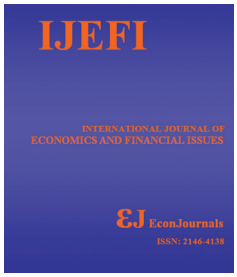

International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2016, 6(3), 1155-1164.

Analysis of the Relationships between Financial Development and Economic Growth through Romer's Expanding Variety of Products Model: The Case of Turkey

Oğuzhan Yilmaz*

Street: 66; No: 21/19, 34513 İstanbul, Turkey. *Email: oguzhanyz@yahoo.com

ABSTARCT

In this article the relation between financial development and growth is examined with the help of the Romer model. In the model growth of the economy is sustained by consistent innovations and openings of new sectors that require large scale and long-term committed capital. We propose that only a well-developed financial system can provide the necessary efficient flow of capital in the economy and enable more diversification and stimulation of investment in more productive but riskier areas. Defining different monetary, loan and security variables as indicators of financial development, long-term equilibrium relation with national income was studied through time series analysis with data belonging to the Turkish economy. The econometric results support the hypothesis about existence of a co-integrating relation between financial development and growth.

Keywords: Financial Development, Romer Growth Model, Innovation, Co-integration
JEL Classifications: C22, F4, O16, O31, 052

1. INTRODUCTION

Economic growth is very important for various reasons; it often associates with more consumption and utility, more production and employment, more accumulation of capital and wealth, more resources for social projects, and promotion of innovations that make our lives better. Any factor that affects growth will also be important. And any public policy that take into account those factors will be more appropriate and successful. Financial development has been found one of the key factors in the growth process by many theoretical and empirical studies (King and Levine, 1993; Merton, 1995; Levine and Zervos, 1996; Neusser and Kugler, 1998; Beck et al., 2000; Valev and Rioja, 2002; Rousseau and Vuthipadadorn, 2005).

This study looks at the issue from both theoretical and empirical perspectives. First with the help of Romer's expanding product variety model (Romer, 1990) I put forward some ideas that highlight the close relation between financial development and growth more directly. Basing the explanations directly on a well-known important growth model would strengthen exposition. Second with data belonging to Turkish economy I conduct an empirical research and get affirmative results about the existence of long-term equilibrium relations (co-integration) between growth and financial development. In the chosen period Turkey was one of the developing countries that were experiencing economic and financial restructuring. The transitions from a planned economic growth model to free markets economy; from import substitution to free international trade model; and from a heavily regulated financial system to to a less repressed and open model have been just a few examples of important structural changes. So the results may be meaningful for other similar countries.

Romer's model shows how an economy can keep growing by introduction of new products and opening of new sectors. Instead of just mentioning the functions of the financial system in the economy I tried to establish the roles and importance of a well-functioning financial system in supporting the innovation process, hence the growth. Mainly it helps flow of capital from relatively less productive existing sectors, firms, and products to those that are more productive but requiring large scale long-term capital,

and in this way it helps reduce overall risks through diversifications promoting more investments.

In the empirical work with data belonging to Turkish economy's 1980-2012 period I took trade mark applications as indicators of product innovation and looked at its relations with growth and financial variables through time series analysis (co-integration analysis). To my knowledge this is the first time in the growth-finance literature that trade mark applications are used in explanations. Financial variables are chosen from monetary, credit and security aggregates. I keep the number of financial variables as many as possible (instead of just using a few variables as often seen in the literature) and pre-tested them to see any hidden relation that is potentially built between the components of financial aggregates and economic growth as suggested by Granger and Yoon (2002). The results have supported the hypothesis that there are long-term equilibrium relations (co-integration) between financial development and growth.

2. THEORETICAL CONSIDERATIONS: EXPANDING VARIETY OF MODEL

Here I first describe the basic properties of the model and draw some conclusions related to the important roles of the financial system in supporting a sustained growth process. Then I try to explain the conclusions with the help of ideas and models studied in the literature.

2.1. Main Properties of the Model and Related Conclusions

In many growth models such as Solow-Swan growth model and Ramsey model technical progress is not determined endogenously. The expanding product variety model displays technological advances in a way. In the model total output increases as product variety increases which is resulted in by purposeful research and development (R&D) activities. The general problem of diminishing marginal product of capital is overcome by opening of new sectors (introduction of new products) and employment of capital in these new industries.

