	0.72	0.45
Sub-Saharan Africa	DV = 1 if Sub-Saharan African countries included in the sample	0.71	0.45
Rest of the world	DV = 1 if rest of the world (mainly high income OECD countries) included in the sample	0.66	0.47

Note: DV stands for dummy variable, FD stands for financial development..

5.1. Differences in Research Design

Differences in research design can be divided into four categories: differences in specification, data characteristics, estimation characteristics and publication characteristics. Furthermore, we divide differences in specification across studies into differences in measurement characteristics of financial development and economic growth and differences in conditioning variables controlled for in primary regressions. This division is appropriate since as discussed in Section 3.2, there is no consensus among researchers on the most appropriate measure of financial development. Similarly, none of the proxies for financial development commonly used can meaningfully capture the overall financial development. Moreover, about 50 variables have been found significant in explaining economic growth (Levine & Renelt 2002). Given the large number of potentially important variables, researchers are not of the same opinion which variables should be included in the empirical growth models. Thus, primary studies vary considerably in this respect as well.

These study characteristics related to research design were coded for each single study and a comprehensive dataset was derived. Based on this dataset we can meaningfully assess the relationship between financial development and economic growth and see whether differences in research design lead to different finance-growth results. All characteristics related to research design are discussed in this section.

5.1.1. Proxy Measures for Financial Development

Various measures that approximate the degree of financial development have been used in the empirical literature. To account for the different measures of financial development we construct several dummy variables. The variable *Activity1* and *Activity2* equal one if private domestic credit provided by deposit money banks to GDP and private credit by deposit money banks and other financial institutions to GDP is used as an indicator of financial development, respectively. Similarly we construct dummy variables for bank ratio, private credit/domestic credit, stock market capitalization, stock market activity and turnover ratio. In the same vein, the dummy variable *Other* equals one if some other indicator that those explicitly controlled is used as an indicator of financial development in the primary study. The most commonly employed measure of financial development is financial depth, which is thus used as the base one. In addition, since the indicators of financial development are divided into

those related to the development of financial intermediaries and those related to the development of stock markets, we can test whether the services provided by each of them are relatively more important for the growth process.

Moreover, some primary studies include several measures of financial development in the same regression. For this reason, we have also included a dummy variable *Joint* to trace whether simultaneously examining the effects of more financial development indicators leads to different results. When more indicators of financial development are entered in the same regression, it is usually a stock market and a bank based indicator of financial development (e.g. Levine & Zervos 1998) to see whether the different services they provide are additive in nature. In the same vein, we construct a dummy variable C*hange* if financial development is measured in changes rather than in levels and *Non-linear* if some non-linear specification of financial development is used.[28]

5.1.2. Nature of the Dependent Variable

Focusing on classical growth regressions, several dummy variables are constructed representing the nature of the dependent variable in equation (1). As discussed in Section 3.2, researchers most frequently use GDP growth or per capita GDP growth rate measured either in real or nominal terms. We construct dummy variables *GDP per capita*, *GDP* and *real GDP* which equal one if the corresponding indicator of economic development is used in a primary study, with *real GDP per capita* as the base variable.

5.1.3. Conditioning Variables Characteristics

This set of moderator variables captures the differences in explanatory variables controlled for in the original regressions while examining the finance-growth nexus. It takes into account that differences in reported estimates within primary studies and between them can be partly explained by differences in conditioning variables controlled for in original regressions. With these variables we will test whether the

[28] Examples of non-linearities in financial development measurements include, for example, powers of financial development measures, terms represeting interactions (products, ratios) of financial development measures either with other financial development measures or with variables unrelated to financial development (e.g. inflation, employment, government consumption, etc.).

reported results are sensitive to the conditioning variables included in the original regressions.

"*Most investigators consider only a small number of explanatory variables when attempting to establish a statistically significant relationship between growth and a particular variable of interest*" (Levine & Renelt 2002, p. 942). In this respect, we include variable *Regressors* which refers to the total number of explanatory variables included in the regression (excluding the constant term). This variable should shed some light on whether including more explanatory variables results in different finance-growth nexus estimation. The rationale here is that including more control variables lessens the effect of omitted variable bias and thus can lead to different finance-growth estimates.

