Hacettepe University Graduate School of Social Sciences
Department of Economics
Ph.D.

Nonlinear Approach to Financial Development – Economic Growth Nexus: Evidence from Developed and Developing Countries

Zeynep ERÜNLÜ

Ph.D. Dissertation

Ankara, 2018

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Prof. Dr. Hakan Naim Ardor (Jury President)

Assoc. Prof. Ayşen Sivrikaya (Advisor)

Assoc. Prof. A. Yasemin Yalta

Assoc. Prof. Özgür Teoman

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Zeynep ERÜNLÜ

ETİK BEYAN

Bu çalışmadaki bütün bilgi ve belgeleri akademik kurallar çerçevesinde elde ettiğimi, görsel, işitsel ve yazılı tüm bilgi ve sonuçları bilimsel ahlak kurallarına uygun olarak sunduğumu, kullandığım verilerde herhangi bir tahrifat yapmadığımı, yararlandığım kaynaklara bilimsel normlara uygun olarak atıfta bulunduğumu, tezimin kaynak gösterilen durumlar dışında özgün olduğunu, Doç. Dr. Ayşen ARAÇ danışmanlığında tarafımdan üretildiğini ve Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü Tez Yazım Yönergesine göre yazıldığını beyan ederim.

Arş. Gör. Zeynep ERÜNLÜ

To my beloved mum Sema and dad Nihat ☺…

ACKNOWLEDGMENTS

First and foremost, I would like to thank my advisor Assoc. Prof. Ayşen Sivrikaya for her guidance, encouragement, criticism and motivations throughout the research process. It has been an honor to be her Ph.D. student and has been a pleasure to have the opportunity to work with her.

I would like to express my gratitude to the members of my dissertation committee, Prof. Hakan Naim Ardor, Assoc. Prof. A. Yasemin Yalta, Assoc. Prof. Özgür Teoman and Assoc. Prof. Ayşegül Çorakcı for their suggestions and contributions.

I am also grateful to Prof. Nadir Öcal and Prof. Burak Günalp for their continuous support and encouragement. I also want to thank Assoc. Prof. Ayşegül Çorakcı for her advice, endless support and motivation. I am feeling extremely lucky for having her in my life.

Thanks to all of the instructors and professors that I forgot to mention for their help, valuable effort and contributions to my education.

I gratefully acknowledge the support of my best friend Berna Öztürk who has been in my life since primary school. She is always with me with her endless patience and makes my life enjoyable. I am also thankful to Barbaros Güneri who shares all the burden of my study next to his from the beginning of our Ph. D. years.

I would also like to thank to my friends, Zehra Burçin Kanık, Pembegül Çetiner Karataş and Zeynep Birce Ergör for the supportive and friendly environment they provided. Also thanks to all of my friends that I have neglected in my dissertation process for their understanding.

I owe my deepest gratitude to my mother, Sema Bayramoğlu, to my dad, Nihat Bayramoğlu and to my brother Fuat Can Bayramoğlu for their sacrifice, endurance and

moral support not only in this dissertation but also throughout my life. My mother Semoş and my dad Nihis, devoted their life to me and to my brother. Words cannot express my feelings and gratefulness for them. This dissertation is a dream of my dad and I am honored to make his dream come true. I hope I will continue to make them happy and deserve their love in my future life. They are the meaning of my life.

I offer sincere thanks to my mother in law, Müzeher Erünlü, to my father in law, Osman Ahmet Erünlü and to my brother in law, Can Erünlü for their continuous support and motivation.

Finally, I have my special thanks to my husband Coşar Erünlü for his patience, everlasting support and understanding. He has never left me alone, has encouraged me, has always trusted me and has shared my stress during my Ph.D. Whenever I need moral support, I know that he is always there. This dissertation cannot be completed without him.

ABSTRACT

ERÜNLÜ, Zeynep. *Nonlinear Approach to Financial Development – Economic Growth Nexus: Evidence from Developed and Developing Countries,* Ph.D. Dissertation , Ankara, 2018.

While there is a general consensus among economists on the fundamental role that financial markets play in fostering economic growth, theoretical and empirical work supporting this idea is still very much in progress. This thesis aims to shed light on this issue by providing new empirical evidence using several relevant macroeconomic variables that are expected to affect the finance-growth relationship as state variables. Namely, in this study the financial development - economic growth nexus is investigated. To this end, Hansen (1999)'s Panel Threshold Regression Model for a panel of 56 countries is applied over the period 1967-2016. The estimation results reveal that financial development has a positive and significant effect on economic growth in all developing countries. However, for developed countries, financial development negatively affects growth, except for the case when growth is used as state variable. This study suggests that it is crucial for the policymakers to know the threshold values. If the optimal level of finance is known, the policymakers can implement policies that can prevent the detrimental effects of the *too much finance* on the economy.

Key Words: Financial Development, Economic Growth, Panel Threshold Regression Model.

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INTRODUCTION

2008 global financial crisis has reinforced the view that the financial sector is crucial for an economy as its effects are quick and even sharp on the growth rates of the countries. In the aftermath of this crisis, as one of the old issues in the economics literature, the effects of finance on economic growth has again gained importance and been addressed by many contemporary economists. Although it has been studied intensively, there is still no consensus on the causal relationship and the channels between them. This thesis aims to investigate the finance-growth nexus by using a nonlinear modelling approach.

There are five views in the literature on the direction of the causality between financial development and economic growth performance. The first view is the supply-leading hypothesis, based on Schumpeter (1934), that supports the direction of the relationship is from financial development to the growth. On the contrary of the supply-leading hypothesis, Robinson (1952) claims that financial development does not lead to economic growth, oppositely the expansion in the economy yields an increase in the financial development. The second view is called demand-following hypothesis. Patrick (1966) suggests that while supply leading hypothesis is appropriate for the earlier stages of the development, demand following hypothesis is valid for the other stages. A bidirectional relationship is another view and according to the supporters of this kind of relationship, finance and growth affect each other. Some economists indicate that the relationship is over-stressed (Lucas, 1988) or there is no relationship and in last, some economists find a negative/insignificant relationship.

The causal relationship between financial development and economic growth has not been clear from the results of the studies in the literature employing linear approach. It is likely due to the fact that either this relationship is mismodelled or there are omitted variables that affect the relationship between them in the models. For these reasons, in this thesis not only a nonlinear approach is applied to examine this nexus, but also many candidates which may affect this relationship are tested to find the threshold in case there is any.

In this thesis, the relationship between financial development and economic growth is examined using an unbalanced panel data model which consists of both macroeconomic and financial variables of 27 developed and 19 developing countries, covering the 1967-2016 period. Economic growth rate is described as annual GDP per capital growth rate and market capitalization of listed domestic companies (as a percentage of GDP) is utilized as the financial indicator which is one of the most widely used indicators in the literature. It describes not only the size and the value of the capital market but also the changes in the total activity of the market.

This thesis has several novelties. One of them is that it uses the Panel Threshold Regression model (PTR) of Hansen (1999). Although there are many sources which creates the nonlinear structure for the relationship between financial development and economic growth, such as transaction costs, spillovers, business cycles and shocks, only a limited number of the studies have used nonlinear approaches to modelling.

The second novelty of this thesis is that the relationship between financial development and economic growth is examined in a framework that it is conditional not only on the level of inflation as in several studies in the literature, but also on investment, trade openness, economic growth rate and institutional quality. Using many candidates as state variables is the main contribution of the thesis to the existing literature.

The third novelty of this thesis is that the control variables are selected following Hineline (2007), which uses Bayesian Model Averaging (BMA) technique. BMA takes averages of many different competing models and includes model uncertainty in the results related to parameters and predictions. As explanatory variables, inflation, openness and investment are selected by means of BMA and they are used in the model representing the relationship between financial development and economic growth.

This thesis is organized as follows. The relationship between financial development and economic growth is analyzed in chapter 1 by examining the conceptual framework of the financial system, the evolution of the finance growth relationship and empirical literature on the causal relationship between finance and growth. In chapter 2, the

theoretical economic growth models that involve financial sector are briefly summarized. In chapter 3, the nonlinear empirical studies in the literature are given and chapter 4 is devoted to the econometric methodology, data and empirical results of this study. The findings of the thesis are summarized in conclusion.

CHAPTER 1

THE RELATIONSHIP BETWEEN FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH

The relationship between financial development and economic growth is one of the most debated topics in the economic literature. This chapter briefly provides these debates in chronological order. Accordingly, first, the conceptual framework of the financial system is given. Second, the evolution of the finance-growth nexus and last, the empirical literature on the causal relationship are analyzed.

1.1 CONCEPTUAL FRAMEWORK: FINANCIAL SYSTEM

A well-organized financial system, consisting of financial markets, financial intermediaries and their services, is considered as one of the main factors for a well-functioning economy. This is because financial system organizes the rotation of the funds between the economic units that have fund surplus and the ones that need funds.

The rotation of the funds can be done directly or indirectly. In direct finance, financial intermediary institutions, banks, credit institutions and insurance companies etc. bring together the fund suppliers and the fund demanders via financial instruments such as deposits and loans. Indirect finance is a type of finance in which intermediary does not exist. In this type, capital market instruments are used (Ağır, 2010).

Financial markets consist of money and capital markets. Compared to the capital market as the period funds used is short, money market is more liquid. While money market includes foreign exchange market, capital market includes primary and secondary markets. Primary markets are the markets for the first-time buyers of securities/instruments and securities that are newly issued. In the secondary market, previously issued securities are traded (Seyidoğlu, 1999).

To the extent of the organizational behavior, the financial market can be formal or informal. In the formal financial market, the fund transfers can be in a physical environment and are controlled by the government (Seyidoğlu, 1999). Banks and stock market can be given as examples of formal markets. Conversely, in the informal markets, the exchange of funds does not take place in a physical environment. As the government is not controlling this type of markets, they are more flexible compared to the formal markets in warrants and terms (Önder, Türel, Ekinci and Somel, 1993).

Financial system makes market frictions to be ameliorated. The market frictions are resulted from asymmetric information and transaction costs that the economic units meet in exchange of the funds. Levine (1997) lists the basic functions of financial system as follows: i) Mobilizing savings, ii) Acquiring information and allocating resources, iii) Monitoring managers and exerting corporate control, iv) Facilitating risk management and v) Easing exchange. By using these functions, financial system has two channels to lead to an increase in economic growth; i) Capital accumulation and ii) Technological innovation.

The first function is the mobilization of the savings. In the evaluation of the capital accumulation obtained from the different savers in order to realize the investments, financial system will dissipate the risk and strengthen the liquidity (Ağır, 2010). The rate of transformation of the savings to the investment is important for an efficient market. By mobilizing the savings, the resource allocation will be better and technological innovation will increase.

The second function is acquiring information and allocating resources. It is hard and costly for an investor to collect information about investment opportunities and this difficulty decreases the incentive of making investment. Financial system decreases the information and transaction costs and supplies information to the investors and therefore resource allocation will become better. By the chances of initiating new goods and new production processes given to the investors, financial development increases the rate of technological innovation and by this channel economic growth will be experienced (Levine, 1997).

Managers have an advantage from the outside investors as they are inside of the firm. By the monitoring of the financial institutions, the asymmetric information can be decreased. The details of the received credits can be followed and the management can be dismissed. This control mechanism is a threat for the management and causes them to manage the firms more efficiently. Therefore, by monitoring managers and exerting corporate control function, capital accumulation and technological innovation channels both affect economic growth.

Fourth function is facilitating risk management. “In the presence of specific information and transaction costs, financial markets and institutions may arise to ease the trading, hedging and pooling of risks” (Levine, 1997, 691). The main function of the financial system is to diversify the risks especially liquidity risk and this can occur in the presence of the market frictions. “If the financial system does not enhance the liquidity of long-term investments in high-return projects, investment decreases” (Levine, 1997, 692). Diversification of the portfolio in the innovate projects, decreases the risk and thus increases investments. Risk management also increases the technological innovations as agents try to increase their technological progress for the profit motivation. Successful technological progress increases the economic growth. Thus, both channels affect growth in risk management function of the financial system (King and Levine, 1993)

Easing exchange is the last function of the financial system. In the developing economies, new instruments are needed for the response to the financial instrument demand. Well-organized financial systems ease the exchange of the goods and services, makes it easier and cheaper to access funds and reduces the financial intermediation cost. A decrease in the financial intermediation cost promotes technological innovations and thus economic performance.

Financial system can be structured in several ways with different allocative efficiencies. In the finance literature, there are four views highlighting the better allocative efficiencies, which are bank-based view, market-based view, the law and finance view, and the financial services view. The bank-based view claims that banks have a prominent role of mobilization of the savings, designation of the investment projects

and taking the risks. The supporters of the bank-based view argue that contrary to the banks, the stock markets have several deficiencies such as free rider problem[1], asymmetric information[2] and ineffective corporate control over resource allocation (Stiglitz, 1985-93; Levine, 2000).

The market based view indicates that the liquid and well-functioning markets alleviate risk management, reduce the risk through diversification, capital allocation, corporate control and alleviating the problems of the powerful banks (Levine and Zervos, 1998 and Luintel et al. 2016). A deficiency of the bank based financial systems is that they involve intermediaries that have a big influence over the firms which can affect the economy negatively (Levine, 2000). As banks can use their information about the firms and as they have ability to extract rents from the firms, in the sense of new investment, powerful banks can extract more than the expected profits of the investment which reduces the motivation of innovation and decelerates economic growth.

According to the financial services view, the availableness and the quality of the financial services are important factors for economic growth, not the composition of the system- whether it is market based or bank based. This view proposes that governments create an atmosphere where the market structures do not prevent each other and allows both of them (Levine, 2000). Levine and Zervos (1998) show that independent of the level of development in the banking sector, stock market liquidity increases economic growth. While they indicate the independence of the stock market, study of Demirgüç-Kunt and Maksimovic (1998) show that banks and markets can act as complements.

Last, the law and finance view[3] points out the importance of the role of the legal system in the finance-growth nexus. According to La Porta, Lopez-de-Silanes, Shleifer and Vishny (1998), strong legal atmosphere is necessary for the foreign investors to invest

[1] Free rider is a market failure. A person who does not pay anything but benefits from the goods, services and resources is called free rider. This problem is observed especially in the public goods.

[2] Asymmetric information is an information failure and expresses the unequal amount of knowledge among groups.

[3] Mostly associated with La Porta, R., Lopez-de-Silanes, Shleifer, Vishny (1997, 1998, 1999, 2000a, 200b), La Porta, R., Lopez-de-Silanes, Shleifer (2008).

in a country. The national legal origin is also important as it determines the investor protection. The countries traditionally apply English common law, Roman civil law, French, German and Scandinavian civil laws. The countries accepting English common law face with little impediments while reaching external finance in comparison with French civil law countries. It should not be considered that this view does not agree with either bank-based or market-based financial structure, it only predicts that the development level identified by the legal atmosphere is better for estimating the effect of financial development on growth (Levine, 2000).

Several economists (Arestis, Demetriades and Luintel (2001), Demirhan et al. (2011), Tadesse (2002)) consider that bank-based financial system is better at mobilization of the savings and the designation of the investments especially in the early stage of the development process than the market-based system. However, some other economists (Bhattacharya and Chiesa (1995), von Thadden (1995)) examine the allocative efficiency of the market-based system and express that market based structure has more advantages in allocating capital and alleviating the possible issues related with strong banks in (Levine, 2005).[4] Therefore, there is no consensus in the literature on which structure of the financial system is better to function well and to boost economic growth.

1.2 THE EVOLUTION OF THE THINKING ON FINANCE-GROWTH RELATIONSHIP

The role of well-functioning financial markets in the economic development of the countries goes long way back to Bagehot (1873) and Schumpeter (1911). Schumpeter (1911) claims that banks manage the financial intermediating activities, direct the financial resources to the productive fields and thus increase the economic development of a country. Therefore, financial development leads to an increase in economic growth

[4] For the literature on this debate see also Allen and Gale (1997,2000), Levine (2000), Demirgüç-Kunt and Levine (2000), Stulz (2001), Beck, Demirgüç-Kunt and Levine (2001), Beck and Levine (2002), Demirgüç-Kunt and Maksimovic (2002), Beck, Demirgüç-Kunt and Levine (2003), Luintel, Khan, Arestis and Theodoridis (2008), Lee (2012) and Luintel, Khan, Leon-Gonzalez and Li (2016).

rate. Patrick (1966), on the one hand, names this Schumpeterian view as “supply-leading hypothesis”.

On the other hand, Robinson (1952) claims that when there is an expansion in the economy, the households’ and firms’ demand for the financial goods and services increases. In order to meet the demand, new financial products emerge and the financial system expands. Opposite to the supply-leading view, financial development does not lead to economic growth, the expansion in the economy yields an increase in the financial development. The financial system development is a result of actual demands in the economy (Prochniak and Wasiak, 2017). This view is called “demand-following hypothesis” by Patrick (1966).

Furthermore, Patrick (1966) claims that while supply leading hypothesis is more applicable for the earlier stages of the development, demand following hypothesis is valid for the later stages. Accordingly, financial system provides services that lead technological development and hence an increase in economic growth rate in the earlier stages of the development. In the following stages of the development, economic growth enhances demand for financial instruments and services, which yields developments in the financial system.

Along with Robinson’s argument, the Schumpeterian view has been advocated so far. For example, Gurley and Shaw (1955) and Goldsmith (1969) indicate that under-developed financial systems delay economic growth. They claim that, in order to grow, a country should widen and deepen its financial system, by which savings and investments can increase (Ang, 2008). This view is named as “financial structuralist view”.

In post-war periods, the financial structuralist view did not have much effect on the economy policies, which might be because “Keynesian financial repressionist ideology” was dominant during that period (Ang, 2008). This ideology supports restrictive policies on financial systems such as high required reserve ratio, interest rate controls etc. These

policies decrease the motivation of saving that results in a decrease in the available funds for the investors.

Keynesian financial repressionist ideology was then questioned by Mc Kinnon (1973) and Shaw (1973). According to Mc Kinnon (1973) and Shaw (1973), the high required reserve policy reduces savings and deteriorates the resource allocation. As they support liberalization, opposite to the Keynesian financial repressionist ideology, their view is named as "financial liberalization view".