A basic version of the model described by Barro and Sala-i-Martin (2004) is as follows (Also see; Acemoğlu, 2009; Aghion and Howitt, 2009): Producers of final output hire labor and intermediate inputs and combine them to produce final output. R&D companies try to develop new intermediate goods. Once a product has been invented the R&D firm obtains a perpetual patent, which allows the firm to sell the good at whatever price it chooses. Households maximize utility, subject to their budget constraints.

Production function for final good producer *i*

$$Y_i = A \cdot L_i^{1-\alpha} \cdot \sum_{j=1}^{N} (X_{ij})^{\alpha} \quad (1.1)$$

A: An overall measure of productivity or efficiency, it is the same for all producers.
L_i: Labor input.
X_{ij}: The employment of the j[th] type of specialized intermediate good. This quantity is determined by equalizing its marginal product to its marginal cost.

$$X_{ij} = L_i \cdot \left(\frac{A\alpha}{P_j}\right)^{1/(1-\alpha)} \quad (1.2)$$

N: Number of varieties of intermediates.

α parameter: $0 < \alpha < 1$.

The production function in Equation (1.1) specifies diminishing marginal productivity of each input L_i and X_{ij} and constant returns to scale in all inputs together. Growth is sustained by consistent introduction of new types of intermediate goods that solves diminishing marginal product and growth problem.

For the R&D firm the present value of the returns from discovering the j[th] intermediate good is given by:

$$V(t) = \int_t^{\infty} \pi_j(v) . e^{-\bar{r}(t,v).(v-t)} \, dv \quad (1.3)$$

$\bar{r}$: The average interest rate between times *t* and *v*.

$$\bar{r}(t,v) \equiv \left[\frac{1}{(v-t)}\right] . \int_t^v r(w) \, dw \quad (1.4)$$

$\pi_j(v)$: The profit flow at date *v*. It is assumed that J type intermediate good's marginal and average cost is a constant and normalized to 1. Hence the profit flow is given by,

$$\pi_j(v) = \left[P_j(v) - 1\right] . X_j \quad (1.5)$$

2.1.1. Conclusion

Through continuous introduction of new goods and opening of new sectors the problem of diminishing marginal product of capital can be solved and growth can be sustained.

2.1.1.1. Potential connection 1

A well-functioning financial system makes the flow of capital from a firm or a sector which has relatively low level of marginal productivity to the opening of new industries and introduction of new goods (especially to the sectors which require long-term commitment and high level of minimum scale) possible, efficient and faster. By this way it contributes to sustained economic growth.

2.1.1.2. Potential connection 2

If we take into account the fact that in the real world returns from different products, firms and industries are not as certain as assumed in the model and they are fluctuating and risky we can appreciate that introduction of new ones will reduce overall risk by providing more diversification and make ıncome (micro and macro) more regular. With this another means of risk reduction there will be increase in investments in risky but high return promising areas. A well-developed financial system boosts investments by enabling individuals and firms to be better exposed to the risks with all its instruments and practices (such as easing change of ownership and derivative products).

2.2. Existence of Indivisible Projects, Critical Levels and Long-term Commitment Requirements

Production of many goods and services is possible (profitably) only when reached a minimum scale. In the process of growth the opening of these large scale sectors is both inevitable and very supportive. Accordingly financing of these large scale firms become especially important. It becomes necessary that big funds come together and long-term financing is maintained.

Hicks (1969) suggested that fixed-capital investments were very important for the industrialization which was seen primarily in Europe, England. The kind and amount of fixed capital investments were increased rapidly. He said that the answer to the question of how these investment increases which were never seen at that scale before happened was the financial developments occurred in that period. Fixed investments are usually sunk and have more liquidity risk, for these kind of investments it becomes indispensable that capital gains momentum, the usable funds and liquidity increase.

With the opening of higher value adding companies not only the growth process is continued but also it is made faster. The big enterprises founded in the construction, automotive, and electronics sectors which naturally have high value addition contribute growth from following perspectives as well:

- Realization of economics of scale;
- Facilitating a necessary environment for specialization which is accepted as one of the most important productivity increasing development;
- Providing mass employment and regular income for many.