Authors of studies focusing on economic growth control for different potentially important variables in the growth regressions. Yet, many authors acknowledge the sensitivity of results to the set of conditioning variables (Levine & Renelt 1992; Arestis & Demetriades 1997). The variables *Macroeconomic stability*, *Political stability*, *Trade*, *Income*, *Human*, *Investment*, *Financial crisis* and *Time dummy* are all dummy variables equal to one if the authors of underlying primary studies account for these factors that may affect economic development. Levine & Renelt (1992) study the robustness of coefficient estimates in cross-country growth regressions to changes in conditioning information set. They find that empirical findings are fragile to alterations in explanatory variables. In this respect, we hypothesize that the estimated coefficient on financial development may depend to some extent on conditioning variables included in the regressions.[29]

The *Macroeconomic stability* dummy equals one if the primary study controls for macroeconomic stability in the conditioning data set. Macroeconomic stability may include variables such as inflation, government size (e.g. government expenditure to GDP) or interest rate. *Political stability* variables are related to indicators that shed some light on country`s political stability, including number of revolutions and coups, number of assassinations or some measure of political rights, civil liberties or indices of democracy, political freedom, political instability or ethnic division. *Trade* includes variables related to international trade, such as trade openness, exports or imports to

[29] As noted in Abreau et al. (2005, p. 27) in their meta-analysis on beta-convergence: "*the simulation experiments in Koetse et al. (2004) and Keef & Roberts (2004) show that for a meaningful and statistically unbiased comparison, it is crucial that the meta-specification contains a judicious account of the conditioning variables of the primary studies.*"

GDP or current account balance. *Income* controls for the level of initial income in the estimation and thus controls for convergence. This results from the theory of conditional convergence which states that countries with lower initial income will tend to grow faster. *Human* covers variables related to human capital accumulation such as school enrolment rates, average years of schooling or investment in education. *Investment* is included in order to control for the level of investment (such as share of investment in GDP or foreign direct investments) in the economy. *Financial crisis* equals one if indicators of financial fragility are included as additional explanatory variables in the estimation of classical growth regression. Lastly, *Time dummy* equals one if time dummies are included in the estimation.

5.1.4. Data Characteristics

These variables examine the structure of the data. We control for the number of countries and time units included in the estimation as well as for the total number of observations used in the estimation (*sample size*). In order to examine the importance of data frequency on estimated coefficients we included the variable *Length*. This variable measures the number of years in the time unit.[30] Time series models usually use annual data, typical panel data growth studies commonly use data averaged over five-year periods, whereas pure cross country regressions average data over several decades. Beck & Levine (2005), for example, find that using annual data rather than data averaged over five-year periods results in the breakdown of relationship between financial intermediary development and economic growth. Averaging observations over longer time intervals is also associated with information loss. Some authors emphasize the importance of using sufficiently low-frequency data in order to control for business cycles and crises and thus focus entirely on the long-run growth effects (among others, Beck & Levine 2004; Levine 1999). Others emphasize the importance of distinguishing between short and long-run effects of financial development on economic growth. For example, Loyza & Ranciere (2006, p. 1069) find that "*a positive long-run relationship between financial intermediation and output growth can coexist with a negative short-run relationship*".

[30] For example, a study covering the period 1981 – 2000 that averages data for each 5 years will have 20 years of data producing only 4 time units. In this case, *Length*=5.

We also include a variable *Log* which equals one if the dependent variable of the primary study was a logarithm of GDP or GDP per capita in real or nominal terms. *Cross-section* and T*ime-series* dummies equal one if cross-sectional or time-series data are used with the P*anel data* as the base.

In the same respect, we have included a dummy variable capturing the effect whether using a relatively homogeneous sample of countries leads to different results. Dummy variable *Homogeneous* equals one if regional cross-country sample is used, if countries are similar in terms of per capita income (the primary study estimates separately the finance-growth nexus for high, low and middle income countries) or if the focus of primary study is a single country. There are apparent disadvantages resulting from including heterogeneous countries together including that it is not reasonable to draw proper conclusions for individual countries based on such full sample estimate. For example, Ram (1999) points to structural heterogeneity across countries considered homogeneous and thus pooled together by King & Levine (1993).

5.1.5. Estimation Characteristics

Different estimation techniques have been employed in the finance-growth literature with GMM system estimator being today's best practice. Different results in the empirical literature examining the finance-growth nexus may be partly explained by differences in estimation techniques. Moreover, researchers themselves usually employ several estimation techniques in the same study to see whether the results are robust to the choice of estimation technique. With different estimation techniques, empirical findings can particularly suffer from simultaneity bias and omitted variable bias due to the endogenous nature of some explanatory variables and unobserved country or region specific effects, respectively.