In the early 1980s, financial liberalization view of Mc Kinnon and Shaw was criticized by Neo-structuralists (Ang, 2008). The pioneers of Neo-structuralists were van Wijnbergen (1982-83), Taylor (1983) and Buffie (1984). Their model assumes that households have three types of assets that are substitute for each other: Bank deposits, gold and curb market loans. For instance, an increase in bank deposit rates reduces investment as households substitute curb market loans for deposits. This yields decreases in loanable funds and output (Ang, 2008). They support that if there is an efficient curb market, financial liberalization cannot increase growth (as credit supply is lowered). However, Fry (1988) and Owen and Sollis-Fallas (1989) critise neo-structuralists as they give so much importance to the unorganized curb markets which are not efficient as commercial banks.

In the early 1990s, finance is introduced to the endogenous growth models and the relationship between growth and finance has tried to be explained[5]. Endogenous growth models are mostly concentrated not on the amount of investment like Mc Kinnon and Shaw's financial liberalization view, on the efficiency of the investment. While Mc Kinnon and Shaw models emphasize the role of financial development on economic growth, the models employing financial development in endogenous growth show the reciprocal interactions between them (Ang, 2008). Higher economic development increases the demand for the financial system and leads to a more efficient and competitive financial system. At the same time, financial intermediaries provide worthful information and thus, investment projects will be more efficient by decreasing

[5] These models are explained in the next chapter.

the informational discrepancy, therefore capital accumulation increases, resource allocation become more efficient and economic growth occurs. (Ang, 2008).

1.3 EMPIRICAL LITERATURE ON THE CASUAL RELATIONSHIP BETWEEN FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH

In the linear literature although there have been many studies that analyze the relationship between finance and economic growth, there has not been a consensus on their causal relationship. On one hand, Gupta (1984), King and Levine (1993), de Gregorio and Guidotti (1995), Levine and Zervos (1998), Rousseau and Watchel (1998), Rousseau (1999), Kar and Pentecost (2000), Levine, Loayza and Beck (2000), Xu (2000), Arestis, Demetriades and Luintel (2001), Ünalmış (2002), Müslümov and Aras (2002), Graff (2002), Calderon and Liu (2003), Christopoulos and Tsionas (2004), Beck and Levine (2004), Thangavelu and Jiunn (2004), Ghirmay (2004), Rioja and Valev (2004a), Shan (2005), Caporale, Howells and Soliman (2005), Aslan and Küçükaksoy (2006), Acaravcı, Öztürk and Acaravcı (2007), Abu Bader and Abu-Qarn (2008), Enisan and Olufisayo (2009), Cooray (2010), Kar, Nazlıoğlu and Ağır (2011), Hassan, Sanchez and Yu (2011), Herwartz and Walle (2014), Seven and Yetkiner (2016), Durusu-Çiftci, İspir and Yetkiner (2017) find results that supports the supply leading hypothesis, on the other hand, Jung (1986), Kar and Pentecost (2000), Thangavelu et al. (2004), Ang and Mc Kibbin (2007), Kandır, İskenderoğlu and Önal (2007), Zang and Kim (2007), Odhiambo (2008), Adeyeye, Fapetu, Aluko and Migiro (2015), Hassan, Sanchez and Yu (2011) and Kar, Nazlıoğlu and Ağır (2011) find demand following results in their studies. Apart from supply leading and demand following hypothesis, Demetriades and Hussein (1996), Luintel and Kahn (1999), Ünalmış (2002), Al- Yousif (2002), Shan and Morris (2002), Calderon and Liu (2003), Dritsakis and Adamopoulos (2004), Ghirmay (2004), Shan and Jianhong (2006), Shahbaz et al. (2008), Demirhan, Aydemir and İnkaya (2011), Hassan, Sanchez and Yu (2011), Araç and Özcan (2014), Marques, Fuinhas and Marques (2013) and Swamy and Dharani (2018) find the relationship is bidirectional, Lucas (1988), Naceur and Ghazouani (2007), Zang and Kim (2007) claim that the relationship is overstressed and not significant. The studies including de Gregorio and Guidotti (1995), Bencivenga and

Smith (1991), Ram (1999), Dawson (2003), Boyreau- Debray (2003), Akinlo (2004), Rousseau and Vuthipadadporn (2005) and Naceur and Ghazouani (2007) find that the relationship between financial development and economic growth is insignificant.

There is also an extensive “too much finance” literature which points out that above a threshold level of the financial development, financial development hinders economic growth. In order not to digress, this literature is not discussed in this thesis.

The causal relationship between financial development and economic growth has not been clear from the results of the studies in the literature employing linear approach. It is likely due to the fact that either this relationship may be mismodelled or there might be other variables that affect the relationship between them. For this reason, in this thesis not only is nonlinear approach applied to examine this nexus, but also many candidates which may affect this relationship are tested to find the threshold in case there is any.

CHAPTER 2

THEORETICAL LITERATURE: ECONOMIC GROWTH MODELS INCLUDING FINANCIAL DEVELOPMENT

Economic growth can be defined as an increase in the countries goods and services produced. As economic growth rate is important for the countries, numerous theorical and empirical studies have been conducted to investigate the underlying factors that affect growth and the channels to the economic growth. Finance is an important factor as it affects the growth rate by its functions; mobilization of the savings, acquiring information, allocating resources, monitoring the institutions, facilitating risk management and easing exchange by increasing capital accumulation and technological innovation. Therefore, in this chapter, the theoretical literature on the relationship between finance and economic growth are summarized in order. The literature can be divided into two; the endogenous growth based models which include finance and the neoclassical growth based models that embody the financial sector.

2.1 ENDOGENOUS GROWTH BASED MODELS INCLUDING FINANCE

In this subchapter, the endogenous growth models that include financial market variables are analyzed briefly and given chronologically beginning from the first study by Greenwood and Jovanovic in 1991 to the best of our knowledge. These growth models can be classified according to the role that the financial system plays in the economic development of a country. First, Greenwood and Jovanovic (1990), Bencivenga and Smith (1991), Pagano (1993), Berthelemy and Varoudakis (1996), Blackburn and Hung (1998), Deidda (2006), and Wu, Hou and Cheng (2010) take into account the allocative role of the financial system. Second, Levine (1991) and Saint-Paul (1992) discuss the importance of financial markets in reducing risks through portfolio diversification along with role that finance plays in fostering specialization. Last but not least, Greenwood and Smith (1997), Galetovic (1996), and Khan (2001) examine the significance of financial incentives in the adoption of new technologies.

2.1.1 Greenwood and Jovanovic (1990)

In their study 'Financial Development, Growth and the Distribution of Income' which is published in 1990, Greenwood and Jovanovic assess the important role of the financial intermediaries in the analyzing the information and channeling the savings to the efficient investments. They investigate the link between financial intermediation and economic growth and find an inseparably relationship. ''Financial intermediation promotes growth because it allows a higher rate of return to be earned on capital, and growth in turn provides the means to implement costly financial structures'' (Greenwood and Jovanovic, 1990, 1076). Consistent with Patrick (1966), they found that in the early stages of development, financial system is almost absent and the growth in the economy is slow. "Economies have to grow rich enough before they choose to pay the sunk costs needed to set up financial systems" (Galetovic, 1996, 550). As the economy reaches an intermediate level of development, participation to the financial system increases and financial sector expands. Investors are now informed about the composite technological shocks[6] in the economy and therefore with having information, investors invest more and economic growth raises.

2.1.2 Bencivenga and Smith (1991)

In their study 'Financial Intermediation and Endogenous Growth', Bencivenga and Smith (1991) examine whether the existence of the financial intermediaries changes the individuals' decisions about the liquid or illiquid investment. They develop an endogenous growth model in which intermediaries decrease redundant capital liquidation and promote growth by affecting resource allocation by productive investments.

The model that Bencivenga and Smith (1991) propose is a three-period-lived overlapping-generations model and there are two kinds of investment. One of them is

[6] There are two production opportunities; first one is safe but relatively low return on investment, second one is a higher return but more risky investment. Risky technology includes two kinds of shocks; aggregate disturbance and individual specific shocks. With wide portfolios, financial intermediaries ameliorate these shocks in the best way so that the allocation of the savings are efficient and therefore financial development causes economic growth (Greenwood and Jovanovic, 1990).

liquid investment that is not productive directly, the other one is illiquid investment which yields productive capital. The financial development levels are assumed to be exogenously determined by legislation and government regulations. In the economies that are not developed, equity or bond markets have a little role compared to banks. In the lack of the banks, too much investment is self-financed and also one should be aware of the random liquidity risks. There can be long delays between the investment expenditures and the return of capital which is realized.

All capital is owned by the entrepreneurs (old agents). In the production process they use only their capital. k_t denotes the capital of the entrepreneur and L_t is the units of labor employed at time t. The consumption goods are produced by the production function in Equation (1.1);

$$y = \bar{k}_t^{\delta} k_t^{\theta} L_t^{1-\theta} \tag{1.1}$$

where $\theta \in (0,1)$ and $\delta = 1-\theta$

$\bar{k}_t^{\delta}$ shows the average capital stock per individual, $\delta, \theta, 1-\theta$ show the output elasticity of average capital stock, capital and labor, respectively. There is no population growth in the economy and only the young generations work. Labor endowment at age two and three is zero. Utility function of the young entrepreneurs is given as Equation (1.2)

$$u(c_1, c_2, c_3; \phi) = -\frac{(c_2 + \phi c_3)^{-\gamma}}{\gamma} \tag{1.2}$$

where $\gamma \succ -1$ and ϕ are an individual-specific random variables at the beginning of the age two. c_1, c_2, c_3 denote consumption levels at the ages one, two and three, respectively.

In the model there are 2 assets: Liquid investment and illiquid investment. In the type of liquid investment, when a unit of the consumption good is invested at time t, it returns $n \succ 0$ units of consumption at $t+1$ and $t+2$. One unit of consumption good invested at returns R units of the capital good at time $t+2$ is called illiquid investment. If the investment of the capital good at time t is liquidated at time $t+1$, its return is only x units of the consumption good, where $0 \preceq x \prec n$.

In the model with financial intermediaries, young individuals invest all their money and do not consume at time t. Intermediaries collect deposits from young savers and make both liquid and illiquid investments. Here, liquid asset is the reserve holdings for the individuals who want to withdraw their money. An individual that withdraw her money at time $t+1$, gets r_{1t} units of consumption good for each unit deposited. If one wants to withdraw her money at time $t+2$, gets r_{2t} units of the capital good and $\tilde{r}_{2t}$ units of the consumption good per unit deposited.

The equilibrium output rate is obtained by solving utility maximization and profit maximization problems, which is given in Equation (1.3)

$$\frac{\bar{k}_{t+2}}{\bar{k}_t} = R(1-\theta)\pi^{\theta-1}q_t = \mu \qquad (1.3)$$

As labor's share on output $(1-\theta)$ increases, capital production becomes easier (R increases), investment on the illiquid assets increases q_t and the fraction of the agents $(1-\pi)$ who withdraw their money one period after making deposit decreases, so that growth rate of output increases.

If there are no financial intermediaries, all capital accumulation must be self-financed and young savers have no chance to pool liquidity risks. In this situation the new equilibrium output rate is equal to

$$\frac{\bar{k}_{t+2}}{\bar{k}_t} = R(1-\theta)\pi^{\theta} q_t^{*} = \mu^{*} \qquad (1.4)$$

This model suggests that the investment in liquid assets in the model without financial intermediaries is greater than the ones in the model with them. In the economies with financial intermediaries, the investment decisions are more optimal than the economies without financial intermediaries[7]. In short, financial intermediaries increase the equilibrium growth rate by changing the turnover rate of investment into capital and raising the productive investments.

This model shows that the countries with competitive intermediaries such as banks grow faster than the countries without them. This is because they have an important role on the economic growth as they provide liquidity and enhance the saving compositions. [8]They also decrease the fraction of savings that are held as unproductive liquid assets and therefore according to the liquidity needs, they hinder the misallocation of the investment.

2.1.3 Levine (1991)

In the study 'Stock Markets, Growth and Tax Policy', published in 1991, Levine develops an endogenous growth model with a stock market which allocates risk. They investigate how the stock market changes the investment incentives and steady-state growth rate (Levine 1991).

According to the model, the investors face with the liquidity and productivity risks. First, productivity risk arises in the final period of production and if the investor is risk averse, investment (to the firms) will be effected negatively. Stock markets allocate this risk by allowing them to invest in different firms. Second, the liquidity risk arises if

[7] For the proof see (Bencivenga and Smith, 1991, 205-206).
[8] The other main roles banks can be listed as follows: a) They collect deposit and lend them to the large number of agents, b) They hold liquid reserves incase a withdrawal demand, c) They issue liabilities more liquid compared to their assets, d) They remove the necessity of self-financing of the investment.

liquid shocks are not publicly observable and the insurance contracts can be not fully sufficient to eliminate the risks of the individuals. Herein, financial contracts protect the investors who face with the liquidity shocks and help the investors to sell their shares to other investors.

In the model, the agents live three periods, a countable infinity of agents are born in each period and there is no population growth. The utility function of the young agents is as follows:

$$u(c_1, c_2, c_3) = -\frac{(c_2 + \phi c_3)^{-\gamma}}{\gamma} \qquad (1.5)$$

where $\gamma \succ 0$ and γ, c_1, c_2 and c_3 show relative risk aversion coefficient, first, second and third period consumption, respectively. In the first period, consumption has no utility, therefore all income is saved. Financial system and policies cannot change the saving rate.

The agent-specific, privately observed random variable ϕ becomes known at the beginning of the second period and distributed as below:

$\phi = 0 \rightarrow$ probability $1 - \pi$

$\phi = 1 \rightarrow$ probability π.

Here the preference implies the desired liquidity. At the first period, the preferences of the individual are unknown therefore liquidity risk emerges. If $\phi = 0$, individual wants to consume all of his/her wealth at period two. But there is no aggregate liquidity risk as $1 - \pi$ of each generations preferences are type zero and π are type one. On the presence of the unobservability in the preferences, insurance contracts cannot eliminate the liquidity risk. (Levine, 1991).

Agents are born in time t, get wage (w_t) by working and make investments. There are two investment technologies in the production: liquid storage technology and risky & illiquid technology. In liquid storage technology, investment occurs at time t. The production of consumption goods can be made at t+2 and t+3. In the illiquid technology, consumption goods are produced in two-staged, two-period process by using physical capital, labor and human capital[9]. Individuals augment human capital at the first stage (including $t+1$ and also in a part of the $t+2$) of the production. Therefore, only in the third period individuals have human capital. "Each individual's accumulation of human capital depends positively on a) his interactions with others (see Lucas, 1988), b) the amount of resources invested by the individual and c) the average amount of capital invested and maintained in the firm for two periods." (Levine, 1991, 1449). Hence, human capital can be written as

$$h_{t+2} = H\bar{W}_{t+2}^{\delta}\left(qw_t\right)^{\varepsilon} \tag{1.6}$$

where $1 \prec \delta, \varepsilon \prec 0$, H is a constant, h, qw_t and $\bar{w}_{t+2}$ denote, human capital, invested resources and the average quantity of resources maintained in the firm respectively (Levine, 1991).

At period three, the production function of the entrepreneurs is;

$$y_{t+2} = \bar{\eta}_{t+2} h_{t+2} L^{1-\vartheta}{}_{t+2} \tag{1.7}$$

Where L_{t+2} shows the hired labor at period two and is firm-specific productivity shock and $0 \prec \vartheta \prec 1$.

[9] 'Human capital is nontradable and represents the knowledge and skills embodied in individuals' (Levine, 1991, 1449).

By solving the representative individual's utility maximization problem, Levine (1991) finds the two-period equilibrium growth rates of the economy without and with stock markets as follows

$$g_{yws} = y_{t+2}/y_t = h_{t+2}\Big/ h_t = \frac{HW^{\delta}_{t+2}\left(qw_t\right)^{\varepsilon}}{h_t} = Hpq \qquad (1.8)$$

$$g_{ysm} = y_{t+2}/y_t = h_{t+2}/h_t = H\pi^{-\delta}pq^{s} \qquad (1.9)$$

Where g_{yws} shows the growth rate without stock market and g_{ysm} shows the growth rate with stock market. q, ϑ, π are the investment proportion, entrepreneur's share of output and the proportion of the individuals who want to consume their income in the first period. For simplicity $\rho = (1-\vartheta)\pi^{\vartheta}$ is assumed. Here, the growth rate of the economy with the stock market is higher than the one without stock market.

This model suggests that stock market promotes growth by facilitating the liquidity and productivity risks. As in many of the endogenous growth models, in this model, the steady-state per capita can grow, in case the agents make investment that leads high rates of human capital accumulation and technological progress. In addition to that, this model shows that the average amount of capital used in the production has positive effects on the human capital (Levine 1991, 1446).

2.1.4 Saint-Paul (1992)

In the study entitled 'Technological Choice, Financial Markets and Economic Development', Saint-Paul (1992) shows that financial markets lead the better division of labor in between financial markets and firms, which results in increasing specialization in production at a higher risk. The high risk is spreaded by the help of financial markets and the productivity growth promotes economic growth.

In the model, there are two cities. In each city there is a continuum of entrepreneurs endowed with one unit of capital and a continuum of entrepreneurs endowed with the technological knowledge (for the production).

Let ψ denote an index of technological flexibility. Less specialization in the production is shown by greater value of ψ. In the first village, if ψ is chosen as technology, $A(1-\psi)$ units of good one and $Af\psi$ units of good two are produced. f denotes an index of cost of flexibility and $f \prec 1$. If the second village chooses technology ψ, it can produce ψ units of good 1 and $A(1-\psi)$ units of good 2. Thus, first and second village have comparative advantage on first good and second good, respectively.

There are two periods in the model. In the first period entrepreneurs sell the goods to consumers, which are identical. In the second period, there is a taste shock and only either good one or good two are demanded (Saint-Paul, 1992).

This model follows the model in Romer (1988), which assumes that there is constant returns to capital. The production function can be written as:

$$Y = BK^{1-b}L^{b}$$

where $1-b$ and b denote the output elasticity of capital and labor. As B is defined as a linear function of the capital stock it can be written that, $B = CK^{b}$.

As in Diamond (1965), each generation lives two periods and endowed with one unit of labor in the first period. The utility function for each agent is as follows;

$$u(c_1, c_2) = c_1^{a} + \beta c_2^{a} \qquad (1.10)$$

$0 \prec a \prec 1$ and c_1 and c_2 are the consumptions in the period one and two. In the representative village, $Ak_t(1-\psi)$ units of comparatively advantaged good and $Ak_t f\psi$ units of the other good are produced.