As the economy develops many structural transformations increase the importance of financial system. A new effect which we may call "waging effect" can be explained as this: With development the people which have employment in agriculture or other low value adding but usually self-employment sectors and firms begin to work at big enterprises and factories now with wages. Their regular income and so their saving capacity increase. As this happen the people which have investment opportunities are becoming not the same people which have usable funds. These funds could support the growth of the economy only if they are redistributed to the industries, firms and projects which need additional capital so as to realize all kinds of investment opportunities. The savings of now waged people if they are held in cash would not contribute to any capacity or productivity increases. They must be transformed into productive capital somehow.

Capital markets, by allowing uninterrupted exchange of ownership in a deep market pave the way to many investments and implementation of better technologies which require huge funds to come together and have at the same time high liquidity risk when ownership is restricted to a few.

Bencivenga et al. (1996) treated the ideas about the technologies which require long-term committed and illiquid investments in their model: "These technologies are different from productivity and time perspective. The technologies requiring long time capital formation periods are not put into practice unless enough liquidity is provided by the financial system. Well-developed financial markets allow resell ownership of these investments. By this they provide balance between two conflicting effects in the investment process: Investors (for many reasons) demand liquid assets although often the most productive capital investments are illiquid" (Bencivenga et al., 1996. p. 20).

Long-term projects are important for many reasons. They reduce uncertainties with plans for the future. Spreading the spending for these projects over time both do not create inflationary pressures and at the same time makes the income from them more regular. Reduction of fluctuations in income will have positive effects on growth.

Jeong and Townsend (2005. p. 2) pointed out the relationship between the foundation of new industries and productivity increases: "When an economy is engaged in structural transformation, compositional changes among sectors or activities, across which productivity levels differ on the extensive margin, contribute not only to output growth but also to productivity growth, without true underlying technical change."

2.3. Reduction of Economic and Financial Fluctuations, Uncertainties and Risks

An important difference between sectors are about how much fluctuating and risky their returns are. It is mostly assumed (may be established, Pennacchi, 2008; Ingersoll, 1987) in the literature that people in general are risk-averse. Therefore risk assessments become very important in determining which sectors are going to newly open and which ones will be expanded with additional investments.

It would not be wrong to assume that the risky returns from different products and industries are not totally correlated. It would be possible to get more regular income if the number of products which could be put in a portfolio (both commercial and investment) is increased, eliminating diversifiable risks. Clearly each new product reduces others' risk at some degree. And this increases the flow of funds into areas which were not invested before because of their total risk. In turn the new flow of funds facilitates the opening of new sectors more and more. The overall risks have been reduced further and hence a virtuous cycle begins and continues.

In their model about this issue, Acemoğlu and Zilibotti (1994) have reached similar conclusions and additionally they link up the failure of many countries in entering a sustained growth process (take-off) with their failure to start off the diversification process because of insufficient capital: "We construct a model where, at early stages of development the presence of indivisible projects limits the degree of risk-spreading (diversification) that the economy can achieve. The desire to avoid highly risky investments slows down capital accumulation and the inability to diversify all idiosyncratic risks introduces high uncertainty in the growth process" (Acemoğlu and Zilibotti 1994, abstract). As a conclusion from their model they say: "Intuitively, if all agents invest a lot in the risky assets, all sectors can be opened, and because all risks are diversified, the representative agent wants to invest a high proportion of his savings (in our case, all of it) in risky assets" (Acemoğlu and Zilibotti, 1994. p. 30).

With the increase in depth, extend, and efficiency of the financial system in its functions, the conversion of composition of investments, and in this way the reduction of economic fluctuations becomes easier. In periods of economic stagnation as returns from short-term projects (their opportunity costs) fall long-term investments may become more attractive and fluctuations may reduce if the financial system is well organized and works properly.

Regarding the subject Aghion et al. (2005) built a model and made a panel study involving the 1960-2000 period. They found that a lower degree of financial development predicts a higher sensitivity of both the composition of investment and mean growth to exogenous shocks, as well as a stronger negative effect of volatility on growth. In their model they say "Because it takes longer to complete, long-term investment has a relatively less pro-cyclical return but also a higher liquidity risk. Under complete financial markets, long-term investment is countercyclical, thus mitigating volatility. But when firms face tight credit constraints, long-term investment turns pro-cyclical, thus amplifying volatility. Tighter credit therefore leads to both higher aggregate volatility and lower mean growth for a given total investment rate" (Aghion et al. 2005, abstract).