As the time goes by, more advanced econometric models are used in order to address some of the shortcomings associated with classical cross-section regressions (OLS estimations). Hence, recent empirical literature focuses on the issue of simultaneity bias between financial development and economic growth. While a large number of empirical studies found that higher level of financial development would lead to higher economic growth, some authors (among others, Robinson 1952) argue that economic growth increases the demand for financial services and ultimately leads to higher financial development. In this respect, earlier studies could establish a positive

relationship between financial development and output growth just because the issue of endogeneity was not considered.

In cross-section studies some authors use initial values of financial development and other explanatory variables in the regression to deal with the simultaneity bias (e.g. King & Levine 1993; Deidda & Fattouh 2002; Rousseau & Wachtel 2011). However, as discussed by Manning (2003) and mentioned above, the simultaneity bias may still remain an issue. Other authors use countries' legal origins as instrumental variables (IV) for financial development to deal with simultaneity bias (e.g. Levine 1999 and Levine et al. 2000).[31] Levine et al. (2000) in the first stage of the analysis, regress financial intermediary development indicators on the dummy variables for German, English and French legal origin (relative to Scandinavian). These dummy variables are found to meaningfully explain the variation in financial intermediary development indicators across countries. In the second stage of the analysis, the economic growth is regressed on the exogenous component of financial intermediary development (legal origins). Even though IV estimator corrects for endogeneity of at least some regressors, it does not correct for omitted variable bias resulting from country specific effects.

Panel data techniques allow for the exploitation of time dimension of the data resulting in gains in degrees of freedom. Standard panel data techniques, fixed effects (FE) or random effects (RE) differ in their assumptions. While in fixed effects model, the individual effect is considered constant, in RE model this effect is purely random. Fixed effects model solves the issue of omitted variable bias due to unobserved country or region specific effects. However, this technique does not explicitly deal with the issue of endogeneity bias. On the other hand, random effects model addresses the issue of endogeneity (Tsangarides 2002) but does not address the bias resulting from country specific effects. In short, both FE and RE provide only halfway solution to the problem of omitted variable bias and simultaneity bias.[32] Fixed effects estimation has been used in 11 out of 67 studies (with an average impact factor of the outlet of 0.2) and random effects estimation in just 4 studies (with an average impact factor of the outlet 0.33).

[31] McCaig & Stengos (2005) suggest and use alternative instrument for financial development combined from the fraction of years of independence since 1776, absolute latitude or ethnic fractionalization, etc., and reaches similar conclusions of positive effect of exogenous component of financial development on economic growth.

[32] Tsangarides (2002) discusses these issues in detail.

To address both issues at once, researchers employ Generalized Method of Moments estimator (GMM). GMM has been employed in 33 journals with an average impact factor of the outlet of 0.33. Based on the GMM estimation results, Levine et al. (2000, p. 44) note: "*we can safely discard the possibility that the relationship between financial intermediary development and growth is due to simultaneity bias or to omitted variables*". System GMM estimator is now commonly used in the empirical literature and is often referred to as best practice estimator for dynamic panels.

In this respect, it is important to take the differences in estimation techniques into account in order to capture how different estimation techniques can lead to different results. In this respect we construct a dummy variable for OLS, IV, FE, RE, GMM equaling one if that particular estimation technique is employed.[33] In addition to coding different econometric techniques, since different approaches have been employed in order to deal with the issue of endogeneity bias we construct a dummy variable *Endogeneity*. This variable equals one if endogeneity is addressed. This will enable to see whether correcting for endogeneity bias leads to different estimation results. By constructing this variable we hypothesize that studies which do not explicitly address the issue of simultaneity bias may lead to biased results (Ang 2008).

5.1.6. Publication Characteristics

Journal impact factors have been extensively used as proxy measures of journal quality in meta-analyses (Rusnak et al. 2011; Havranek & Irsova 2010). Following these authors we add the recursive RePEc impact factor as of July 2012 of the outlet each study was published in to account for the possibility that results systematically differ across journals of different quality. We also included the variable *Year of publication* for two reasons. Firstly, we hypothesize that the perception of the importance of financial development in economic growth may have changed over time. If this is the case, results that are in accordance with the prevailing view may be more likely to be published. Secondly, the published pattern may also have changed because more recent studies could benefit from the application of new econometric techniques which take into account simultaneity or omitted variable biases as well as unobserved country or

[33] Further distinguishing between GMM in differences, GMM system estimator and GMM levels estimator do not affect the results.

region specific effects and thus can lead to different empirical effects. However, this is doubtful as we explicitly consol for estimation technique in this meta-analysis.