The saving rates and average growth rates for the financial and non-financial equilibrium are found as below.

In the non-financial equilibrium, the saving rate is found as

$$s_{nf} = b/\left[1+(1-\psi)(\beta/2)^{1/a-1}(A(1-b))^{a/a-1}\right] \qquad (1.11)$$

and economy grows at an average rate of

$$g_{nf} = As_{nf}(1+(f-1)\psi)/2-1 \qquad (1.12)$$

In the financial equilibrium, the saving rate is found as

$$s_f = b/\left(1+\beta^{1/a-1}(A(1-b/2)^{a/a-1}\right)$$

and the economy grows at a rate of

$$g_f = As_f/2-1.$$

These findings indicate that the saving rate is higher in the existence of the financial markets which yields higher growth in the economy. This is because “in the absence of the financial market, agents can limit risks only by choosing less specialized and less productive technologies” (Saint-Paul, 1992, 763). This trade-off may cause multiple equilibria which allow some economies to be at low level and some economies to be at

high level equilibrium. At the low equilibrium, financial system is underdeveloped, division of labor is not well, technology is unspecialized and at the high equilibrium vice versa. Therefore, these findings can be used to explain the differences in the economic growth rates of the countries.

2.1.5 Pagano (1993)

In the study entitled 'Financial Markets and Growth: An Overview', Pagano (1993) uses AK model in order to analyze the effects of financial development on economic growth. Aggregate output is a linear function of the aggregate capital stock:

$$Y_t = AK_t \tag{1.13}$$

Pagano's model is a reduced form of Romer (1988)'s model where each firm faces constant returns to scale technology but productivity is an increasing function of aggregate capital stock (K_t). This model is also similar to Lucas (1988)'s model as K_t is the sum of physical and human capital and capital is reproducible with identical technologies (Pagano, 1993).

The population is constant and there is a single good that can either be consumed or invested. Capital depreciates per period by a fraction (δ) of it. Equation (1.14) shows the gross investment

$$I_t = K_{t+1} - (1-\delta)K_t \tag{1.14}$$

Capital market equilibrium requires that the gross savings (S_t) be equal to gross investments (I_t) but a fraction of savings is lost in the financial intermediation process:

$$\vartheta S_t = I_t \tag{1.15}$$

Using Equation (1.13), the growth rate of the economy at time t is equal to

$$g_{t+1} = Y_{t+1} / Y_t - 1 = K_{t+1} / K_t - 1 \tag{1.16}$$

The steady state growth rate can be written as:

$$g = A\frac{I}{Y} - \delta = A\vartheta s - \delta \tag{1.17}$$

where gross saving rate is denoted as s. Therefore, financial development can affect growth by increasing the fraction of saving transferred to investment (ϑ), social marginal productivity of capital (A) and private saving rate (s).

The first way to enhance economic growth rate is to increase the fraction of saving transferred to investment. In order to explain this, let us consider the fraction of the savings $(1-\vartheta)$ which goes to banks for the spread between borrowing and lending, commissions, fees etc. This fraction can be accepted as the leakages of resources. The better developed financial system reduces these leakages and hence makes the economic growth rate to increase.

Second source of higher growth rates in an economy is the social marginal productivity of the capital. Financial intermediaries gather information about the alternative investment projects, ensure risk sharing, direct individuals to more riskier investments but more productive technologies. All of these lead to an increase in the social marginal productivity of the capital, thus, in turn, higher economic growth rate (Pagano, 1993).

The last way of financial development's impact on growth is to change the saving rate. However, the direction of this impact in this channel is ambiguous. On the one hand, as capital markets develop, households have better insurance for the endowment shocks, better risk diversification in the rate of return, which increases savings. On the other hand, first if credits can be obtained quickly and cheaply by means of the development in capital markets, saving rates can diminish. Second, as capital markets develop, the range of the interest rate paid and received becomes narrow, which can decrease savings (Pagano, 1993).

2.1.6 Berthelemy and Varoudakis (1996)

In their study entitled 'Economic Growth, Convergence Clubs and the Role of Financial Development', Berthelemy and Varoudakis (1996) employ a theoretical model that shows the mutual externality between banking and real sectors.

Consumers holds only the financial intermediaries (V) whose real return is r (the real rate of interest). The representative consumer's objective function and budget constraint is given in Equation (1.18)

$$\max \mathrm{U}_0 = \int_0^{\infty} \frac{\mathrm{C}_t^{1-\sigma} - 1}{1-\sigma} \mathrm{e}^{-\rho t} \mathrm{dt} \tag{1.18}$$

$\dot{\mathrm{V}}_t = \mathrm{r}\mathrm{V}_t + \mathrm{w} - \mathrm{C}_t$ where ρ, w, σ and C denote time preference rate, the rate of real wage and consumption, respectively. The Keynes-Ramsey condition is obtained by solving the optimization problem in Equation (1.18):

$$\frac{\dot{\mathrm{C}}_t}{\mathrm{C}_t} = \frac{1}{\sigma}(\mathrm{r} - \rho) \tag{1.19}$$

Symmetrical firms use constant returns to scale technology with respect to physical capital (K) and efficient labor (E_u)[10] and their production function is assummed to be Cobb-Douglas type:

$$Y = AK^{\alpha}\left(E_u\right)^{1-\alpha} \tag{1.20}$$

In the model, investment can be only through the bank loans. The amount of investments that are intermediated by each bank j, represents a fraction (ϑ_j) of the current savings that it collects. How much of the savings will be a source of funds for the bank is a function of the employment level of the representative bank. Assuming v_j shows the employment level in the representative bank, $\vartheta_j = \vartheta_j\left(v_j\right)\left(\vartheta_j' \succ 0\right)$is assumed. Using the symmetry of the banks, $v_j = (1-u)/n$ in the steady state (Berthelemy and Varoudakis, 1996, 303-304).

At the individual bank level and aggregate level;

$$K_j = \vartheta_j S_j \rightarrow K = \vartheta S \tag{1.21}$$

where $S = Y - C$, the equation becomes;

$$\vartheta = \vartheta\left(\frac{1-u}{n}\right) \tag{1.22}$$

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[10] The efficiency of labor depends on the capital labor ratio in the real sector $E = \frac{K}{u}$.

where $\vartheta' \succ 0$. From the Equation (1.21) the financial intermediation technology implies that there is increasing returns to scale at the level of banks, with respect to savings S_j and employment v_j (Berthelemy and Varoudakis, 1996). This can be explained by learning by doing effects of the financial intermediations that affect productivity of labor in the banking sector.

By using capital accumulation equation $K = \vartheta S$, capital growth rate is equal to $g = \dot{K}/K = \vartheta S/K$. The labor market equilibrium is as follows;

$$g = (1-\alpha) A \frac{(1-\varepsilon)}{\varepsilon} \frac{(1-u)}{u} \vartheta \tag{1.23}$$

where $\sigma'/n = \varepsilon$ and ε denotes the elasticity of ϑ.

At the long-run equilibrium, u and n are constant for this reason $\dot{K}/K = \dot{Y}/Y = \dot{C}/C = g$. The endogenous variables are the growth rate (g), net return on savings (r), the financial intermediation margin (i), the allocation of the labor between real and financial sector (u) and the number of banks (n), and they are determined at steady state.

Rewriting the Keynes-Ramsey condition yields Equation (1.24).

$$g = \frac{1}{\sigma}\left[\alpha A (1-\varepsilon)\vartheta - \rho\right] \tag{1.24}$$

Berthelemy and Varoudakis (1996) find a two-equation system that determines the long-run steady-state growth rate (g) and $v = (1-u)/n$. ''In order to reach to the long run equilibrium with a positive growth rate, financial intermediation (size) must exceed a

certain threshold level which corresponds to an unstable equilibrium'' (Berthelemy and Varoudakis, 1996, 309).

This model shows that as real sector grows, financial market also enlarges and bank competition and the efficiency will increase. Development in the banking sector raises the return on savings, capital accumulation and growth (Berthelemy and Varoudakis, 1996). In this study, learning by doing externalities[11] in the real sector are assummed to be the source of the endogenous growth model.

2.1.7 Galetovic (1996)

In his study entitled 'Specialization, Intermediation and Growth', Galetovic (1996) develop a standard knowledge-driven growth model. The economy is similar to Romer (1990)'s model. There are three goods produced which are final output, a continuum of intermediate inputs and ideas. The factor of production is raw labor and used in the production of ideas and final output and hired in a competitive market. Time is continuous and the production is made by perfectly competitive firms. Their technology can be written as follows

$$Y_t = L_Y^{1-\alpha} \int_0^{A_t} x(i)^{\alpha} di \qquad (1.25)$$

where $L_Y, x(i)$ and A_t denote labor, i^{th} intermediate good and the measure of the intermediate goods available at time t, respectively. Intermediate goods are produced using idea and physical capital by a large number of infinitely-lived firms. Ideas are nonrival as in Romer (1990) and there is no depreciation in the physical capital. There is free entry to the market (Galetovic, 1996).

[11] "Learning by doing" can be defined as the experience and knowledge that the workers gain and the new skills that they learn from their work which yields an increase in productivity.

Research firms' output is stochastic; with $1-\alpha$ probability it produces nothing, with α probability it is successful and it produces $s^{\vartheta}A_t$ (where $\vartheta \in (0,1)$) of new ideas. They do not pay for knowledge A_t. Denoting L_A as the number of research firms, q as the fraction of the successful ideas, s denotes the degree of specialization, the growth of the stock of ideas can be written as;

$$\dot{A}_t = qs^{\vartheta}L_A A_t \tag{1.26}$$

In the model, the entrepreneurs and workers infinitely live. Their aim is to maximize the consumption given in the equation (1.27)

$$\int_t^{\infty} e^{-\rho(\tau-t)} \ln C_\tau d\tau \tag{1.27}$$

where ρ, C denote the subjective discount rate and consumption.

At the equilibrium, agents' intertemporal optimization condition can be written as

$$\frac{\dot{C}}{C} = r - \rho \tag{1.28}$$

where r is constant interest rate.

When the model is solved for a balanced growth equilibrium, growth rate is found as in Equation (1.29)

$$g = \frac{\alpha L s^{\vartheta} - R\rho}{(1+\alpha)R} \rightarrow \alpha L s^{\vartheta} - R\rho \succ 0 \tag{1.29}$$

otherwise $g = 0$. (where R shows the cost of short term working capital). Equation (1.29) indicates that economic "growth is driven by specialization, but large monitoring costs can halt it" (Galetovic, 1996, 556).

According to the model, when the firms get specialized, financial intermediaries endogenously arise as they eliminate the duplication of monitoring effort and make the monitoring cheaper. Without intermediaries, the monitoring effort increases as specialization increases and economic growth may not be sustainable due to the high monitoring costs. In sum, this model shows that for an economy to grow, specialization must increase and for the growth to be sustainable, financial intermediaries must arise. (Galetovic, 1996).

2.1.8 Greenwood and Smith (1997)

In the study published in 1997 entitled 'Financial Markets in Development and the Development of Financial Markets', Greenwood and Smith develop two models in order to investigate the role of financial markets in the allocation of the funds in the most effective way by using Diamond (1965)'s model and the role of markets in the specialization in the country. In the formation of the market, there is perfect competition among the provider of the market services and the equilibrium is Pareto optimal (Greenwood and Smith, 1997).

In the model individuals are assumed to live two periods. There is only a single consumption good. The production function is constant returns to scale, and for the production of the consumption good, intermediate inputs are used while to produce intermediate inputs, capital and labor are used. Labor is not traded and each young agent is endowed with one unit of labor. Capital depreciates fully in the production process. The technology for producing intermediate goods is given in Equation (1.30)

$$x_t(i) = Ak_t(i)l_t(i)^{1-\delta} \tag{1.30}$$

Where i, $x_t(i), l_t(i)$ and $k_t(i)$ denote each young agent, the quantity of the intermediate goods that young agent produces, labor and capital, respectively.

Let c_t show the final consumption goods at time t and k_{t+1} show the capital stock at time $t+1$. The production of k_{t+1} by using intermediate goods with regard to the technology is given in Euation (1.31):

$$c_t + (k_{t+1}/R) = \left[\int_0^1 x_t(i)^{\vartheta} di\right]^{1/\vartheta} \tag{1.31}$$

with $\vartheta \prec 1$. All young have identical preferences at time t. Suppose c_j denotes the consumption of an individual at age j, the utility function can be written as

$$u(c_{1t}, c_{2t}; \phi) = -\left[(1-\phi)c_{1t} + \phi c_{2t}\right]^{-\gamma/\gamma} \tag{1.32}$$

with $\gamma \succ -1$ and ϕ represent the individual specific preference shock whose probability distribution is as follows:

$\phi = 0 \rightarrow$ with probability $1-\pi$

$\phi = 1 \rightarrow$ with probability π

The growth rates under financial autarky, considering banking and equity markets are given as below respectively,

$$(1-\vartheta)\pi \mathrm{RAQ}^{a}(\mathrm{RAQ}) = \sigma^{a} \tag{1.33}$$

$$(1-\vartheta)\mathrm{RAQ}^{b}(\mathrm{RAQ}) = \sigma^{b} \tag{1.34}$$

$$(1-\vartheta)\mathrm{RA}\pi = \sigma^{e} \tag{1.35}$$

where RAQ denotes the return on capital and equal to $\mathrm{R}\rho_{t+1}$.

The results of the model indicate that the growth rate of an economy with banks is higher than the growth rate of the financial autarky case. Besides, in the existence of the relatively risk-aversed individuals, equity markets raise the growth rate relative to the presence of banks in the relatively risk-aversed individual case.

2.1.9 Blackburn and Hung (1998)

In their study 'A Theory of Growth, Financial Development and Trade', Blackburn and Hung (1998) express the joint determination of real and financial development. They define financial development as the emergence of a new financial institution. In the presence of asymmetric information, financial intermediaries monitore (ex-ante monitoring is assumed.) the risky investments. ''Firms require external finance for the research and development activities and the outcome of such activity is private information'' (Blackburn and Hung, 1998, 108). This private information causes moral hazard problem. This is solved using incentive-compatible loan contracts with fixed cost that includes the cost of monitoring and is formed in the model endogenously in the research and development process. Financial intermediation also reduces the cost of evaluation of the project. Despite these costs, financial intermediation appears in the model endogenously.

The basic growth model -the increasing product variety model- of Grossman and Helpman (1989) and Romer (1990) is used. In the model, the population growth is constant and agents are living infinitely. The final goods sector and the producer goods sector are the sectors that productive activity occurs. Except for intermediate goods market which operates in monopolistic competition, the markets are perfectly competitive.

The model predicts that the relationship between financial development and growth is mutual. Besides, the model shows that financial liberalization and trade liberalization affect the growth of the financial intermediation positively but only trade liberalization has a direct positive impact on economic growth. Therefore, this study proposes that for higher growth rate, countries take measures for removing the trade barriers. Furthermore, this study points out that the cross-country differences between countries is explained by the differences in the financial systems.

2.1.10 Khan (2001)

In the study entitled 'Financial Development and Economic Growth', Khan (2001) investigates the impact of the financial development on growth considering external finance. He develops a theory of financial development with costs stemming from the asymmetric information related to the external finance. "Over time, as increasing numbers of producers gain access to external finance, borrowers' net worth rises relative to debt" (Khan,2001,413). This causes a decrease in the cost of intermediation and increases the return of the investment.

The model indicates that the cost of external finance or equally financial contracting efficiency affects the economic growth rate. As new technology is adopted, financial intermediation increases over time endogenously. An increase in the external finance causes an increase in the financial development. Khan (2001) finds mutual relationship between finance and growth. Economic growth increases financial development by increasing borrower's net worth and financial development reduces the cost of the

financial contracts, raises the return on debt and investment, decreases the spread of borrowing and lending rates and thus increases economic growth.

2.1.11 Deidda (2006)

In the study entitled 'Interaction between Economic and Financial Development', Deidda (2016) analyzes the role of financial instruments on economic growth. Financial development occurs endogenously and takes place after exceeding a certain threshold economic development. It is assumed that the financial sector consumes the real resources.

The model consists of a continuum size of households and infinitely-lived firms. Population of the household has a simple overlapping generations with each generation living two periods. The financial intermediation is costly. Firm's production technology is more productive than households' by economies of scale and specialization.

The households with identical preferences have a utility function as in Equation (1.36)

$$U_t = \log c_{1,t} + \delta \log c_{2,t} \qquad (1.36)$$

where δ is a discount factor and $\delta \prec 1,$ and $c_{1,t}$ and $c_{2,t}$ show the consumptions in the first and second period.

The young households endowed with labor get real wage (w_t). A part of real wage is consumed and saved.

Production is made by both households and firms. Capital accumulation fully depreciates and it needs one period. The production function of households is as in the Equation (1.37):

$$Y_t = \psi B_t K_t^{\alpha} L_t^{1-\alpha} \tag{1.37}$$

where Y_t, K_t, L_t denote output, capital and labor. ψ, α are exogenous productivity parameters and $B_t = k_t^{1-\alpha}$ is a positive technology-specific effect $\left(k_t = \frac{K_t}{L_t} \right)$ (Deidda, 2006).

The firms' production function is as in Equation (1.38):

$$Y_t = \omega A_t K_t^{\beta} L_t^{1-\beta} \tag{1.38}$$

where $A_t = k_t^{1-\beta}$ and $\omega, \beta \succ 0$.

In the model it is assumed that firm's production technology is more productive than households' one and no matter of the value of the capital/labor ratio, the marginal returns to labor and capital are higher in the production of the firms' production technology. Accordingly, $\omega \succ \psi$, $\beta\omega \succ \alpha\psi$ and $(1-\beta)\omega \succ (1-\alpha)\psi$ should be hold.