It is not necessary to relate long-term investments and the risk with them only to physical capital formations. Aghion et al., emphasized that many other activities (especially in their model) can be accepted as investments. "There are various interpretations of what the two types of investment and the liquidity shock represent. For example, the short-term investment might be putting money into one's current business, while long-term productivity-enhancing investment may be starting a new business. Or, the short-term investment may be maintaining existing equipment or buying a machine of the same vintage as the ones already installed, while the long-term investment is building an additional plant, investing in R&D, learning a new skill, or adopting a new technology. Similarly, the liquidity shock might be an extra cost necessary for the new technology to be adapted to domestic market conditions once the new technology has been adopted; or a health problem which the entrepreneur needs to overcome or otherwise she won't be alive to enjoy the fruits of her long-term investment; or some other idiosyncratic shock that is threatening to ruin the entrepreneur's business unless she has enough liquidity to overcome it" (Aghion et al., 2005. p. 6).

3. LITERATURE REVIEW

The empirical studies differ from each other in many respects: The period, the countries, the indicators for economic performance and financial development, and the methods such as cross-section or time series analysis.

King and Levines' work (1993) may be regarded the first modern leading study in the finance-growth research. Examining a cross section of about 80 countries for the period 1960-89, they found that various measures of financial development are strongly associated with both current and later rates of economic growth.

Levine and Zervos (1996) studied 41 countries and the 1976-89 period. They used a composite index that consist of different measures of stock market's size, liquidity, and international openness. The results pointed out a strong relation with growth.

Rousseau and Wachtel (2005) researched the 1960-2003 period and 80 countries. They found that the relationship between finnacial development and growth has weakened after 90s. Moreover the effect disappears in some model specifications.

Valev and Rioja (2002) studied the 1961-95 period and 74 countries. They found that financial development affects economic growth through productivity increasing channel in developed countries and through capital accumulation channel in developing countries.

Loayza and Ranciere (2002) researched the 1960-1995 period and 74 countries. They found that the positive effect of the increase in financial aggregates on growth deceases over time especially in the coutries which frequently has financial crises. Moreover the effect is negative in the periods of crises.

Neusser and Kugler (1998) studied the 1970-991 period and 13 the Organization for Economic Co-operation and Development countries. They chosed manufacturing sector's production and its productivity as the indicator for economic performance and financial sector's total production as the financial development indicator. They found a co-integration relation for a half of the countries.

Rousseau and Vuthipadadorn (2005) researched the 1950-2000 period and many Asian countries such as Japan, Korea, India ect. For many countries they found that the relation with capital accumulation is positive and important but the relation with gross domestic product (GDP) is weak.

Abu-Bader and Abu-Qarn (2008) studied the 1960-2004 period and six middle east countries (Egypt, Israil, Algeria, Tunisia, Fas and Suria). They found a unidirectional causation from at least one of the indicators for financial development such as M2 and private loans to ecconomic growth for the most of the countries. Exceptionally the direction of causation is from growth to financial variables for Israil.

Esso (2009) researched the 1960-2005 period and the member countries of ECOWAS (The Economic Community of West African States). Altough a positive long-run relation is found for four countries including Niger and Togo the relation has negative sign for two countires. For other countries they report no relationship between finance and growth.

Darrat (1999) studied the 1964-1993 period and these three countries: Turkey, Saudi Arabia, UAE (United Arab Emirates). He found that the direction of causation both in the short and long run is from financial variables to growth for Turkey. For UAE the relation is short term and between credit aggregates and growth. The relation is found long-run and both directional for Saudi Arabia.

Kar and Pentecost (2000) researched the 1963-1995 period and Turkey. They used monetary aggregates and loans as the financial

variables. They found that all variables have a co-integration with growth. But the direction of causation is from finance to growth only with M2. For credit variables it is from growth to financial aggregates.

Halıcıoğlu (2007) studied the 1968-2005 period and Turkey. He used the ratios of broad maney and banking sector liabilities to GDP. He found that there is a co-integration relation and the deepening of financial sector is effective on growth through that relation. He claims that the time series method of autoregressive distributed lag (ARDL) is used for the first time in a study on growth- finance relation for Turkey.