5.2. Real Differences Across Countries and Time Periods

Not only study characteristics but also real world factors may drive the differences of results in the finance-growth studies. That is, financial development may have different growth effects on different regions. Also, there is a possibility that stock markets and banks may have played different roles in accounting for economic growth across time. There is theoretical and empirical evidence supporting the hypothesis of region specific financial development-economic growth effects. For example, Patrick (1966) hypothesized that the role of financial development in economic growth changes over the stage of economic development. Or more recently, the notion that the growth effect of financial development depends on the level of economic development is supported by Deidda & Fattouh (2002). Empirically, several studies have noted that the growth effect of financial sector development varies across countries (for instance, De Gregorio & Guidotti 1995; Odedokun 1996; Ram 1999; Rousseau & Wachtel 2011; Manning 2003; Yu et al. 2012, etc.).

To address the possibility that finance-growth nexus may vary across different geographic regions we include regional dummies. In this respect, we divide countries into eight geographic regions as follows: *South Asia*, *Asia*, *Europe*, *Latin America & Caribbean*, *Middle East & North Africa*, *Sub-Saharan Africa*, *Rest of the world* (mainly high income OECD countries), with *East Asia & Pacific* as the base region. By including these variables we will test the stability of reported regression coefficients across geographic regions and thus across different levels of economic development. If this hypothesis holds and the effect of financial development on economic growth varies across geographic regions or countries at different levels of economic development, then it is not sensible to pool different countries together. Thus, it may provide us with useful recommendations for future research. Lastly, this distinction is also important for providing meaningful policy implications across geographic regions.

In order to investigate finance-growth effects across time period, we construct decade dummy variables: *1960s*, *1970s*, *1990s* and *2000s* which equals one if data from corresponding decades were used, with the *1980s* as the base. We chose the *1980s* as

the base period in order to test the hypothesis of Rousseau & Wachtel (2011) who argue that the effect of financial development on economic growth has declined after the 1980s. Rousseau & Wachtel (2011) argue that using more recent data results in weakened finance-growth relationship compared to original studies using sample from 1960-1989. By including these decade dummies we will be able to see whether the effect of financial development on economic growth changed over time. We hypothesize that new and more advanced financial institutions may provide better services to the economy and thus more enhanced economic growth than earlier institutions. On the other hand, more liberalized and internationally integrated systems may be more prone to financial crises and thus hamper economic growth prospects.

6. Results of Meta-Regression Analysis

In the preceding Sections, we saw that the estimates related to the effect of financial development on growth differ considerably in sign and magnitude. The meta-regression analysis is specifically designed to model this heterogeneity in reported estimates with respect to differences in model specification, data characteristics, estimation characteristics, publication characteristics or time periods and regions being analyzed. Finally, 31 variables out of a total number of 51 explanatory variables included in equation (13) proved to be significant in explaining the variation in reported estimates on the finance-growth nexus. This provides us with an insight into the heterogeneity in results on the effect of financial development in economic growth. The regression results suggest that heterogeneity in effect sizes arises not only due to differences in research design but also due to real factors such as differences between regions and time periods. Table 5 presents the results of MRA given by equation (13), taking into account all 1334 available observations.

Table 5: Meta Regression Analysis - Explaining the Differences in Finance-Growth Nexus (n=1334)

Moderator variables			All variables	Specific
Differences due to research design	**Differences in dep. var.**	GDP per capita	0.041(0.064)	
		GDP	0.314***(0.071)	0.242***(0.062)
		Real GDP	0.208***(0.072)	0.157**(0.064)
	Data characteristics	No. of countries	-0.002***(0.000)	-0.002***(0.000)
		No. of time units	0.000(0.000)	
		Sample size	-0.237***(0.024)	-0.237***(0.022)
		Length	0.012***(0.002)	0.012***(0.002)
		Log	-0.101**(0.043)	-0.069*(0.037)
		Cross-section	0.065**(0.032)	0.070**(0.031)
		Time series	0.449***(0.158)	0.408***(0.151)
		Homogeneous	-0.037(0.024)	
	Measures of FD	Activity1	-0.029***(0.011)	-0.031***(0.010)
		Activity2	0.037**(0.015)	0.037**(0.015)
		Bank	0.001(0.015)	
		Private/dom. credit	-0.053**(0.024)	-0.051**(0.024)
		Market capitalization	0.128***(0.016)	0.128***(0.016)
		Market activity	0.151***(0.014)	0.148***(0.013)
		Turnover ratio	0.087***(0.015)	0.087***(0.015)
		Other	0.077***(0.013)	0.077***(0.013)
		Non-linear	-0.006(0.010)	
		Changes	0.084(0.066)	
		Joint	-0.044**(0.017)	-0.048***(0.016)