In financial autarky, there is no financial transaction, which means that firms are not active. Households work and hire labor when they are young and make production when they are old. When they are young they save a fraction of their wages so that the capital-labor ratio at time $t+1$ is equal to;

$$k_{t+1} = s(1-\alpha)\psi B_t k_t^{\alpha} \tag{1.39}$$

When the private rate of return to capital and B_t is replaced, the growth rate of the financial autarky depends on the saving rates and exogenous productivity parameters. It can be written as in Equation (1.40):

$$g_{FA} = s\psi(1-\alpha)-1 \tag{1.40}$$

In the existence of the financial intermediation, production is made only by firms. Showing loan rate with R_t and assuming $R^L{}_t = \beta\omega k_t{}^{\beta-1}A_t$, a single firm's demand for the loans is as follows:

$$b_t = L_{t+1}\left(\frac{\beta\omega A_{t+1}}{R^L{}_{t+1}}\right)^{1/1-\beta} \tag{1.41}$$

Equation (1.42) shows the balance sheet of a representative bank which gives a proportion z_t of its loans:

$$D_t = z_t b_t + C(z_t)b_t + E \tag{1.42}$$

where D_t shows deposits, $z_t b_t$ loans, $C(z_t)b_t$ the variable part and E is the fixed part of the cost of lending (Deidda, 2006, 237).

After substituting the equilibrium values of deposits and loans into the last equation, Equation (1.43) is yielded,

$$H_s(1-\beta)\omega k_t = \left[n_t z_t + n_t C(z_t)\right]\frac{H}{f_t}k_{t+1} + n_t E \tag{1.43}$$

The last equation indicates that aggregate deposits must be equal to the sum of aggregate loans aggregate consumption of resources by n_t operating banks. H shows the number of the firms, $\frac{H}{f_t}$ gives the amount of labor per firm.

The equilibrium level of capital per unit of labor at time $t+1$ is

$$k_{t+1} = \frac{\left[s(1-\beta)\omega k_t - n_t E/H\right]}{1+AC(z_t)} \tag{1.44}$$

Equating the profit function to zero and substituting the equilibrium level of capital per unit of labor $n_t = \frac{H\left[(1-\beta)^2\right]\omega s}{E}$, the equilibrium growth rate of the economy with financial intermediaries is yielded as in Equation (1.45):

$$g_{FI} = \frac{(1-\beta)\omega\beta s}{1+AC(z_t)} - 1 \tag{1.45}$$

with $z_t = \min\left(z_m, \frac{H}{n_t}\right)$.

The growth rate is decreasing in z_t, as specialization decreases, variable costs of intermediation gets higher (Deidda, 2006).

According to the model, the effect of financial development on growth is definitely positive only when $\beta/\alpha \prec 1$. When $\beta/\alpha \succ 1$, the effect can be negative (if $1+AC(z_t) \succ \omega\beta/\psi$) or (if $1+AC(z_t) \prec \omega\beta/\psi$) positive.

In this study, Deidda (2016) develops a model in which the impact of costly endogenous financial development on growth is uncertain, financial development may not be sustainable and in the competitive economy, the equilibrium financial intermediation level may be inefficient. These findings are consistent with the literature suggesting that financial development cannot always foster growth, the effect of the financial

development on economic growth depends on the economic development level (Deidda, 2006).

2.1.12 Wu, Hou and Cheng (2010)

In the theorical and empirical study published in 1990, 'The Dynamic Impacts of Financial Institutions on Economic Growth: Evidence from the European Union', Wu, Hou and Cheng (2010) investigate the dynamic effects of the financial institutions – credit and equity markets- on growth by modifying Pagano (1993)'s model.

In the production of the output, there is constant returns to scale;

$$Y_t = AK_t \tag{1.46}$$

where Y_t, K_t andrespectively denote output, capital stock and social marginal productivity of capital. As in Lucas (1988), aggregate capital stock is composed of physical and human capital. There is a single good produced, it can be either invested or consumed. Gross investment (I_t) can be written as

$$I_t = K_{t+1} - (1-\delta)K_t \tag{1.47}$$

where δ denotes constant depreciation rate.

By considering Pecking Order Theory and Trade-off Theory, in this model investment is financed through funds from credit and equity markets. Two sources for the funds determine the gross investment using constant elasticity of substitution (CES) type function below (Wu, Hou and Cheng, 2010).

$$I_t = SF_t(FI_t, SM_t) = \left[\alpha FI_t^{\rho} + \beta SM_t^{\rho}\right]^{\frac{1}{\rho}} \tag{1.48}$$

where FI_t and SM_t show the funds obtained from financial instruments and stock markets, respectively. FI_t is assumed to be a constant fraction of saving S_t; $FI_t = \vartheta S_t$.

Replacing financial instrument and saving equation and rewriting equation (1.48) one obtains Equation (1.49):

$$I_t = \left[\alpha\left(\vartheta S_t\right)^{\rho} + \beta SM_t^{\rho}\right]^{\frac{1}{\rho}} \tag{1.49}$$

Therefore output growth can be defined as

$$g_{t+1} = A\frac{I_t}{Y_t} - \delta = A\frac{\left[\alpha\left(\vartheta S_t\right)^{\rho} + \beta SM_t^{\rho}\right]^{\frac{1}{\rho}}}{Y_t} - \delta \tag{1.50}$$

Thus, the steady state growth of output can be written as

$$g = A\left[\alpha\left(\vartheta s_1\right)^{\rho} + \beta\left(s_2\right)^{\rho}\right]^{\frac{1}{\rho}} - \delta \tag{1.51}$$

$s_1 = \frac{S}{Y}$ shows the steady state saving ratio and $s_2 = \frac{SM}{Y}$ shows the equity to output.

In sum, this model is different from the abovementioned models as it includes both stock markets and financial instruments into the model. Wu, Hou and Cheng (2010) take into consideration the effects of the stock market development while investigating

the relationship between financial development and growth. They find that both stock and credit market development affect economic growth.

2.2. NEOCLASSICAL GROWTH BASED MODELS INCLUDING FINANCE

In this subchapter, the Neoclassical growth based models that include financial variables are discussed briefly. To the best of our knowledge, Atje and Jovanovic (1993) were the pioneer to develop such a neoclassical growth model, but still there is a relatively small body of literature that incorporates financial development into a Neoclassical context. These models will be presented chronologically and may further be divided into two main classes according to the role that finance plays in the economic growth process. While in Atje and Jovanovic (1993), Cooray (2010), and Durusu-Çiftci, İspir and Yetkiner (2017) the allocative role of the financial system is considered, in Deidda and Fattouh (2002) the risk diversification role of financial markets is highlighted.

2.2.1 Atje and Jovanovic (1993)

In the study entitled 'Stock Markets and Development', Atje and Jovanovic (1993) investigate the effect of financial development on the level and growth rate of economic performance. While searching the growth effects[12], Greenwood and Jovanovic (1990)'s model, for the level effects[13] Mankiw, Romer and Weil's model (1992) (MRW) is followed. The model that investigates the level effect can be summarized as below.

In MRW, the production function is given in Equation (1.52):

$$Y = F_t^{\alpha} K_t^{\beta} H_t^{\gamma} \left(A_t L_t\right)^{1-\alpha-\beta-\gamma} \tag{1.52}$$

[12] Growth effect can be defined as a permanent increase in the growth rate of the level of output.
[13] A temporary increase in the growth rate is called level effect.

Population and technology grow endogenously with a rate of n and , respectively. Here F, K, H denote three forms of capital: Financial, physical and human capital. Let s_i show saving rate $(i = F, K, H)$ and δ show the common depreciation rate, following the logic used by MRW, the steady-state per capita GDP growth equals to Equation (1.53) (Atje and Jovanovic, 1993, 635):

$$\ln \frac{Y_t}{L_t} = \ln A_0 + gt - \left(\frac{\alpha + \beta + \gamma}{1 - \alpha - \beta - \gamma} \right) \ln (n + g + \delta) + \left(\frac{1}{1 - \alpha - \beta - \gamma} \right) [\alpha \ln s_F + \beta \ln s_K + \gamma \ln s_H] \quad (1.53)$$

They empricially test equation (1.53) for 40 countries through 1960-1985 and find that if stock market is used as financial indicator, finance affects economic growth significantly positive and if banking sector is used as financial indicator, finance does not have such a significant positive effect on growth.

2.2.2 Deidda and Fattouh (2002)

In the study "Non-linearity between finance and growth", Deidda and Fattouh (2002) present a simple OLG model in which the agents are risk averse and financial transactions are costly. In the model there are firms existing along infinite time of period and identical individuals living two periods. Individuals are endowed with a unit of labor in their first period (Deidda and Fattouh, 2002). The utility function can be written as in Equation (1.54)

$$U = c_{2,t}^{1-\rho} \quad (1.54)$$

where $c_{2,t}$ denotes the second period consumption and t shows the generation.

In the first period, young individuals supply their labor to the firms, get w_t and do not consume any of it, all of the salary is totally saved. One can save in two ways; deposits and self-financing of investment (I_t) in physical capital - $K_{t+1} = I_t$ -. The production function is assumed as in Equation (1.55)

$$y_t = x(\phi) K_t^{\alpha} L_t^{1-\alpha} A_t \tag{1.55}$$

where $x(\phi) \sim N(\phi, \sigma^2)$ and $A_t = K_t / L_t$.

Firms have access to similar production technology and the only difference is in the total productivity parameter which is assumed to be $x(\psi) \sim N(\psi, \sigma^2)$, with $\psi \succ \phi$ (Deidda and Fattouh, 2002).

If transaction costs are feasible, agents diverge the risks and savings will be canalized to more productive technology investments available for the firms and hence the efficiency increases.

In the model there is an assumption that transactions have a fixed cost denoted as E. The single intermediary can guarantee a safe return in deposits (Deidda and Fattouh, 2002, 340).

$$R^d_t = \alpha\psi - E\alpha\psi / w_t \tag{1.56}$$

where $w_t = (1-\alpha) y_t$.

The certain equivalent self-financed investment can be written as

$$R^{c^*} = \alpha\phi\left(1-\rho\alpha^2\sigma^2/2\right) = \alpha\phi\omega \tag{1.57}$$

where $\omega = \left(1-\rho\alpha^2\sigma^2/2\right)$.

If the deposits are in the form of $y_t \geq E\psi/\left[(1-\alpha)(\psi-\phi\omega)\right]$, agents will save. This indicates that the financial intermediation emerges at $y^* = E\psi/\left[(1-\alpha)(\psi-\phi\omega)\right]$.

The equilibrium growth rate in the existence of financial intermediation is

$$g_{FI} = (1-\alpha)\psi - E\psi/y_t - 1 \tag{1.58}$$

Equation (1.58) shows that g_{FI} is increasing in the level of income and in the transition period, y_t can take value in the range of y^* and $(1-\alpha)\phi\left(y^*-\varepsilon\right) \simeq (1-\alpha)\phi y^*$. For $y = y^*$, the equilibrium growth rate with financial intermediation becomes

$$g_{FI} = (1-\alpha)\phi\omega - 1 \tag{1.59}$$

The growth rate with financial autarky is $g_{FAT} = (1-\alpha)\phi - 1$. The results show that if intermediation occurs at y^*, its growth impact is negative. But if $y_t = (1-\alpha)\phi y^*$,

$$g_{FI} \geq g_{FAT} \leftrightarrow \frac{\psi}{\phi} - \omega \leq (1-\alpha)\left[\psi-\phi\right] \tag{1.60}$$

$$g_{FI} \prec g_{FAT} \leftrightarrow \frac{\psi}{\phi} - \omega \succ (1-\alpha)\left[\psi-\phi\right] \tag{1.61}$$

Suppose that equation (1.60) is satisfied. ‘‘The immediate growth effect of financial development will be still negative so as long as the level of income in the transition period is sufficiently close to y^* and positive otherwise” (Deidda and Fattouh, 2002, 341).

The model suggests that the risk averse agents may prefer the financial transaction costs and these costs decreases the returns to financial autarky as transactions allow risk diversifications. In this case there is a possibility of experiencing negative growth rates. But if the growth rate stays positive, the economy will reach to a steady-state growth rate which is greater than the growth rate in the financial autarky. Furthermore, this model shows that the growth effect of financial development is positive at high levels of development whereas it is uncertain at the low levels of development, which is different from the existing literature.

2.2.3 Cooray (2010)

In the study entitled ‘Do Stock Markets Lead to Economic Growth’, Cooray develop Mankiw, Romer and Weil (1992)’s (MRW) model by incorporating stock market variable into the model. Like Atje and Jovanovic (1993), this model examines the effect of stock market development on both the level and growth rate of the economy.

In the model, capital has two segments: Non-stock market capital and stock market capital. Stock market capital is considered as a separate variable in the production function. With these two features, this model differs from the model of Atje and Jovanovic (1993).

The production function can be defined as

$$Y_t = K_t^{\alpha} H_t^{\beta} S_t^{\gamma} \left(A_t L_t\right)^{1-\alpha-\beta-\gamma} \tag{1.62}$$

where Y, K, H, S, A, L denote output, capital, human capital, stock market indicator, the technology level and labor, respectively. Capital is composed of non-stock market capital (NS_t) and stock market capital (S_t) and can be written as;

$$K_t = (NS_t)^{\pi} (S^t)^{1-\pi} \tag{1.63}$$

where π and $1-\pi$ are the factor shares of non-stock market and stock market capital, respectively.

In the model, L_t and A_t grow exogenously at rates n and , respectively and capital depreciates at rate δ. As in Mankiw-Romer-Weil (1992)'s model, g and δ are assumed same accross the countries. Letting s_K, s_S and s_H represent gross investment in physical capital, gross investment in the stock market and gross investment in human capital, the steady-state level of per capita output in logarithmic form can be written as (Cooray, 2010, 451-452).

$$\ln\left[\frac{Y_t}{L_t}\right]^* = \ln A_0 + gt + \frac{\alpha}{1-\alpha-\beta-\gamma}\ln s_K + \frac{\beta}{1-\alpha-\beta-\gamma}\ln s_H + \frac{\gamma}{1-\alpha-\beta-\gamma}\ln s_S - \frac{\alpha+\beta+\gamma}{1-\alpha-\beta-\gamma}\ln(n+g+\delta) \tag{1.64}$$

MRW model assumes the technology growth rate as constant accross countries

$$\ln A_0 = a_0 + \mu \tag{1.65}$$

where a_0 and μ denote a constant and a country specific shock respectively.

By using the last assumption and equation (1.64) the model is estimated by using Equation (1.66)

$$\ln\left[\frac{Y_t}{L_t}\right] = a_0 + a_1 \ln s_K + a_2 \ln s_H + a_3 \ln s_S + a_4 \ln\left(n + g + \delta\right) + \mu \qquad (1.66)$$

The estimation of the model reveals that stock market development has an important role in the determination of the long-run growth. As in MRW, human capital is also found an important determinant of long-run growth. The model propose that policymakers increase the size, the liquidity and the activity of stock market in order to raise economic growth rate.

2.2.4 Durusu-Çiftci, İspir and Yetkiner (2017)

In order to investigate the long run growth effect of stock and credit market developments, Durusu-Çiftci, İspir and Yetkiner (2017) employ an augmented version of Solow (1956) - Swan (1956)'s growth model by considering financial markets as in Wu, Hou and Cheng (2010)'s model.

Trade-off theory is followed and it is assumed that investment is financed externally. The economy is closed and aggregate saving is comprised of credit and stock markets. Investment is financed with debt and equity by Cobb-Douglas type saving function (Durusu-Çiftci, İspir and Yetkiner, 2017).

$$\mathbf{S_t} = \mathbf{FI_t}^{\beta}\mathbf{SM_t}^{1-\beta} \qquad (1.67)$$

where $0 \prec \beta \prec 1$ and FI and SM are the sources of funds and denote credit markets/financial intermediation and stock markets, respectively. The production function at time t can be defined as in Equation (1.68):

$$Y_t = K_t^{\alpha} \left(A_t L_t\right)^{1-\alpha} \tag{1.68}$$

where α is the production elasticity of capital and $0 \prec \alpha \prec 1$. Y_t, K_t, A_t and L_t show output, physical capital, technological progress and labor force respectively.

Population growth and technological progress grow exogenously at a rate n and x $\left[\frac{L_{t+1}}{L_t} = 1+n, \frac{A_{t+1}}{A_t} = 1+x\right]$.

In Solow model an important equation is given in equation (1.69)

$$K_{t+1} - K_t = S_t - \delta K_t \tag{1.69}$$

where $K_{t+1} - K_t$ is the net investment at time $t+1$, S_t is gross saving and δ is the constant depreciation rate. Including financial markets, equation (1.69) becomes

$$K_{t+1} - K_t = FI^{\beta}{}_t SM_t^{1-\beta} - \delta K_t \tag{1.70}$$

Multiplying and dividing the first term in the right hand side in the equation by Y_t yields;

$$K_{t+1} - K_t = \left(\frac{FI_t}{Y_t}\right)^{\beta} \left(\frac{SM_t}{Y_t}\right)^{1-\beta} Y_t - \delta K_t \tag{1.71}$$

Rewriting the equation (1.71) by considering $FI_t/Y_t = sfi$, $SM_t/Y_t = ssm$, defining capital per efficient capital and output per efficient capita; $\tilde{k}_t \equiv K_t/A_t L_t$ and $\tilde{y}_t \equiv K_t/A_t L_t$ and transforming the steady state of output per effective capita into output per capita and taking natural logarithms of the sides of the equation gives the steady state output per capita (y_{ss}); (Durusu-Çiftci, İspir and Yetkiner, 2017, 294).

$$\ln(y_{ss}) = \ln(A_0) + (1+x)t + \left(\frac{\alpha\beta}{1-\alpha}\right)\ln(sfi) + \left(\frac{\alpha(1-\beta)}{1-\alpha}\right)\ln(ssm) - \left(\frac{\alpha}{1-\alpha}\right)\ln\left[n+\delta+(1+n)x\right] \tag{1.72}$$

In sum, this model shows that the credit and stock markets are the long-run determinants of GDP per capita.

This chapter reveals that finance positively affects growth of the economy (with the exception of Deidda (2006), who find that the effect is uncertain) and in some cases only after a certain threshold of development. In the theoretical literature, there is little doubt about the existence of the causal relationship between financial development and economic growth but considering the relationship in a linear context may have misleading results. Therefore, the following chapter gives the empirical studies that examine this relationship in a nonlinear modelling approach.