Continued on next page

Table 5: Meta Regression Analysis - Explaining the Differences in Finance-Growth Nexus (continued)

Moderator variables			All variables	Specific
Differences due to research design	**Estimation characteristics**	OLS	0.069*(0.038)	0.028***(0.010)
		IV	0.002(0.030)	
		FE	0.040(0.037)	
		RE	0.050(0.040)	
		Endogeneity	0.032(0.039)	
	Conditioning variables	Regressors	-0.008**(0.003)	-0.006**(0.003)
		Macro stability	0.029(0.022)	
		Pol. stability	0.036(0.045)	
		Trade	0.013(0.020)	
		Initial income	0.188***(0.054)	0.184***(0.049)
		Human capital	0.081**(0.036)	0.092***(0.035)
		Investment	-0.242***(0.052)	-0.225***(0.047)
		Fin. Crisis	0.232***(0.067)	0.262***(0.061)
		Time dummy	0.046(0.035)	
	Publication characteristics	Journal impact factor	0.109**(0.044)	0.079*(0.042)
		Publication year	0.029***(0.006)	0.022***(0.005)
Differences due to real factors	**Differences between time periods**	1960s	-0.185***(0.035)	-0.144***(0.030)
		1970s	0.153***(0.039)	0.120***(0.036)
		1990s	-0.077*(0.046)	-0.118***(0.034)
		2000s	-0.069(0.043)	
	Differences between regions	South Asia	-0.013(0.041)	
		Asia	0.003(0.032)	
		Europe	0.132***(0.033)	0.131***(0.020)
		Latin America	0.104***(0.031)	0.108***(0.027)
		MENA	0.034(0.027)	0.047*(0.025)
		Sub-Saharan Africa	-0.091**(0.037)	-0.082***(0.027)
		Rest of the world	-0.032(0.032)	
		1/SEpkk	1.804***(0.151)	1.805***(0.133)
		Constant	-8.032***(0.629)	-7.754***(0.587)
		Observations	1334	1334
		Studies	67	67
		Within-study correlation	0.66	0.62

Notes: Dependent variable: t-statistics of the estimated coefficient related to financial development. Estimated by mixed effects multilevel model. Standard errors in parentheses; ***,**,* denote significance at the 1%, 5% and 10% level, respectively. FD stands for financial development.

The results of the MRA with all potentially relevant moderator variables are listed in the third column (labeled All variables) of Table 5. The final specification in the rightmost column of Table 5 is reached by sequentially omitting moderator variables that did not prove to be significant (labeled Specific). This is so called "general to specific" modeling, which is a common practice in MRA (Stanley 2005). Based on the likelihood ratio test the null hypothesis of no between study heterogeneity is rejected at 1% level which supports the use of mixed effects multilevel model.

In addition to the highly significant coefficient on precision, we identified several variables that significantly influence the average reported effect of financial

development on economic growth. The coefficient on precision is in line with the results of Table 3. Thus, it suggests again an authentic empirical effect but this time the interpretation is not as simple as in Table 3 as the effect depends on all moderator variables included in the regression. Moreover, moderator variables were divided by partial correlations' standard errors, adding to complexity of interpretation. The sources of heterogeneity that are statistically significant are discussed further below.