CHAPTER 3

EMPRICIAL LITERATURE OF THE NONLINEAR APPROACH TO THE FINANCIAL DEVELOPMENT-ECONOMIC GROWTH NEXUS

This chapter provides the empirical literature of the nonlinear approach to financial development-economic growth nexus. The first subchapter explains the studies using nonlinear techniques and separate financial development indicators. In the second subchapter, the studies that use linear techniques and but find nonlinear results are given. In the last part of the chapter, table 1 and 2 summarize all of the studies mentioned in this chapter.

3.1. STUDIES USING NONLINEAR TECHNIQUES

In this subchapter, the studies using nonlinear econometric techniques are given according to their state variable used.

Deidda and Fattouh (2002), Shen and Lee (2006), Huang and Lin (2009), Shen, Lee, Chen and Xie (2011), Chen, Wu and Wen (2013), Mbome (2016) use income as state variable. Also in addition to state variable income, Egert and Jawadi (2018) use financial development and stock market development and İbrahim (2007) use financial development and human capital levels.

Deidda and Fattouh (2002) present a simple model which investigates a non-linear and non-monotonic relationship between financial development and economic growth. They apply a threshold regression model using 119 countries of King and Levine's (1993) data set through 1960-1989. They find that while in the low income group there is no significant relationship between financial depth and growth, there is highly significant relationship in the high income countries.

Shen and Lee (2006) investigate this relationship over 48 countries for the 1976-2001 period both in linear and in nonlinear methods; linearity by using POLS and

nonlinearity by using the squares of the financial development variables. In the linear model, they find that only stock market development has positive effect on economic growth. When squares of the bank development variables are considered, the relationship between growth and bank development can be described as a weak inverse U- shape which becomes stronger combined with squared additional stock market variables. Thus, they find financial development and growth may be in a nonlinear form.

Huang and Lin (2009) investigate whether the finance growth relationship changes according to the different stages of economic development. By using the dataset of Levine, Loayza and Beck (2000) they estimate a novel threshold regression with the instrumental variables (IV) approach proposed by Caner and Hansen (2004) for 71 countries through 1960-1995. They find strong evidence that supports a non-linear, positive effect of financial development on economic growth in both high and low income countries. The positive effect is larger in the low-income countries in comparison to the high-income ones.

In order to show the nonlinear relationship between financial development and economic growth, Shen, Lee, Chen and Xie (2011) use OLS and the flexible nonlinear regression model of Hamilton (2001) and divide 46 countries according to their income levels as; 24 high-income, 16 middle-income, 6 low-income over the period 1976-2005. The effects of both banking and stock market development effects on growth are analyzed. They find that while banking sector development and economic growth relationship exhibits an inverted U-shape (positive relationship up to a threshold and after that level there is negative relationship), stock market development and economic growth relationship is positive-asymmetric √-shaped (negative weak relationship before a threshold level, but after passing the threshold level, relationship changes to positive).

Chen, Wu and Wen (2013) employ a panel data for 28 provinces of China over the period 1978-2010. They split the provinces into two according to their income as; low income and high income and investigate the effects of finance on the economic growth.

Their findings show that for high income provinces; the effect is positive and large, but for low income provinces; there is little evidence for the positive effect.

Mbome (2016) employs GMM and PSTR for a sample of 64 developed and developing countries over the period 1980-2010. The impact of financial development on economic growth changes for different economic and financial development levels. Financial development increases growth in the countries that are in the middle phase of industrialization. In high and low income, financial deepening decreases growth. He also finds two thresholds in the finance economic growth relationship. Financial development affects growth positive in the range of 48-84 % which showed that private credit in less developed and high developed is not promoting growth. He also finds that neither too much finance is bad for growth nor too little finance is.

Egert and Jawadi (2018) analyze the nonlinear relationship between economic growth and financial development for two different panels. The first panel includes 100 countries over the period mid 1990s-2012 and the other panel covers most of the OECD countries for over 30 years. For econometric analysis they use Hansen (1999)'s threshold regression and GMM. A certain threshold level beyond which financial development affects economic development negatively is not found but they find an evidence for a decline in the positive effect of finance on higher financial development levels. It is revealed that banking and stock market finance are complementary. In developed countries, the effect of finance is found to be stronger and the effect is weaker in countries with low trade openness.

İbrahim (2017) studies the finance and economic growth relationship by considering the initial levels of human capital, income per capita and financial development. He employs Hansen (1996, 2000) sample splitting and threshold estimation technique for 26 sub-Saharan Africa countries over 1980–2014. Nearly in all results, financial sector development effects economic growth positively, but below the threshold level, the effect is insignificant.

Huang and Lin (2007) use stock market capitalization as a state variable and they have employed the data set of Levine and Zervos (1998). They test Minier (2003)'s results by using the threshold regression approach of Hansen (1996, 2000) for 42 countries through 1976-1993. They find no evidence of dividing the sample into two discrete regimes as in Minier (2003). The countries are divided into two according to their stock market capitalizations; large and small stock markets. In small stock market countries, the effect of the financial development on the economic growth is negative but in large stock market countries, it is positive.

Law, Azman-Sanini and İbrahim (2013) is the only study that uses institutional quality as the state variable. They employ a data set of 85 countries over 1980-2008 in order to analyze if the financial development-economic growth nexus varies in different levels of institutional development by using Hansen (2000) threshold regression and Caner and Hansen (2004) instrumental variable threshold regression. They use three banking sector development indicators (% of GDP); private sector credit, liquid liabilities and commercial bank assets as financial development proxies. They find that the financial development-growth nexus is depending on institutions. After exceeding an institutional threshold level, financial development raises growth, the growth effect of financial development on economic growth is positive and significant but in the institutions that are below the threshold level, financial development has an insignificant effect on economic growth. Their results are consistent with the empirical work by Deidda and Fattouh (2002), Rioja and Valev (2004b), Shen and Lee (2006), Ergüngör (2008), Hung (2009) and Cecchetti and Kharroubi (2012).

Financial development is used as a state variable in the studies of Lee and Wang (2010), Law and Singh (2014), Samargandi, Fidrmuc and Ghosh (2015) and Ruiz (2018). Lee and Wang (2010) analyze the financial development economic growth relationship over 1950 to 2005 for 10 Asian countries by using threshold vector autoregressive (TVAR) model. They use financial development as a threshold and divided the sample into high and low financial development regimes. The results indicate that there is nonlinear relationship between these two variables in 8 countries and in the high financial development regime; financial development increases economic growth in many

countries, while in the lower regime its effect is not prevalent (no universal conclusion). Therefore, it is found that the effect of financial development on growth can change according to the backgrounds of the 10 countries.

Law and Singh (2014) show that finance-growth relationship is nonlinear by using Kremer, Bick and Nautz (2013) dynamic panel threshold method for 87 developed and developing countries through 1980-2010 period. The results show that finance has positive effect on economic growth up to the threshold which is found %88 and after that point it harms growth. This implies that finance and economic growth relationship is nonlinear or has an inverted U-shaped relationship. They also find that estimated threshold level is higher in developed countries.

Samargandi, Fidrmuc and Ghosh (2015) analyze the financial development economic growth relationship for 52 middle income countries (23 upper and 29 lower middle-income countries) by applying pooled mean group estimations in a dynamic heterogeneous panel setting for the period 1980-2008. They argue that in the long run financial development and economic growth have a significant inverted U-shaped relationship. But in the short run the relationship is not significant. With the help of this finding they claim that in middle income countries, too much finance can have a negative effect on growth. They also find that up to the threshold point an increase in finance increases growth but above the threshold level it diminishes growth.

Ruiz (2018) studies the nonlinear relationship between financial development and economic growth considering institutional investors for 116 economies for 1991–2014 using dynamic panel threshold technique. He finds that the countries that are below the finance threshold grow slower than the countries that are above the threshold those growing faster. Finance threshold is lower in the developing countries and although the effect of the finance on economic growth is positive and bigger for industrialized countries, for developing countries an exact result is not found.

Huang, Lin, Kim and Yeh (2010) use inflation as state variable and in the study of Jude (2010) inflation rate, government expenditure as a ratio of gross domestic product, degree of openness to trade and financial development are used as state variables.

Huang, Lin, Kim and Yeh (2010) employ Caner and Hansen (2004)'s IV threshold regression to the Levine et al. (2000)'s dataset for a large cross-section of 71 countries through 1960-1995. They find inflation thresholds 7.31 and 7.69% according to the conditional information sets used and below the threshold, the effect of the financial development on growth is significantly positive while, above the threshold this effect is insignificant.

Jude (2010) employs a data set of 71 developed and developing countries over 1960-2004 period and uses panel smooth transition regression in order to analyze the nonlinearities and several threshold variables in the finance-growth relationship. He finds that the relationship is nonlinear, and inflation rate, government expenditure ratio, degree of openness and financial development affects the relationship.

An error correction model and a nonlinear smooth transition error correction technique is employed by Chiou-Wei, Zhu and Wu (2010) for South Korea over the period 1970Q1-2004Q1. They examine that in the long run there is a bidirectional causal relationship between financial development and economic performance. They reveal that financial development has a positive effect on economic growth and nonlinear model is more accurate than the linear one. Also in the short run, this effect is not stable and may not be positive.

Using NARDL, Moyo, Khobai, Kolisi and Mbeki (2018) perform a study that investigated banking-stock market financial measures effect on economic growth for Brazil covering 1985-2015. They examine that financial development affect economic growth either positive or negative according to the proxies used. While the banking sector measures of financial development are affecting economic growth negatively, stock market development proxies are affecting positively.

3.2. STUDIES USING LINEAR TECHNIQUES

In this subchapter, the empiricial studies that are using linear techniques but finding nonlinear relationship are given. The studies are given chronologically beginning from the study of Berthelemy and Varoudakis (1996). They state that endogenous growth models are used in many studies investigating financial development and economic growth relationship and it is found that the factors that increases capital productivity may have an effect on the steady-state equilibrium growth rate. They build a model that consider a mutual effect between financial and real sector and found that there may be multiple steady-state equilibrium of endogenous growth. If multiple equilibria exist, the relationship between financial development and economic growth is nonlinear. They also employ Summers and Heston's cross country data base completed by Barro to analyze the relationship in Taiwan and Senegal by using OLS for years 1960-85. They find that wrong financial policies have an adverse effect on the growth.

Rousseau and Watchel (2002) investigate whether there is an inflation threshold in the finance-growth nexus by using a series of rolling panel regressions for 84 countries through 1960-1995. They find that when inflation is below the inflation threshold of 13-25%, financial depth has a positive effect on economic growth. When inflation is below a threshold of 6-8%, the effects are significantly positive.

Minier (2003) employ 42 countries of Levine and Zervos (1998)'s data over 1976-1993 and use regression tree analysis (semi-parametric analysis) to investigate the correlation between financial development and economic growth relationship and whether this relationship is affected by the financial and economic development levels. They find that correlation between growth and financial development are different across countries' development levels. In the countries that reach high market capitalization levels, financial development-growth relationship is positively correlated. For the countries that have low market capitalization levels, this relationship does not occur. This indicates that to experience the positive effect of financial development on growth, a country should reach a certain level of market capitalization.

Ergüngör (2008) examines the effects of the market-oriented and bank-oriented structures of the financial system on economic growth for 46 countries through 1980-1995 period. By using standard growth model and two stage least squares, he find that there is a nonlinear relationship between growth and financial structure and financial system structure matters for economic growth.

Rousseau and Yılmazkuday (2009) analyze the inflation-finance-growth relationship by a trilateral graphical approach for 84 countries through 1960-2004. Their results reveal that higher financial development levels with low inflation yields higher economic growth, but high inflation hinders the finance-growth nexus. At the middle range inflation levels (4-19%), the relationship is so strong that a little change in the inflation has a large effect on the relationship.

Yılmazkuday (2011) examines the nonlinearities in the finance - economic growth relationship for 84 countries over 1965-2004. Inflation, openness, optimal government size and per capita income are used as thresholds. The results show that; an inflation rate above 8% removes the positive effect of finance on growth, for high (low) income countries large (small) government size damage finance-growth relationship, for moderate levels of per capita income, catch up effects via finance-growth relationship are higher and optimal trade openness is found to be below 35% for high income countries and above 75% of low income countries means low income countries need higher levels of openness.

Arcand, Berkes and Panizza (2012) employs semi-parametric estimations, OLS and system GMM in panel and cross-sectional data for more than 100 countries through 1960-2010 and shows that in the countries with small and intermediate financial sectors there is a positive and robust correlation between financial depth and economic growth. However they examine a threshold calculated as 80-100% of GDP and above this threshold, finance affect economic growth negatively. This means that there is non-monotonic relationship between economic growth and the size of the financial sector and this is consistent with the vanishing effect of finance findings.

By using data sets of Durlauf et al. (2008) and Beck, Demirgüç-Kunt and Levine (2000) and kernel methods that allows nonlinearities and endogenous regressors Henderson, Papageorgiou and Parmeter (2013) indicates that for 101 middle and high income countries through 1960-2000, the positive effect of financial development on economic growth is significant and positive and increases over time. But for low income countries this effect does not exist or exists barely. The relationship between the two variables is highly nonlinear in more developed countries.

By using dynamic panel regressions for 132 countries covering 1980-2005, Beck, Georgiadis and Straub (2014) examines that there is a threshold in the financial development and economic growth that changes according to the controlled variables of the country. Although the structural characteristics are controlled, finance affect economic growth positively up to the threshold level and beyond this level the effect disappears. They investigate the reason of the non-linear relationship and find that nonlinearity result from the omitted factors in the literature. They also find that the omitted factors may have a negative effect on growth in developed financial systems.

Sahay, Čihák, N'Diaye and Barajas (2015) investigate the financial development-economic growth nexus for 128 countries over 1980-2013 by using dynamic GMM. They find that, financial development increases growth in high and low levels of financial development. As in Arcand et al. (2012), at higher levels of development, this positive effect ultimately becomes negative.

Adeniyi, Oyinlola Omisakin and Egwaikhide (2015) study the financial development economic growth relationship for Nigeria for the period 1960-2010. They especially investigate the nonlinearities in the relationship and find that financial development affects growth negatively before thresholds are introduced. The effect becomes positive after the consideration of the squared terms. They also add that financial development has a little effect on economic growth primarily.

Breitenlechner, Gachter and Sindermann (2015) worry about the relationship between finance and economic growth in the crisis times and employed a dynamic panel and

system GMM estimation for 74 countries for the 1960-2011 period. They find that in the non-crisis times, the relationship is nonlinear (inverse U-shape) and positive long run relationship exists whereas in crisis times the effect becomes negative.

Seven and Yetkiner (2016) analyze the financial development economic growth relationship by using system GMM for 146 countries over 1991–2011 period. Their results show that in low and middle income countries, the effect of banking sector development on growth is positive while in high income countries it is negative. Stock market development effect on economic growth is different from the banking sector development results and the relationship is positive in middle and high income countries.

da Silva, Tabak, Cajueiro and Fazio (2017) employ cross sectional and panel data sets in order to analyze the financial depth and the relationship between economic growth and its volatility by using OLS, IV, POLS, FE, dynamic panel Arellano-Bond estimator for 52 countries over 1980–2011. As financial depth increases, growth volatility increases more than the average growth. While financial depth continues to increase in the middle run, after passing a certain threshold level, finance effects growth negatively and increases volatility. But it may increase relatively long-term growth before the long-term threshold is reached.

Prochniak and Wasiak (2017) analyze both theoretical and empirical relationship between financial system-economic growth nexus. They used Blundell and Bond's (1998) GMM system estimator for 62 (28 EU, 34 OECD) countries over 1993-2013 period. They find that using some financial proxies yield positive and nonlinear relationship with economic growth but after some level is achieved, the relationship becomes negative and financial development affects economic growth negatively.

Ehigiamusoe, Lean and Lee (2018) investigate the impact of inflation on finance – growth nexus for 18 West African countries over the period 1980-2014. By using dynamic fixed effect, mean group estimator, pooled mean group estimator, dynamic IV, 2SLS, SUR, they find an inflation threshold of 5,62 %. Beyond the threshold, the effect

of finance on economic growth is negative. The results also reveal that, an increase in financial development and a decrease in inflation have bigger advantages than a simultaneous increase in both of them in West Africa region.

Table 1 and 2 chronologically indicate a brief summary of the studies mentioned in this chapter.

Following the literature given in this chapter, this thesis utilizes the market capitalization of listed domestic companies (percentage of GDP) as an indicator for financial development which in fact shows the stock market development. Trade openness, inflation, economic growth rate, investment and institutional quality are used as candidate state variables. These variables are all widely used in the abovementioned literature.

Table 1. Studies using nonlinear techniques

Study	Sample Countries	Sample period	Methods	Findings
Deidda and Fattouh (2002)	119 countries	1960-1989 Cross-sections	threshold regression model, The sample is divided as; high and low income countries	There is nonlinear relationship between finance and economic growth. In high income countries finance is significant determinant for growth but in low income countries it is insignificant.
Shen and Lee (2006)	48 countries	1976-2001	linearity by using Pooled Ordinary Least Squares (POLS) and nonlinearity by using the squares of the financial development variables (sample is divided as; high, middle and low income)	In the linear model, they find that only stock market development has positive effect on economic growth. When squares of the bank development variables are considered, the relationship between growth and bank development can be described as a weak inverse U- shape which becomes stronger combined with squared additional stock market variables. Thus, they find financial development and growth may be in a nonlinear form.
Huang and Lin (2007)	42 countries	1976-1993	the threshold regression approach of Hansen (1996, 2000)	The countries are divided into two according to their stock market capitalizations; large and small stock markets. In small stock market countries, the effect of the financial development on the economic growth is negative but in large stock market countries, it is positive.

Huang and Lin (2009)	71 countries	1960-1995 (average) Cross-sections	Caner and Hansen (2004) Instrumental Variable Threshold Regression The sample is divided as; high, low income countries	They find strong evidence that supports a non-linear, positive effect of financial development on economic growth in both high and low income countries. The positive effect is larger in the low-income countries in comparison to the high-income ones.
Chiou-Wei, Zhu and Wu (2010)	South Korea	1970Q1-2004Q1	Error correction model and a nonlinear smooth transition error correction technique.	They examine that in the long run there is a bidirectional causal relationship between financial development and economic performance. They reveal that financial development has a positive effect on economic growth and nonlinear model is more accurate than the linear one. Also in the short run, this effect is not stable and may not be positive.
Lee and Wang (2010)	10 Asian countries	1950-2005	threshold vector autoregressive (TVAR) model	There is nonlinear relationship between these two variables in 8 countries and in the high financial development regime; financial development increases economic growth in many countries, while in the lower regime its effect is not prevalent. (no universal conclusion). Therefore, it is found that the effect of financial development on growth can change according to the backgrounds of the 10 countries.
Jude (2010)	71 countries (developed and developing)	1960-2004	PSTR	He finds that the relationship is nonlinear, and inflation rate, government expenditure ratio, degree of openness and financial development affects the relationship.

Huang, Lin, Kim and Yeh (2010)	71 countries	1960-1995	Caner and Hansen (2004)'s IV threshold regression	They find inflation thresholds 7.31 and 7.69% according to the conditional information sets used and below the threshold, the effect of the financial development on growth is significantly positive while, above the threshold this effect is insignificant.
Shen, Lee, Chen and Xie (2011)	46 countries 24 high-income, 16 middle-income, 6 low-income	1976-2005 (panel data, 5 year averaged)	OLS, the flexible nonlinear regression model of Hamilton (2001)	While banking sector development and economic growth relationship exhibits an inverted U-shape (positive relationship up to a threshold and after that level there is negative relationship), stock market development and economic growth relationship is positive-asymmetric √-shaped (negative weak relationship before a threshold level, but after passing the threshold level, relationship changes to positive).
Chen, Wu and Wen (2013)	China's 28 provinces	1978- 2010 Panel data	Hansen's (1999) threshold regression model (sample is divided into 4; poor, low, middle, high income)	Their findings show that for high income provinces; the effect is positive and large, but for low income provinces; there is little evidence for the positive effect.
Law, Azman-Sanini and Ibrahim (2013)	85 countries	1980-2008	Hansen (2000) threshold regression and Caner and Hansen (2004) instrumental variable threshold regression	They find that the financial development-growth nexus is depending on institutions. After exceeding an institutional threshold level, financial development raises growth, the growth effect of financial development on economic growth is positive and significant but in the institutions that are below the threshold level, financial development has an insignificant effect on economic growth.

Law and Singh (2014)	87 developed and developing countries	1980-2010 (averaged over 5 year periods) Panel data	Kremer et al. (2013) dynamic panel threshold method -	The results show that finance has positive effect on economic growth up to the threshold which is found %88 and after that point it harms growth. This implies that finance and economic growth relationship is nonlinear or have an inverted U-shaped relationship. They also find that estimated threshold level is higher in developed countries.
Samargandi, Fidrmuc and Ghosh (2015)	52 middle income countries (23 upper and 29 lower middle-income countries)	1980-2008	pooled mean group estimations in a dynamic heterogeneous panel setting. Bick (2010) and Kremer et al. (2013) proposed a dynamic panel threshold estimator	In the long run financial development and economic growth have a significant inverted U-shaped relationship. But in the short run the relationship is not significant. With the help of this finding they claim that in middle income countries, too much finance can have a negative effect on growth. They also find that up to the threshold point an increase in finance increases growth but above the threshold level it diminishes growth.
Mbome (2016)	64 developed and developing countries	1980-2010	GMM, PSTR	Financial development increases growth in the countries that are in the middle phase of industrialization. In high and low income, financial deepening decreases growth. He also finds two thresholds in the finance economic growth relationship. Financial development affects growth positive in the range of 48-84 %.
Ibrahim (2017)	29 Sub-Saharan Africa countries	1980-2014 (cross-country data)	Hansen (1996, 2000) sample splitting and threshold estimation technique.	Nearly in all results, financial sector development effects economic growth positively, but below the threshold level, the effect is insignificant.

Ruiz (2018)	116 economies	1991-2014 (3 year average annual)	Dynamic panel threshold technique, Kremer et al. (2013)	He finds that the countries that are below the finance threshold grow slower than the countries that are above the threshold those growing faster. Finance threshold is lower in the developing countries and although the effect of the finance on economic growth is positive and bigger for industrialized countries, for developing countries an exact result is not found.
Moyo, Khobai, Kolisi and Mbeki (2018)	Brazil	1985-2015	NARDL	They examine that financial development affect economic growth either positive or negative according to the proxies used. While the banking sector measures of financial development are affecting economic growth negatively, stock market development proxies are affecting positively.
Egert and Jawadi (2018)	100 countries (developing, emerging and advanced) & most of the OECD countries	Mid 1990s-2012 & over 30 years	Hansen (1999) threshold regression, GMM	A certain threshold level beyond which financial development affects economic development negatively is not found but they find an evidence for a decline in the positive effect of finance on higher financial development levels. It is revealed that banking and stock market finance are complementary. In developed countries, the effect of finance is found to be stronger and the effect is weaker in countries with low trade openness.

Table 2. Studies using linear techniques and finding nonlinear relationship

Study	Sample Countries	Sample period	Methods	Findings
Berthelemy and Varoudakis (1996)	Taiwan and Senegal	1960-1985	OLS, BETA convergence	They build a model that considers a mutual effect between financial and real sector and find that there may be multiple steady-state equilibrium of endogenous growth. If multiple equilibria exist, the relationship between financial development and economic growth is nonlinear. And also the wrong financial policies have an adverse effect on the growth.
Rousseau and Watchel (2002)	84 countries	1960-1995	a series of rolling panel regressions	They find that when inflation is below the inflation threshold of 13-25%, financial depth has a positive effect on economic growth. When inflation is below a threshold of 6-8%, the effects are significantly positive.
Minier (2003)	42 countries (11 low capitalization, 31 high capitalization)	1976-1993	regression tree analysis (semi-parametric analysis)	They find that correlation between growth and financial development are different across countries' development levels. In the countries that reached high market capitalization levels, financial development-growth relationship is positively correlated. For the countries that have low market capitalization levels, this relationship does not occur. This indicates that to experience the positive effect of financial development on growth, a country should reach a certain level of market capitalization.
Ergüngör (2008)	46 countries	1980-1995 (average) Cross-country sections	standard growth model, Two stage Least Squares with heteroscedasticity-consistent standard	He finds that there is a nonlinear relationship between growth and financial structure and financial system structure matters for economic growth.

			errors	
Rousseau and Yılmazkuday (2009)	84 countries	1960-2004	a trilateral graphical approach	The results reveal that higher financial development levels with low inflation yields higher economic growth, but high inflation hinders the finance-growth nexus. At the middle range inflation levels (4-19%), the relationship is so strong that a little change in the inflation has a large effect on the relationship.
Yılmazkuday (2011)	84 countries	1965-2004	two-stage least squares regressions	The results show that; an inflation rate above 8% removes the positive effect of finance on growth, for high (low) income countries large (small) government size damage finance-growth relationship, for moderate levels of per capita income, catch up effects via finance-growth relationship are higher and optimal trade openness is found to be below 35% for high income countries and above 75% of low income countries means low income countries need higher levels of openness.
Arcand, Berkes and Panizza (2012)	More than 100 countries	1960-2010 Panel data and Cross-sections (subsamples)	Semi-parametric estimations, OLS, system GMM	In the countries with small and intermediate financial sectors there is a positive and robust correlation between financial depth and economic growth. However, they examine a threshold calculated as 80-100% of GDP and above this threshold, finance affect economic growth negatively.
Henderson, Papageorgiou and Parmeter (2013)	101 countries	1960-2000(5 year non overlapping)	Nonparametric kernel regression, (OLS, local-linear least-squares (LLLS)	They indicate that for 101 middle and high income countries through 1960-2000, the positive effect of financial development on economic growth is significant and positive and increases over time. But for low income countries this

			estimator.)	effect does not exist or exists barely. The relationship between the two variables is highly nonlinear in more developed countries.
Beck, Georgiadis and Straub (2014)	132 countries	1980-2005	dynamic panel regressions , system GMM	Although the structural characteristics are controlled, finance affect economic growth positively up to the threshold level and beyond this level the effect disappears. They also investigate the reason of the non-linear relationship and found that nonlinearity result from the omitted factors in the literature. The omitted factors may have a negative effect on growth in developed financial systems.
Sahay et al. (2015)	128 countries	1980-2013	Dynamic GMM	They find that, financial development increases growth in high and low levels of financial development. As in Arcand et al. (2012), at higher levels of development, this positive effect ultimately becomes negative.
Adeniyi, Oyinlola Omisakin and Egwaikhide (2015)	Nigeria	1960-2010	Cointegration, ARDL	They find that financial development affects growth negatively before thresholds are introduced. The effect becomes positive after the consideration of the squared terms. They also add that financial development has a little effect on economic growth primarily.
Breitenlechner, Gachter and Sindermann (2015) crisis	74 countries	1960-2011(5 years average) panel data	Pooled IV and dynamic panel-system GMM.	They find that in the non-crisis times, the relationship is nonlinear (inverse U-shape) and positive long run relationship exists whereas in crisis times the effect becomes negative.
Seven and Yetkiner (2016)	146 countries (45 high-income, 77 middle-income	1991-2011	System GMM	Their results show that in low and middle income countries, the effect of banking sector development on growth is positive while in high income countries it is negative. Stock market development effect on economic growth is different from the banking sector development results. The relationship is positive

	countries, 24 low-income countries)			in middle and high income countries.
da Silva, Tabak, Cajueiro and Fazio (2017)	52 countries	1980-2011 (panel data and cross-sections) (5 year non overlapping intervals)	OLS-IV, pooled OLS (POLS), a fixed effects specification (FE), and the dynamic panel Arellano-Bond estimator (AB)	As financial depth increases, growth volatility increases more than the average growth. While financial depth continues to increase in the middle run, after passing a certain threshold level, finance effects growth negatively and increases volatility. But it may increase relatively long-term growth before the long-term threshold is reached.
Prochniak and Wasiak (2017)	62 countries (28 EU, 34 OECD countries)	1993-2013 (5 year averaged)	Blundell and Bond'(1998)s GMM system estimator	They find that using some financial proxies yield positive and nonlinear relationship with economic growth but after some level is achieved, the relationship becomes negative and financial development affects economic growth negatively.
Ehigiamusoe, Lean and Lee (2018)	16 West African countries	1980-2014	Dynamic fixed effect, mean group, pooled mean group estimators, dynamic IV, 2SLS, SUR.	They find an inflation threshold of 5,62 %. Beyond the threshold, the effect of finance on economic growth is negative. The results also reveal that, an increase in financial development and a decrease in inflation have bigger advantages than a simultaneous increase in both of them in West Africa region.

CHAPTER 4

ECONOMETRIC METHODOLOGY AND EMPRICAL RESULTS

This chapter includes three subchapters. In the first subchapter the econometric methodology is defined, in the second subchapter, the data is given and finally in the last subchapter the empirical results are expressed and discussed.

4.1 METHODOLOGY

The threshold autoregressive (TAR) model was developed by Tong (1978). Hansen (1999) extended this model to panel data and introduced Panel Threshold Regression model (PTR). In this thesis, PTR model of Hansen (1999) is used for the empirical analysis.

The observed data are taken as $\{y_{it}, q_{it}, x_{it}\}$ where i indicates individuals and t indicates the time. y_{it} and q_{it} denote the dependent and state variable, respectively and they are both vectors (as a variable a scalar vector). x_{it} is the explanatory variables and it is taken as data matrix (as a variable it can be denoted as a vector). The PTR model can be written as follows:

$$y_{it} = \beta_i + \alpha_1' x_{it} I(q_{it} \leq \gamma) + \alpha_2' x_{it} I(q_{it} \succ \gamma) + \varepsilon_{it} \tag{4.1}$$

where $I(\cdot)$ denotes the indicator function. The PTR model can also be represented as a two separate equation where the variance of both equations are different then each other as follows:

$$\begin{aligned} y_{it} &= \beta_i + \alpha_1' x_{it} I(q_{it} \leq \gamma) + \varepsilon_{it} \rightarrow \text{if } q_{it} \leq \gamma \\ y_{it} &= \beta_i + \alpha_2' x_{it} I(q_{it} \succ \gamma) + \varepsilon_{it} \rightarrow \text{ if } q_{it} \succ \gamma \end{aligned} \tag{4.2}$$

A more compact representation is as follows:

$$x_{it}(\gamma) = x_{it} I(q_{it} \le \gamma)$$
$$x_{it}(\gamma) = x_{it} I(q_{it} \succ \gamma) \tag{4.3}$$

$\alpha = \left(\alpha_1' \alpha_2'\right)'$ so that equation (4.1) can be rewritten as

$$y_{it} = \beta_i + \alpha' x_{it} I(\gamma) + \varepsilon_{it} \tag{4.4}$$

The data can be divided into two regimes depending on the relationship between the threshold variable and threshold value ($q_{it} \le \gamma$ or $q_{it} \succ \gamma$). The regimes are determined by different α_1 and α_2. x_{it} and q_{it} are time variant and the state of the model is determined by state variable q_{it}. The error term ε_{it} is assumed to be independent and identically distributed with zero mean and finite variance σ^2.

Taking averages of equation (4.4) over t yields,

$$\bar{y}_i = \beta_i + \alpha' \bar{x}_i(\gamma) + \bar{\varepsilon}_i \tag{4.5}$$

Where

$$\bar{y}_i = T^{-1} \sum_{t=1}^{T} y_{it}$$

$$\bar{e}_i = T^{-1} \sum_{t=1}^{T} e_{it} \tag{4.6}$$

$$\bar{x}_i(\gamma) = T^{-1} \sum_{t=1}^{T} x_{it}(\gamma)$$

Equation (4.5) can be divided as

$$\bar{x}_i(\gamma) = T^{-1}\sum_{t=1}^{T} x_{it} I(q_{it} \le \gamma)$$
$$\bar{x}_i(\gamma) = T^{-1}\sum_{t=1}^{T} x_{it} I(q_{it} \succ \gamma) \qquad (4.7)$$

Taking difference of the equation (4.4) and (4.5) yields,

$$y^*_{it} = \alpha' x^*_{it}(\gamma) + \varepsilon^*_{it} \qquad (4.8)$$

where $y^*_{it} = y_{it} - \bar{y}_i$, $x^*_{it}(\gamma) = x_{it}(\gamma) - \bar{x}_i(\gamma)$ and $e^*_{it} = e_{it} - \bar{e}_i$.

Let

$$y^*_i = \begin{bmatrix} y^*_{i2} \\ \vdots \\ y^*_{iT} \end{bmatrix}$$
$$x^*_i(\gamma) = \begin{bmatrix} x^*_{i2}(\gamma)' \\ \vdots \\ x^*_{iT}(\gamma)' \end{bmatrix} \qquad (4.9)$$
$$e^*_i = \begin{bmatrix} e^*_{i2} \\ \vdots \\ e^*_{iT} \end{bmatrix}$$

$y^*_i, x^*_i(\gamma), e^*_i$ denote the dependent, independent and error data for an individual entity in the panel sample. If all panel members are denoted by using $Y^*, X^*(\gamma), e^*$ equation (4.8) will become as follows:

$$Y^* = X^*(\gamma)\alpha + \varepsilon^* \qquad (4.10)$$

For any threshold value, the slope coefficients α can be estimated by OLS.

$$\hat{\alpha}(\gamma) = (X^*(\gamma)'X^*(\gamma))^{-1}X^*(\gamma)'Y^* \tag{4.11}$$

The vector of regression residuals is as follows;

$$\hat{e}^*(\gamma) = Y^* - X^*(\gamma)\hat{\alpha}(\gamma) \tag{4.12}$$

And the sum of squared errors can be written as

$$S_1(\gamma) = \hat{e}^*(\gamma)'\hat{e}^*(\gamma) = Y^{*\prime}(I - X^*(\gamma)'(X^*(\gamma)'X^*(\gamma))^{-1}X^*(\gamma)')Y^* \tag{4.13}$$

Chan (1993) and Hansen (1997) recommended estimation of threshold value $_{(\gamma)}$ by least-squares. Supposing $\hat{\gamma}$ is the value that minimizes the $S_1(\gamma)$, $\hat{\gamma}$ is defined as,

$$\hat{\gamma} = \arg\min_{\gamma} S_1(\gamma) \tag{4.14}$$

Threshold variable $\hat{\gamma}$ should not be selected from too few observations in order to prevent this issue, the search in equation (4.14) is employed by skipping (1%,5%) percent of data in each end of the distribution instead of traditional %15. Moreover, for a better search of threshold, the grid search employed as 0.1 increments which enhances the finding better threshold value that minimizes SSR. Hence the grid search has been started, first %1 then %5 and finally 10% and end up at 99%, 95% and 90% of the distribution and thus the adequate number of observations take place in each regime is guaranteed.

Once $\hat{\gamma}$ is estimated, the slope coefficient, the residual vector and the residual variance is equal to $\hat{\alpha} = \hat{\alpha}(\hat{\gamma})$, $\hat{e}^* = \hat{e}^*(\hat{\gamma})$ and $\hat{\sigma}^2 = \frac{1}{n(T-1)}\hat{e}^{*\prime}\hat{e}^* = \frac{1}{n(T-1)}S_1(\hat{\gamma})$ respectively.

PTR models allow for the cross section variations and time changes in the variables and in the model threshold levels are determined endogenously. In PTR models, the regime switching takes place sharply. Therefore, this type of modelling is more appropriate for financial data as the behaviour of financial sector is sudden, not gradual. On the other hand, there is also another modelling of the nonlinear behaviour in econometrics literature namely Panel Smooth Transtion Regression (PSTR). PSTR modelling considers the smooth transition from one regime to other regime which is more general modelling with respect to PTR modelling. In other words, Panel Smooth Transition (PSTR) Modelling nests PTR model. As it is mentioned above PTR modelling is more suitable for the financial variables due to the fact that the transition speed is high. On the other hand, by using PTR model less number of nonlinear parameters are estimated, hence the degrees of freedom is increasing. Besides, the PTR model is not faced with the convergence problem and the initial condition problem like the PSTR model. Therefore, this study is free of these problems and more flexible estimating numerous models in this line. However, still the PSTR modelling for the identification phase for finding more suitable threshold variable is used. Linearity test of PSTR models are used in order to determine the number of regimes and find the most reliable state variable (Strikholm and Terasvirta (2005)). They have determined the number of regimes in a TAR model using Smooth Transition Autoregressions for time series framework. Now, this identification process in panel data analysis following Arin, Omay and Ulubaşoğlu (2015) is used. Considering the simpliest case of PSTR[14] model with two regimes;

$$y_{it} = \mu_i + \phi_0' x_{it} + \phi_1' x_{it} G(s_{it}; \gamma, c) + u_{it} \qquad (4.15)$$

[14] STAR model can be interpreted in two ways. i) STAR model can be thought as a regime-switching model that allows for two regimes with the extreme values of $G(s_t;\gamma,c)$ function ($G(s_t;\gamma,c)=0$ and $G(s_t;\gamma,c)=1$) (van Dijk, 1999: 8). ii) STAR model may allow continuum regimes with different $G(s_t;\gamma,c)$ between 0 and 1.

where i=1,…..,N and t=1,…,T, where N and T respectively denotes cross section and time dimensions of the panel. $G(s_{it};\gamma,c)$ is a continuous transition function bounded between [0-1]. c,γ and s_{it} denote threshold, slope and state variable, respectively.