6.1. Regional Effects

The most important finding in the MRA are the different financial development-economic growth effects across regions. Thus, the effect of financial development on economic growth varies across geographic regions or countries either due to different levels of economic or financial development or some other factors. This finding has an important implication for future research as it is apparent that it is not sensible to pool different regions or countries together since the estimated effects are not stable across regions. The coefficients on Latin America and Europe are positive and statistically significant at the 1% level. That is studies that include Latin American or European countries in their sample on average yield higher financial development-economic growth correlation than those that include just countries from East Asia & Pacific which is the base region. For studies that include MENA region in their estimation the growth effect of financial development is higher but the magnitude is lower and less significant than in the previous cases. In addition, studies that include countries from Sub-Saharan Africa report on average lower financial development-economic growth effects. Moreover, the coefficient on *Rest of the world* which includes mainly very rich OECD countries is found insignificantly different form the base regression indicating that in countries with highly developed financial systems, the growth effect is lessened. This suggests a pattern where a certain level of financial and economic development increases the growth effect of financial development but once a certain financial and economic development threshold is reached, the growth effect is inhibited. This gives support to the claim of Rioja and Valev (2004). On the other hand, in countries where financial and economic development is lower, such as in Sub-Saharan African countries, the growth effect of financial development is decreased. Lastly, the growth effect of financial development across the whole Asian continent

seems quite stable as the coefficients for South Asia and Asia are not found to differ compared to East Asian & Pacific countries.

Thus this evidence gives support to studies that claim that the growth effect of financial sector development varies across countries or regions such as Ram (1999), Rousseau & Wachtel (2011), Manning (2003), Yu et al. (2012), among others. However, these findings are not in accordance to De Gregorio & Guidotti (1995) who found that the impact of financial development on growth is negative for a panel of Latin American countries. On the other hand the evidence suggests that the growth effect may be lower in Sub-Saharan Africa region, thus giving some support to Levine et al. (2000).

6.2. Time-varying Effects

In order to investigate the differences in the finance-growth effect for different time periods and test for the hypothesis of Rousseau & Wachtel (2011) who claims that the growth effect of financial development has declined after the 1980s, we included decade dummies with the *1980s* as the base. Indeed the evidence speaks in favor of Rousseau & Wachtel (2011) since the coefficient on *1990s* is found statistically significant and negative. Thus it seems that the growth effect of financial development has declined in the 1990s compared to 1980s. However, the evidence gives also support that the growth effect of financial development for the twenty first century is not significantly different from 1980s as the coefficient for 2000s is found insignificant. Lastly, studies that include data from the 1970s report on average higher growth effect of financial development while studies that include data from the 1960s report on average lower financial development-economic growth effects, compared to the base time period of 1980s. Thus, it would be interesting for future research to analyze the factors behind different decade patterns of financial development.

6.3. Data Characteristics

The results suggest that the number of countries as well as the sample size included in the analysis may also lead to different financial development-economic growth effects. The coefficients of *No. of countries* and *Sample size* are found statistically significant and negative. Thus the more countries and observations are

included in the sample the smaller the growth effect of financial development. Cross-sectional datasets as well as time series studies report on average higher correlations than those using panel data. The variable *Length* which stands for the number of years in the time unit is found positive and significant. That is, studies which average observations across longer periods report in general higher finance-growth effects. Authors usually average observation over longer time span in order to abstract from business cycle fluctuations. This suggests that the growth effect of financial development is higher in the long run than in the short run. Studies that use log transformation of the dependent variable report on average lower finance-growth effects than those that do not use this transformation.

6.4. Nature of the Dependent Variable

In specifications in which the response variable is the growth rate of GDP in real or nominal terms (with the growth rate of real GDP as the reference category) the estimated link between financial development and economic growth is typically higher. On the other hand, it seems that measuring the growth rate of GDP per capita in real or nominal terms has no effect on reported results.

6.5. Proxy Measures for Financial Development

Specifications that use some measure of stock market development such as market capitalization, market activity or turnover ratio typically yield higher growth effects compared to financial depth which is used as the base regressor. These results suggest that services provided by stock markets may have higher growth effect compared to those provided by financial intermediaries. This is in line with Levine & Zervos (1998) who argued that stock markets can provide different kinds of financial services than banks. Some studies focus on the relative importance of bank vis-à-vis stock market based systems. Thus, our findings support the researchers who suggest that stock markets are more efficient at providing financial services which may translate into higher effect on economic growth rates (e.g. Demirguc-Kunt & Levine 1999). As all coefficients related to indicators of stock market development are higher relative to those related to financial intermediaries, it seems that financial structure indeed matters. Other things equal, these findings suggest

that a desired orientation of finance related economic policies is towards formatting more efficient stock markets as they seem on average to be more conductive to economic growth. However, as discussed above, all of the indicators of financial development used in primary studies are only proxy measures for either the development of financial intermediaries or stock markets. Thus some doubt is cast whether these measures can truly capture the services provided by banks and stock markets which may contribute to the growth process (such as mobilizing savings, allocating resources, exerting corporate control, managing risk or easing transactions). Hence the question remains whether the differences in estimated effects of financial intermediaries and stock markets on economic growth are due to real factors (financial structure being important) or just due to differences in how well financial development is measured.