PSTR models contain unidentified nuissance parameters, therefore, direct testing of nonlinearity is not possible. For testing the nonlinearity, linearity (homogeneity) tests are necessary. In order to handle this problem, transition function is replaced with its third order Taylor approximation around $\gamma = 0$ following Luukkonen, Saikkonen and Terasvirta (1988). Then the auxiliary regression is as follows:

$$y_{it} = \mu_i + \phi_0'^{*} x_{it} + \phi_1'^{*} x_{it} s_{it} + ... + \phi_1'^{*} x_{it} s^{m}{}_{it} + u^{*}{}_{it} \qquad (4.16)$$

where $\alpha_1'^{*},.....,\alpha_m'^{*}$ are the parameter vectors. Testing $H_0 : \gamma = 0$ in equation (4.15) gives the same result of testing $H^{*}{}_0 : \phi^{*}{}_1 = ... = \phi^{*}{}_m = 0$ in equation (4.16). This test can be done by using LM test. By denoting the panel sum of squared residuals of the two-regime PSTR model in H_1 as SSR_0, F-Statistic will be:

$$LM_F = \frac{\left(SSR_0 - SSR_1\right) \big/ mk}{SSR_0 \big/ (TN - N - m(k+1))} \qquad (4.17)$$

with an approximate distribution of F(mk, T N − N − k − mk). The candidate transition variables are determined by the p-values of the LM test which the smallest one is indication of the appropriate transition variable. Once the transition variable is determined, it is used in the estimation of PTR model. Thus, a selection of state variable in to Hansen (1999) PTR methodology following AOU (2015) is included. In the next subchapter the data is explained and the estimation results of the PTR model are given.

4.2 DATA

For this study a panel data set which consists of both macroeconomic and financial variables, covering the period 1967-2016 are selected. It includes 56 countries. The

countries may reveal different data characteristics according to their development levels, so that the data set is divided into two subgroups including 27 developed and 19 developing countries. The members of each subgroup are represented in Appendix A. In order robustify the analysis (finance –growth nexus) the control variables are crucial, hence, some relevant control variables in to analysis are included. One should control for the impact of other variables that can be correlated with the rate of economic growth. In order to select control variables, Hineline (2007)[15] is followed. He uses Bayesian Model Averaging (BMA) tecnique which clarifies the uncertainty in the model selection procedure. BMA takes averages of many different competing models thus, include model uncertainty in the results related to parameters and predictions. He finds that the probability of the effect of the inflation, openness and investment on growth is respectively 89%, %92, 100%. Model averaging approach has been studied in many empirical studies[16].

In this study, the finance–growth relationship is modeled with an unbalanced panel data model using inflation (π_{it}), openness (Op_{it}) and investment (I_{it}) as explanatory variables. The economic growth rate is described as annual GDP per capita growth rate, the inflation rate is defined as percentage change of consumer price index (annual), investment is measured as the ratio of gross fixed capital formation to GDP and openness is used as the sum of exports and imports of goods and services as a share of GDP. In the empirical study, all of the variables are tried as state variable. Institutional quality which is not involved in the model is also tried as state variable. The calculation of the institutional quality index is obtained by taking averages of 6 governance indicators measured by Kaufmann, Kraay and Mastruzzi (2011); Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, Control of Corruption. All data source and their definitions are given in Appendix B.

In the finance-growth relationship literature, growth is mainly estimated by using per capita income, GNP- GDP, but financial development has been calculated by using

[15] He used different model spesifications to find the correct control variables that affect growth.
[16] Sala-i Martin, Doppelhofer and Miller (2004), Durlauf, Kourtellos and Tan (2008), Amini and Parmeter (2012) are some examples.

different indicators. Lynch (1996) divides the level of financial development indicators into five groups; quantity measures, structural measures, financial prices, product range and transaction costs. Market capitalization of listed domestic companies (as percentage of GDP) is a quantity measure which is one of the most popular financial indicators are used in both linear[17] and nonlinear[18] studies. It gives not only market size and market value but also shows the change in total activity, ‘‘the market size relative to the size of the economy and thus reflects the importance of financing through equity issuance in the capital mobilization and resource allocation processes’’ (Kim and Lin, 2011, 313). Therefore, it is used as a proxy of stock market development.

4.3 EMPIRICAL RESULTS

The stationary of the series used in the study is tested. For this purpose, Augmented Dickey-Fuller (ADF) test is used and the data is found to be stationary. Since the results of the unit root tests indicate that all the variables are I(0), the next step is estimating the linear model.

The linear model is below

$$Y_{it} = \alpha_{it} + \beta_1 \pi_{it} + \beta_2 I_{it} + \beta_3 op_{it} + \beta_4 K_{it} + e_{it} \qquad (4.18)$$

The variables are demeaned and by demeaning, the fixed effects are eliminated.

In the following subchapters, the estimation results for the developed countries and developing countries are given respectively.

[17] Arestis, Demetriades and Luintel (2001), Müslümov and Aras (2002), Yay and Oktayer (2009), Felek (2016), Swamy and Dharani (2018), Murari (2017). Also Levine and Zervos (1998) and Demirhan, Aydemir and İnkaya (2011) used capitalization of stock market in their studies (not as a share of GDP).
[18] Minier (2003), Shen and Lee (2006), Ergüngör (2008), Shen et al (2011), Samargandi et al (2015), Prochniak and Wasiak (2017).

4.3.1. Estimation Results for Developed Countries

Equation (4.19) shows the linear model for the estimation process of the developed countries:

$$\Delta y_{it} = \underset{(0.916)}{0.002} K_{it} + \underset{(2.447)}{0.036} \pi_{it} + \underset{(4.527)}{0.011} op_{it} + \underset{(7.308)}{0.174} I_{it} \qquad (4.19)$$

Note : The values in the parentheses are t-statistics.

The results of the linear model indicate that inflation, investment and trade openness is found to have a positive and statistically significant effect on growth while stock market capitalization has insignificant effect.

Linearity test results for developed countries are given in Table 3.

Table 3. Linearity results for developed countries

Linearity Test - Financial Indicator: capital					
Transition variable	op_{it}	π_{it}	I_{it}	Δy_{it}	$insqua_{it}$
LM_F stat	6.144	3.272	18.468	15.618	20.350
p-value	(0.002)	(0.038)	(0.000)	(0.000)	(0.000)

After rejecting linearity, the panel threshold model is estimated for developed countries. The transition variable institutional quality is determined endogenously by using linearity test, where all other control variables are tried as a state variable. The results of the PTR model with different state variables are given below.

By using openness as the state variable, the estimated PTR model is as follows:

$$\begin{aligned} \Delta y_{it} = I\left(\underset{(1.363)}{0.003} K_{it} + \underset{(1.680)}{0.026} \pi_{it} + \underset{(3.591)}{0.013} op_{it} + \underset{(5.808)}{0.147} I_{i,t} \right) + \\ (1-I)\left(\underset{(0.913)}{0.005} K_{it} + \underset{(4.292)}{0.446} \pi_{it} + \underset{(5.094)}{0.042} op_{it} + \underset{(0.281)}{0.281} I_{it} \right) \end{aligned} \qquad (4.20)$$

Note : The values in the parentheses are t-statistics.

Table 4. Summary statistics of the estimation using openness as the state variable

	Threshold - openness
Low regime	0.003 (1.363)
High regime	0.005 (0.913)

Stat. significant low	openness (+), investment (+)
Stat. significant high	inflation (+), openness (+), investment (+)
R^2	0.130
SSR/Log likelihood	4360.2378/-1745.8229
threshold	114.054

By using inflation as the state variable, the estimated parameters of the growth-finance nexus are as follows:

$$\begin{aligned}\Delta y_{it} = I\Big(&\underset{(-0.465)}{-0.001}K_{it} - \underset{(-0.617)}{0.018}\pi_{it} + \underset{(4.307)}{0.017}op_{it} + \underset{(1.377)}{0.072}I_{i,t}\Big) + \\ &(1-I)\Big(\underset{(0.817)}{0.002}K_{it} + \underset{(3.925)}{0.067}\pi_{it} + \underset{(1.814)}{0.006}op_{it} + \underset{(8.461)}{0.226}I_{it}\Big)\end{aligned} \tag{4.21}$$

Note : The values in the parentheses are t-statistics.

Table 5. Summary statistics of the estimation using inflation as the state variable

	Threshold - inflation
Low regime	-0.001 (-0.465)
High regime	0.002 (0.817)
Stat. significant low	openness (+)
Stat. significant high	inflation (+), investment (+)
R^2	0.133
SSR/Log likelihood	4337.1399/-1736.6402
threshold	1.790

For the state variable investment the estimated model parameter becomes:

$$\begin{aligned}\Delta y_{it} = I\Big(&\underset{(0.735)}{0.003}K_{it} - \underset{(-1.350)}{0.032}\pi_{it} + \underset{(2.789)}{0.011}op_{it} + \underset{(4.227)}{0.172}I_{it}\Big) + \\ &(1-I)\Big(\underset{(1.770)}{0.004}K_{it} + \underset{(6.249)}{0.133}\pi_{it} + \underset{(3.867)}{0.012}op_{it} + \underset{(8.287)}{0.266}I_{it}\Big)\end{aligned} \tag{4.22}$$

Note : The values in the parentheses are t-statistics.

Table 6. Summary statistics of the estimation using investment as the state variable

	Threshold - investment
Low regime	0.003 (0.735)
High regime	0.004 (1.770)

Stat. significant low	openness (+), investment (+)
Stat. significant high	inflation (+), openness (+), investment (+)
R^2	0.142
SSR/Log likelihood	4301.6548/-1740.6692
threshold	22.275

The estimation results when the transition variable is used as growth rate:

$$\begin{aligned}\Delta y_{it} = I\Big(&\underset{(2.030)}{0.004}\,K_{it} + \underset{(5.008)}{0.077}\,\pi_{it} + \underset{(1.304)}{0.004}\,op_{it} + \underset{(4.227)}{0.172}\,I_{it}\Big) + \\ &(1-I)\Big(\underset{(-0.880)}{-0.004}\,K_{it} - \underset{(-4.110)}{0.156}\,\pi_{it} + \underset{(5.162)}{0.024}\,op_{it} + \underset{(2.640)}{0.117}\,I_{it}\Big)\end{aligned} \tag{4.23}$$

Note : The values in the parentheses are t-statistics.

Table 7. Summary statistics of the estimation using growth as the state variable

	Threshold - growth
Low regime	**0.004 (2.030)**
High regime	-0.004 (-0.880)
Stat. significant low	inflation (+), investment (+)
Stat. significant high	inflation (-), openness (+), investment (+)
R^2	0.174
SSR/Log likelihood	4089.3136/-1717.8626
threshold	3.492

Finally, the institutional quality is used as the state variable, the estimated growth-finance nexus is as follows:

$$\begin{aligned}\Delta y_{it} = I\Big(&\underset{(-1.118)}{-0.011}\,K_{it} + \underset{(1.777)}{0.068}\,\pi_{it} + \underset{(1.986)}{0.018}\,op_{it} + \underset{(4.915)}{0.282}\,I_{it}\Big) + \\ &(1-I)\Big(\underset{(1.694)}{0.006}\,K_{it} + \underset{(4.267)}{0.143}\,\pi_{i,t} + \underset{(2.185)}{0.009}\,op_{it} + \underset{(1.103)}{0.066}\,I_{i,t}\Big)\end{aligned} \tag{4.24}$$

Note : The values in the parentheses are t-statistics.

Table 8. Summary statistics of the estimation using insqua as the state variable

	Threshold - insqua
Low regime	-0.011 (-1.118)

High regime	0.006 (1.694)
Stat. significant low	investment (+)
Stat. significant high	inflation (+), openness (+)
R^2	0.180
SSR/Log likelihood	2639.3283/-882.7809
threshold	1.006

For the developed countries, nearly in all estimated models trade openness has a positive and statistically significant effect on growth both in low and high regimes, which is consistent with the neoclassical theory. Investment, which is another control variable in the model, is also found to have a positive and statistically significant effect on economic growth. This result is also in line with the other findings in the literature. Inflation affects economic growth statistically significant and positive almost in every model no matter which state variable is used. This positive impact of inflation on economic performance is not unexpected. If there is an increase in the inflation rate of the developed country, for instance as a result of printing money, the domestic currency depreciates causing exports to increase and imports to decrease. This in turn promotes economic growth.

For the developed countries when inflation, openness, investment or institutional quality are used as state variables, there is no significant impact of financial development on economic growth is observed. Only in the case where growth is used as a state variable does financial development affect growth significantly.

The 2008 mortgage crisis has reinforced the view that excessive finance can have adverse ramifications for economic performance (Rousseau and Wachtel, 2011; Arcand et al., 2012; Law and Singh, 2014). Before the onset of the 2008 crisis, the developed countries were generally experiencing low levels of inflation and high levels of financial development, but the crisis put a huge question mark over the positive effects of finance on economic growth. This merely paved away to the view that too much finance can in fact harm the economy. ‘‘Excessive financial deepening or too rapid growth of credit may have lead to both inflation and weakened banking systems which in turn gave rise

to growth inhibiting financial crisis'' (Rousseau and Wachtel, 2011, 1). Therefore, governments should not focus on encouraging more finance to experience economic development, but instead should concentrate on adopting policies that can strengthen the quality of the financial system and its instruments. On this regard the empirical studies show that there is a certain level of threshold above which financial development hampers growth. If the optimal level of finance is known and countries have an efficiently functioning system, financial resources will be channelled into productive investments and economic growth will occur (Law and Singh, 2014). Therefore, the main source of economic growth is the quality not the quantity of finance. The results of this study also support this 'too much finance' view in the literature. Financial development has a positive effect on economic performance in all cases except one in which growth is used as a state variable. In this case the threshold level is found to be 3.492%. In the low growth regime, when growth is below this threshold level of per capital gdp growth, financial development affects economic growth significantly positive with a coefficient of 0.004. In the upper regime, however, the same effect is found to statistically insignificant.

4.3.2. Estimation Results for Developing Countries

The linear estimation results for the developing countries are as follows:

$$\underset{}{\Delta y_{it}} = \underset{(3,786)}{0,016\,K_{it}} - \underset{(-3,544)}{0,003\,\pi_{it}} - \underset{(-3,905)}{0,010\,op_{it}} + \underset{(10,459)}{0,230\,I_{it}} \qquad (4.25)$$

Note : The values in the parentheses are t-statistics.

The linearity test results for developing countries are given in table 9. In the linearity test, the lag length is again taken as one.

Table 9. Linearity test results for the developing countries

Linearity Test - Financial Indicator: capital					
Transition variable	op_{it}	π_{it}	I_{it}	Δy_{it}	$insqua_{it}$
LM_F stat	1.944	2.353	6.452	3.727	21.564
p-value	(0.144)	(0.096)	(0.001)	(0.024)	(0.000)

Table 9 shows that the null of linearity is rejected for all state variables except openness. After rejecting linearity the panel threshold model is estimated for the developing countries again using all the control variables separately as a state variable.

By using openness as the state variable the model becomes:

$$\begin{aligned}\Delta y_{it} = I\Big(&\underset{(3.392)}{0.597}\,K_{it} - \underset{(-2.015)}{0.003}\,\pi_{it} - \underset{(-3.204)}{0.568}\,op_{it} - \underset{(-0.072)}{0.016}\,I_{it}\Big) + \\ &(1-I)\Big(\underset{(3.673)}{0.016}\,K_{it} - \underset{(-1.395)}{0.002}\,\pi_{it} - \underset{(-3.890)}{0.010}\,op_{it} + \underset{(10.841)}{0.236}\,I_{it}\Big)\end{aligned} \tag{4.26}$$

Note : The values in the parentheses are t-statistics.

Table 10. Summary statistics of the estimation using openness as the state variable

	Threshold - openness
Low regime	**0.597 (3.392)**
High regime	**0.016 (3.673)**
Stat. significant low	inflation (-), openness (-)
Stat. significant high	openness (-), investment (+)
R^2	0.311
SSR/Log likelihood	4613.7243/-1050.2102
threshold	16.945

If inflation, on the other hand, is used as the state variable the model becomes as follows:

$$\begin{aligned}\Delta y_{it} = I\Big(&\underset{(3.693)}{0.035}\,K_{it} + \underset{(0.596)}{0.008}\,\pi_{it} - \underset{(-1.697)}{0.009}\,op_{it} + \underset{(4.926)}{0.278}\,I_{it}\Big) + \\ &(1-I)\Big(\underset{(2.617)}{0.013}\,K_{it} - \underset{(-3.749)}{0.003}\,\pi_{it} - \underset{(-4.127)}{0.014}\,op_{it} + \underset{(10.006)}{0.241}\,I_{it}\Big)\end{aligned} \tag{4.27}$$

Note : The values in the parentheses are t-statistics.

Table 11. Summary statistics of the estimation using inflation as the state variable

	Threshold - openness

Low regime	**0.035 (3.693)**
High regime	**0.013 (2.617)**
Stat. significant low	investment (+)
Stat. significant high	inflation (-), openness (-), investment (+)
R^2	0.308
SSR/Log likelihood	4631.9183/-1050.9914
threshold	1.533

For the state variable investment the estimated model parameter becomes:

$$\begin{aligned}\Delta y_{it} = I\Big(&\underset{(-0.522)}{-0.084}K_{it} - \underset{(-3.444)}{0.006}\pi_{it} - \underset{(-3.047)}{0.380}op_{it} + \underset{(3.225)}{1.821}I_{it}\Big) + \\ &(1-I)\Big(\underset{(4.155)}{0.017}K_{it} - \underset{(-3.623)}{0.004}\pi_{it} - \underset{(-4.175)}{0.011}op_{it} + \underset{(10.934)}{0.235}I_{it}\Big)\end{aligned} \tag{4.28}$$

Note : The values in the parentheses are t-statistics.

Table 12. Summary statistics of the estimation using investment as the state variable

	Threshold - openness
Low regime	-0.084 (-0.522)
High regime	**0.017 (4.155)**
Stat. significant low	inflation (-), openness (-), investment (+)
Stat. significant high	inflation (-), openness (-), investment (+)
R^2	0.331
SSR/Log likelihood	4479.8719/-1044.3662
threshold	15.543

The estimation results when the transition variable is used as growth rate:

$$\begin{aligned}\Delta y_{it} = I\Big(&\underset{(5.021)}{0.028}K_{it} - \underset{(-3.046)}{0.003}\pi_{it} - \underset{(-4.486)}{0.017}op_{it} + \underset{(6.045)}{0.219}I_{it}\Big) + \\ &(1-I)\Big(\underset{(0.687)}{0.004}K_{it} - \underset{(-5.673)}{0.052}\pi_{it} - \underset{(-2.327)}{0.008}op_{it} + \underset{(3.645)}{0.123}I_{it}\Big)\end{aligned} \tag{4.29}$$

Note : The values in the parentheses are t-statistics.

Table 13. Summary statistics of the estimation using growth as the state variable

	Threshold - openness
Low regime	**0.028 (5.021)**
High regime	0.004 (0.687)
Stat. significant low	inflation (-), openness (-), investment (+)
Stat. significant high	inflation (-), openness (-), investment (+)
R^2	0.347
SSR/Log likelihood	4371.5155/-1039.5060
threshold	5.220

By using insqua as the state variable the model becomes

$$\begin{aligned}\Delta y_{it} = I\Big(\underset{(1.626)}{0.032}\,K_{it} - \underset{(-4.163)}{0.056}\,\pi_{it} + \underset{(-0.333)}{0.008}\,op_{it} + \underset{(4.605)}{0.181}\,I_{it}\Big) + \\ (1-I)\Big(\underset{(3.088)}{0.018}\,K_{it} + \underset{(-1.562)}{0.008}\,\pi_{it} - \underset{(-2.276)}{0.009}\,op_{it} + \underset{(6.564)}{0.216}\,I_{it}\Big)\end{aligned} \tag{4.30}$$

Note : The values in the parentheses are t-statistics.

Table 14. Summary statistics of the estimation using insqua as the state variable

	Threshold - openness
Low regime	0.032 (1.626)
High regime	**0.018 (3.088)**
Stat. significant low	inflation (-), investment (+)
Stat. significant high	openness (-), investment (+)
R^2	0.321
SSR/Log likelihood	2096.3010/-596.6113
threshold	-0.344

For the developing countries the estimation results show that, for each state variable considered, the effect of financial development on growth is positive and significant in at least one of the regimes depending on whether the state variable is above or below the threshold value.

While the control variables openness and inflation are found to have a negative and statistically significant effect on growth, investment is found to have a siginificantly positive effect in nearly all estimations. The negative effect of trade openness on growth is consistent with the short run relationship founded in Samargandi et al. (2015), which means that trade openness can hamper growth. According to Ethier (1982), this negative relationship can be caused by specialization in the wrong sector. Moreover, low income countries are in need of high levels of openness to take the advantages of technologically more developed markets in order to enhance their economic growth. Although openness is the sum of exports and imports of goods and services as a share of gross domestic product (not financial openness which can be indicated as capital mobility) it has a connection with the capital account balance, as well. If a country is experiencing a current account deficit, this current account deficit will be financed by capital inflows. The short-term capital (hot money) inflows are not desired finance tools. As it is known the markets of the developing countries are shallow that a sudden outflow affects the developing economies more than developed countries with a more advanced and deep financial market. Therefore, having a high level of openness may not that much desired for especially developing countries with shallow markets which also lead to fragilities in economic structure.

When the inflation is used as state variable, whether the countries above or below the threshold inflation value of 1.533%, financial development affects economic performance positively with a statistically significant parameter. The coefficients of financial development in lower and upper regime are 0.035 and 0.013, respectively. Equation (4.27) shows the lower regime coefficient of capital is higher than the upper regime. This finding is consistent with the findings of Huang Lin Kim and Yeh (2010). They find a threshold value of 7.69% and below this threshold, financial development has a significant and statistically positive impact on economic growth and for the upper regime (above the threshold) the effect is minor or insignificant. Rousseau and Watchel (2002) show that financial depth has a positive effect on growth when inflation is below the average inflation rate of 13-25% range. When inflation falls below a threshold of 6-8%, the effect of financial depth on economic growth becomes significantly positive. Yılmazkuday (2011) also finds an inflation threshold as 8% and he stated that above

this inflation threshold value, the positive effect of financial development on the long-run growth is disappeared. Ehigiamusoe et al. (2018) finds a 5.62% threshold level for West African region. They state that in the low levels of inflation, the marginal effect of financial development on growth is bigger than in the high levels of inflation which is also consistent with the findings. However, they also find out that when inflation rises above the threshold level, the effect of financial development on growth becomes negative.

This result is different than the results of the other studies in the literature in high inflation regimes depending on bigger cross section and longer time dimension which may be more reliable considering the data set used in the previous studies. Therefore, by using PTR model with extended data set, this study contributes to the literature with this new finding on high regime estimate of the financial development.

Using openness as the state variable, the threshold is estimated as 16.944%. It is founded that in both regimes financial development affects economic growth positive and statistically significant. In the lower regime the coefficient is estimated as 0.597 which is bigger than the upper regime 0.015. The lower regime estimates of the model exhibits that inflation and openness have statistically significant negative effect on growth where investment has negative but statistically insignificant effect on growth. The high regime estimates has shown that inflation has negative and statistically insignificant; openness has negative and investment has positive and statistically significant effect on growth. Yılmazkuday (2011) has stated that for high income countries, financial development with low levels of openness is adequate for enhancing growth. For low level income countries in order to arrive same level of growth increase, financial development has inneed of a more trade openness. This is a simple fact that the low level income countries has shallow financial markets that they have to benefit from the high level income countries financial markets' efficiency (large and technologically advance) via this openness (Yılmazkuday, 2011).

The threshold value is calculated as 15.543% when investment is used as the state variable. In the upper regime the effect of stock market development on economic growth is positive and statistically significant but in lower regime the effect becomes

negative and statistically insignificant. Inflation and openness has negative, investment has positive and statistically significant impact on economic growth in both regimes. It is an expected result for developing countries that more investment promotes finance-growth nexus.

The threshold value is found 5.219% when economic growth is used as state variable which is bigger than the developed countries threshold value of 3.492%. In lower regime, stock market capitalization has statistically significant and positive impact on growth. After growth exceeds the threshold level, the effect become insignificant, means while experiencing high growth, finance has no significant effect on economic growth. Both in the lower and upper regime, inflation and openness have negative and investment has positive and statistically significant effect on growth.

The role of institutions is getting important in the growth literature and also there are lots of studies that show that institutional quality affects growth[19]. If a country has protection of property rights, can guarantee the proper enforcement contracts with institutions have macroeconomic and financial stability and has strong social norms, it has a potential to reduce transaction costs (Fernandez and Tamayo, 2015). A country can have institutions but the important thing is not the existence of the institutions, but the well-functioning institutions. For instance, mostly in developing countries there exist laws but the implementation of law is not enough, there is bribery, corruption and there is no transparency in the government policies. Creating a reliable atmosphere for the investors by making more protection in the property rights, enforcement of the contracts and making institutions better, leads a country to experience more investment/financial development and therefore growth. For developing countries financial development promotes growth only when institutional quality passed a certain level of threshold. This study also finds consistent results with the existent literature for the developing countries. In this study, it is found that in both regimes the effect of financial development on economic growth is positive, where the statistical significance is obtained only in high regime. This finding is also consistent with the upper regime

[19] For detailed information see Acemoğlu, Johnson and Robinson (2001,2002, 2005), Rodrik, Subramanian and Trebbi (2004), Fergusson (2006), Fernandez and Tamayo (2015).

estimates of Law et. al., (2013). However, Law et. al., (2013) has found that in the low regime financial development has a negative and statistically insignificant effect on growth. Fortunately, the insignificance prevails in both studies which is also consistent. In this study, the estimated institutional quality threshold level is lower in the developing countries than developing countries. In the lower regime, inflation has negative, investment has positive and both statistically significant impact on growth whereas in the upper regime, openness has negative, investment has positive and both statistically significant impact on growth.

The findings indicate that for both developed and developing countries there is a non-linear relationship between financial development and economic growth. In both developed and developing country samples the linearity test results reveal that the best state variable is institutional quality. The use of stock market capitalization as a financial development indicator has positive and statistically significant effects on growth in developing countries no matter which state variable is used. For developed countries, on the other hand, financial development has a positive effect on growth only in the case where growth is used as a state variable. Since the developed countries have much higher levels of income, technology, resources, and human capital; financial development is not the only source of economic growth in these countries. This finding is also consistent with the "too much finance" literature that highlights the harm of using too much finance to boost the economies. Heterogeneity of the panel sample with respect to the economic development levels of the countries enforces the division of the data in order to obtain better estimates of the PTR model parameters. Therefore, dividing the sample with respect to the development levels of the countries reduces the heterogeneity bias and leads to unbiased estimates of the PTR model. Moreover, this simple approach in fact allows us to provide parameter estimates for four different regimes: developed countries with high levels of financial development, developed countries with low levels of financial development, developing countries with high levels of financial development, and developing countries with low levels of financial development. Finally, depending on the results of this study and those of previous ones, the impact of financial development on growth is more robust in developing countries

than the developed ones, which means that financial development has better effects on growth in developing countries.

CONCLUSION

This thesis aims to investigate the financial development - economic growth nexus by using a nonlinear modelling approach. To this end, Hansen (1999)'s Panel Threshold Regression Model (PTR) is estimated for a panel of 56 countries over the period 1967-2016. While there is a general consensus among economists on the fundamental role that financial markets play in fostering economic growth, theoretical and empirical work supporting this idea is still very much in progress. Inspite of the burgeoning number of studies in this field, the results still remain largely indecisive due to the different countries, time periods or econometric methodologies utilized. From simple univarite country studies to panel data analysis including various country groups, from linear to nonlinear estimation methodologies financial development - growth relationship has been submitted to all types of analysis. One cannot make a generalization as the countries, their policies, development levels and institutional qualities are not unique. This thesis, therefore, tries to shed light on this issue by providing new empirical evidence including the relevant macroeconomic variables that are expected to affect the finance-growth relationship. These variables are selected following Hineline (2007) and all of them are used as state variables. In addition to these variables, the impact of institutional quality on the finance-growth nexus is also analyzed by including it into the model as a state variable. In the literature, in order to investigate the finance-growth nexus inflation is commonly used as a state variable; but openness, investment and institutional quality have not been used as threholds along with stock market capitalization. This study is the first one that analyzes financial development and growth relationship in these contexts.

In this thesis the PTR model that allows for the cross-section variations and time changes in the variables is used. Also in these models the threshold levels can be determined endogenously and the regime switching takes place sharply. Since financial data is subject to sudden and abrupt changes, the finance-growth relationship is estimated using the PTR model. The results of linearity tests reveal that for both developed and developing countries, financial development and economic growth

relationship is non-linear. More importantly, linearity tests suggest that statistically the best state variable is institutional quality.

For developed countries finance is not found to have any significant effect on growth except for the model with growth used as a state variable. This can be explained by the *too much finance* literature. When financial development exceeds a certain threshold level, it hampers growth. If the optimal level of finance is known and countries have efficient functioning systems, financial resources will be canalized into productive investments and economic growth will actualize. Therefore, it is better for policymakers to know the threshold level in order to prevent these negative effects of finance on growth.

For developing countries the estimation results show that, for each state variable considered, the effect of financial development on growth is positive and significant in at least one of the regimes depending on whether the state variable is above or below the threshold. When inflation and openness are used as the state variables, financial development is found to effect economic performance positively. However, the coefficient is higher in the lower regime. When investment is used as the state variable the effect of stock market development on economic growth is significantly positive only in the upper regime. In the lower regime the effect becomes negative and statistically insignificant. On the other hand, when economic growth is used as the state variable, stock market capitalization has a statistically significant and positive impact on growth in the lower regime. However, after exceeding a certain threshold level, this effect becomes insignificant. When institutional quality is used as the state variable, the effect of capitalization on economic growth is again statistically significant and positive but this time in the upper regime. In this study, below the threshold level, financial development has a negative and statistically insignificant effect on growth. Similar with the other studies in the literature, for developing countries financial development promotes economic growth only when a certain threshold level of institutional development has been reached. The estimated institutional quality threshold level is much lower in the developing countries as they need better institutions than the developed ones.

Overall, financial development has a positive and significant impact on growth in all developing country estimations. However, for developed countries, except for the model with growth as the state variable financial development negatively affects growth.

This thesis shows that it is crucial for the policymakers to know the threshold values. If the optimal level of finance is known, the policymakers can implement policies that lead to more productive investments and that can prevent the detremental effects of the *too much finance* on the economy. Especially in the countries with under-developed financial systems, it is crucial to adopt those policies that widen and deepen the financial sector so that an increase in savings can turn into productive investment, and hence economic growth. The public policies can also have similar positive effects on growth. These are to prevent bribery and corruption, to provide more protective property rights and enforcement of the contracts, to ensure a sound effective and well-organized financial system, and to lead to sustainable growth with low inflation. Rule of law, political stability, voice and accountability, and regulatory quality should also be established. When these measures are applied for a well-functioning financial system and better working institutions, financial development will accelerate economic performance.

APPENDIX A

Using World Economic Situation and Prospects 2017 of United Nations, data is divided into two groups; developed, developing countries as follows:

Developed Countries	Developing Countries
Australia	Argentina
Austria	Brazil
Belgium	Chile
Canada	China
Croatia	Costa Rica
Czech Republic	Dominican Republic
Denmark	Guatemala
Estonia	India
Finland	Korea, Rep.
France	Malaysia
Germany	Mexico
Ireland	Pakistan
Italy	Panama
Japan	Peru
Netherlands	Philippines
New Zealand	Singapore
Norway	Thailand
Poland	Turkey
Portugal	Uruguay
Romania	
Slovak Republic	

Slovenia Spain Sweden Switzerland United Kingdom United States	

APPENDIX B

Definitions of the variables

Variable	Abbreviation	Definition	Source
Gross Domestic Product per capita growth (annual %) [NY.GDP.PCAP.KD.ZG]	$\triangle y$	GDP per capita is gross domestic product divided by midyear population. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.	World Bank-World Development Indicators (WDI)
Gross capital formation (% of GDP) [NE.GDI.TOTL.ZS]	$\mathbf{I}$	Gross capital formation (formerly gross domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories.	World Bank-World Development Indicators (WDI)
Inflation, consumer prices (annual %) [FP.CPI.TOTL.ZG]	π	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly.	World Bank-World Development Indicators (WDI)
Trade (% of GDP) [NE.TRD.GNFS.ZS]	op	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.	World Bank-World Development Indicators (WDI)

Market capitalization of listed domestic companies (% of GDP) [CM.MKT.LCAP.GD.ZS]	K	Market capitalization (also known as market value) is the share price times the number of shares outstanding (including their several classes) for listed domestic companies. Investment funds, unit trusts, and companies whose only business goal is to hold shares of other listed companies are excluded. Data are end of year values.	World Bank-World Development Indicators (WDI)
Institutional Quality	insqua	Simple average of 6 governance indicators; Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, Control of Corruption	Authors calculations from Worldwide Governance Indicators (WGI) by Kaufmann, Kraay and Mastruzzi (2011).

The definition of the institutional quality indicators';

Insqua indicator	Definition
1-Rule of Law: Estimate	Rule of Law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.
2-Political Stability and Absence of Violence/Terrorism: Estimate	Political Stability and Absence of Violence/Terrorism measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.
3-Voice and Accountability: Estimate	Voice and Accountability captures perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. Estimate gives the country's score on the aggregate indicator, in units of a standard normal

	distribution, i.e. ranging from approximately -2.5 to 2.5.
4-Regulatory Quality: Estimate	Regulatory Quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.
5-Control of Corruption: Estimate	Control of Corruption captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.
6-Government Effectiveness: Estimate	Government Effectiveness captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.

Source: Data from database - Worldwide Governance Indicators

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APPENDIX 1

HACETTEPE ÜNİVERSİTESİ
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TEZ ÇALIŞMASI ETİK KOMİSYON MUAFİYETİ FORMU

HACETTEPE ÜNİVERSİTESİ
SOSYAL BİLİMLER ENSTİTÜSÜ
İktisat **ANABİLİM DALI BAŞKANLIĞI'NA**

Tarih: 12/07/2018

Tez Başlığı: Nonlinear Approach to Financial Development-Economic Growth Nexus: Evidence from Developed and Developing Countries

Yukarıda başlığı gösterilen tez çalışmam:

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Öğrenci No: N13241921
Anabilim Dalı: İktisat
Programı: İktisat Doktora
Statüsü: ☐ Yüksek Lisans ☒ Doktora ☐ Bütünleşik Doktora

DANIŞMAN GÖRÜŞÜ VE ONAYI

Bu tez çalışması için herhangi bir Etik Kurul/Komisyondan izin alınmasına gerek duyulmamıştır.

Doç. Dr. Ayşen SİVRİKAYA
(Unvan, Ad Soyad, İmza)

Detaylı Bilgi: http://www.sosyalbilimler.hacettepe.edu.tr
Telefon: 0-312-2976860 **Faks:** 0-3122992147 **E-posta:** sosyalbilimler@hacettepe.edu.tr

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DOKTORA TEZ ÇALIŞMASI ORİJİNALLİK RAPORU

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SOSYAL BİLİMLER ENSTİTÜSÜ
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Anabilim Dalı: İktisat
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Statüsü: ☒ Doktora ☐ Bütünleşik Dr.

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Doç. Dr. Ayşen SİVRİKAYA
(Unvan, Ad Soyad, İmza)

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Student No: N13241921
Department: Economics
Program: Ph.D.
Status: ☒ Ph.D. ☐ Combined MA/ Ph.D.

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