Studies that use private domestic credit provided by deposit money banks to GDP (*Activity1*) as proxy measure for the level of financial development tend to yield lower growth effects of financial development. On the other hand, studies that use private credit as an indicator of financial development (*Activity2*) tend to yield higher correlations. Employing *Other* measure of financial development leads on average to higher finance-growth effects compared to the base regression where financial depth is used as an indicator of financial development.

6.6. Estimation Characteristics

The moderator variable that controlled for endogeneity is not significant in the MRA. Although counter-intuitive at first sight, this fact can be explained in the following way: as GMM estimator (which takes care of endogeneity) is used as the base estimator and parameter estimates related to all other endogeneity-safe estimators (instrumental variables and random effects model) are not statistically significant, we can infer that the constant term (incorporating the effect of estimating via GMM) already captures the effect of using an endogeneity-safe estimation technique. This is further supported by a positive and statistically significant parameter estimate of *OLS* which indicates that studies where endogeneity is not taken care of report on average inflated results. The estimated coefficient on *FE* is not significant either and thus the use of this estimator does not lead to different results than employing GMM which addresses the endogeneity bias. Nevertheless, the insignificant parameter estimate for

fixed effects model can be attributed to a relatively low number of studies that use this estimation technique (out of 1334 observations, only 109 are obtained via fixed effects model while 563 are obtained by OLS). Lastly, since the estimators that address the issue of endogeneity are always at researchers' disposal, it is more appropriate to employ them as not accounting for the issue of endogeneity may always cast doubt on reported estimates.

6.7. Publication Characteristics

Both moderator variables related to publication characteristics, namely *Journal impact factor* and *Publication year*, were found significant and positive. Even though the coefficient on *Journal impact factor* is only weakly significant (at 10% level of significance in the Specific column) it suggests that studies with higher impact factor report on average higher growth effects of financial development. The coefficient on *Publication year* is significant at 1% level of significance in both specifications and thus more recent studies report on average higher growth effects.

The latter result could be driven by a truly strengthening effect of financial development on economic growth (e.g. via a combination of progressing disintermediation and a reported higher efficiency of stock markets to promote economic growth) as time passes. However, this is doubtful. For first, decade dummies do not indicate any clear pattern of increasing average economic growths stemming from financial development. Secondly and more importantly, the positive and significant estimate related to *Journal impact factor* indicates that there is a preference among editors of higher quality journals to publish relatively more positive and statistically significant results. Combined with the positive and significant *Publication year* parameter estimate, we conclude that as the notion of a positive relationship between financial development and economic growth was becoming popular, studies in line with this view were published more with passage of time.

6.8. Conditioning Variables Characteristics

Our meta-regression results also suggest that the reported estimates of finance-growth relationship are quite sensitive to the set of conditioning variables included in the growth regression, collaborating to the findings of Levine and Renelt

(2002) that empirical findings in this area of research are fragile to alterations in explanatory variables. According to our results, if authors of primary studies account for the level of initial income, include some variable related to human capital and financial fragility, then it is more likely to yield a higher estimated effect of financial development on economic growth. On the other hand, specifications that control for the amount of investment in the economy are more likely to report lower correlations between financial development and economic growth. This is quite straightforward as the level of investment in the economy is likely to be a function of financial development. As such it may capture the indirect effect of financial development on economic growth via increasing the level of investments in the economy.

The coefficient related to *Regressors* is found significant at the 5% level of significance and negative. Thus, the higher the number of explanatory variables in growth regression, the lower the estimated effect of financial development. This result speaks in favor of that not including all the relevant conditioning variables may induce the omitted variable bias and thus lead to higher finance-growth effects. These results are quite in line with the view of Levine and Renelt (2002).

Conclusion

In this thesis, we perform a meta-regression analysis of available studies that investigate the financial development – economic growth relationship with at least one Asian country in the dataset. Firstly, we observe large heterogeneity in the reported effects of financial development on economic growth which validates our use of meta-regression analysis in order to disentangle whether there is indeed a genuine effect between these two variables. Moreover, we investigate the presence of publication bias and examine what primary study characteristics influence the reported effect sizes. Our results indicate the absence of publication bias and a positive and moderate link between financial development and economic growth.

More specifically, our meta-regression covered 67 primary studies which provided us with 1334 reported estimates of the financial development - economic growth effect. Apart from standard meta-regression analysis that enabled us to examine the presence of publication bias and the genuine effect size, multivariate meta-regression analysis was performed in order to obtain a deeper understanding of what determines the effect sizes estimated in primary studies. By this technique, we gained insight into what determinants help increase the effect of financial development on economic growth. Thus, more effective economic policy can be formulated using the results of our work.

Differences in effect sizes reported by primary studies arise from differences in research design as well as differences in real factors. When focusing on differences in real factors, several findings arise. Firstly, we find different finance-growth patterns across different regions of the world. This is of crucial implication for future research as it is apparent that pooling different regions together when examining the role of financial development in economic growth is not sensible. Moreover, it implies that there are different returns to promoting finance related economic policies across different regions of the world. Namely, considering the Asian growth effect as the base one, the growth effect of financial development is higher in European and Latin American countries whereas lower in Sub-Saharan African countries and in very rich OECD countries the effect is the same as in Asian countries. This suggests a pattern where a certain level of financial and economic development increases the growth effect of financial development. However, once a certain threshold of financial and economic development is reached, the growth effect is inhibited. Another real factor influencing

the estimated effect size is the time span taken into account in the primary study. Based on the evidence, it seems to be the case that compared to the 1980s the growth effect of financial development has decreased in the 1990s. However, the growth effect of financial development for the 21st century is of the same height as it was in the 1980s.

The last significant real factor influencing the estimated effect is the type of financial system used in the primary study. Our results give support to the notion that financial structure matters for economic development as the contribution of stock markets in the growth process tends to be higher relative to that of financial intermediaries. These findings imply that a desired orientation of finance related economic policies is towards formatting more efficient stock markets as they seem on average to be more conductive to economic growth.

Turning to differences in research design, our meta-regression analysis provides evidence that the reported estimates of finance-growth relationship are sensitive to the set of conditioning variables included in the growth regression. Studies that control for initial income, human capital and financial fragility in their specifications tend to report a higher estimated effect of financial development on economic performance. In the same vein, including only a limited set of conditioning variables translates into higher finance-growth effects. That is, it is important to account for all the potentially relevant determinants of growth in the growth regressions so as not to induce omitted variable bias. In addition, financial development seems to have an indirect positive impact on growth through its impact on investment.

Our results also reveal that not taking into account endogeneity and estimating the underlying relationship by OLS estimator tends to inflate the effect of financial development on economic growth. Thus, it is more appropriate for studies analyzing this effect to control for endogeneity bias by using an appropriate econometric technique.

A specific category in research design factors is data characteristics. In general, holding other factors constant, incorporating data from more countries and using more observations translates into smaller effect of financial development on the growth process. On the other hand, using time series or cross-sectional data yields on average higher correlations than studies building their analysis on panel datasets. Studies that average observations across longer periods report in general higher finance-growth effects, suggesting that the growth effect of financial development is higher in the long-run than in the short-run. In addition, studies that use log transformation of the

dependent variable report on average lower finance-growth effects than those that do not use this transformation.

Next, our results suggest that measuring the dependent variable in real as opposed to nominal terms does not influence the estimated effect size. Conversely, focusing on economy wide values as opposed to per capita values of economic activity leads to increased readings of the discussed effect.

Lastly, our meta-regression analysis indicates that there is a preference among editors of higher quality journals to publish relatively more positive and statistically significant results. Similarly, the reported effect sizes tend to increase over time, possibly due to a generally increasing acceptance of a positive link between financial development and economic growth.

Suggestions for future work stemming from our results are several. For example, the herein presented research could be extended to incorporate all the accumulated evidence on the role of financial development in economic growth, starting with the incorporation of studies that do not examine the finance-growth nexus in the Asian context. This could be further improved by e.g. backward and forward searches of literature in order to obtain more robust results. Next, the question of what leads to different financial development – economic growth patterns across geographical regions remains open. Revealing whether regional differences in the finance - growth are given by different levels of financial development, economic development or some institutional characteristics would help understand the role financial development plays in economic growth and thus help formulate better future economic policies.

Appendix: Studies Used in the Meta-Analysis

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