Oztırk (2008) investigates the causality between financial development and economic growth in Turkey for the period 1975-2004. The empirical investigation is carried out in a vector autoregression framework based on the theory of cointegration and error-correction representation of cointegrated variables. The results provide evidence of the existence of a long-run relationship between financial development and economic growth. The empirical findings in the paper show a two way causality (bidirectional) between financial development and economic growth.

Altıntaş and Ayrıçay (2010) researched the 1987-2007 period and Turkey. With quarterly data and by ARDL metod they got results that indicate a loung-run co-integration relation between real income, financial development, openness, and real interest rates.

Kirankabeş and Başarır (2012) studied stock market and national income. They take Istanbul stock exchange 100 index as the financial variable and used quarterly data and vector error correction model (VECM) estimation method. They concluded that there is a positive unidirectional causation from finance (stock market) to economic growth.

4. ANALYSIS OF THE RELATIONSHIP BETWEEN FINANCE AND GROWTH FOR TURKISH ECONOMY

Here I first describe the method and data then display and discuss the results of econometric estimations and tests such as unit root and co-integration.

4.1. Method and Data

There are many methods that could be used in estimation of co-integration relations. Some of them are system estimation methods and others are single-equation estimation methods. Many methods work with the assumption of that all series have unit roots and some methods do not require that. Phillips and Loretan (1989) did a very comprehensive research about the methods and concluded with many important suggestions to researchers. First of all they say that it is not necessary to use system estimation methods (for example Johansen system method which is widely used in the literature). Any method that takes into account the effects of short term dynamics on the variance of long-term relation would be sufficient. Their suggested method is very similar to Engle-Granger two stage estimation method. In this method first the co-integration relation is estimated and then the residuals from this equation is used in the estimation of difference values (not level values) of the variables. Differences are regressed on both one lag values of the residuals (error correction) and past values of their own and other variables' difference values. The coefficients of the residuals are the error correction coefficients. They are usually negative as required by the fact that the differences must change so as to decrease (correct the errors) distance from long-term equilibrium relationship. If the coefficients are found statistically significant by the tests a model has been built and the relationship has been established.

As mentioned before Johansen system estimation method (VECM) is the most used method especially in the research on the finance-growth relation. However it requires great care for many reasons. On the issue Johansen (2007) said that regression methods are easy and require less care. Johansen (2004) also said that the method of maximum likelihood is very sensitive to the assumptions, the test of autocorrelation must be done diligently, and the assumption that parameters stay unchanged is vital. Furthermore the estimation which is based on the assumption of unchanged parameters is often valid only for short time periods, and making small-sample adjustments is extremely important. Konishi et al. (1993) emphasized that although Johansen method gives better results asymptotically, in small samples (small number of observations) the deviations may be so big and instead of it Stock and Watson's dynamic ordinary least squares (DOLS) method gives better results.

Accordingly in this study first the co-integration relation is estimated by the DOLS method, next the residuals from this equation are used in the regression of difference values, and by this way the correction coefficients are found. Finally it is tried to establish the statistical meaningfulness of the results through Wald test.

This type of methods assume that the series themselves are integrated. For this reason unit root tests must be conducted. There are many unit root tests such as augmented Dickey-Fuller test and Phillips-Perron unit root test. Panel unit root tests also can be used in time series analysis. Accordingly in this study three different panel unit root tests are done, but only Levine, Liu, Chu panel common unit root test results are presented in the tables. Others may be provided if requested.

After determination of that the series have unit roots the co-integration tests are conducted. For this purpose 5 different tests including Phillips-Ouliaris test, Hansen test, and Park added variables test are used, and only the results belonging other two of them, Engle-Granger test and Johansen test are displayed. Among them Johansen test has an advantage over others when there are more than one co-integration relations, but in general it is much more sensitive to the selection of number of lags (Konishi et al. 1993).

After getting positive results from co-integration tests, co-integration relation has been estimated by DOLS method,

as suggested previously. Then, the statistical significance of the coefficients are tested by Wald test for further confirmation.

Following, the residuals from that co-integration equation is analyzed, looking at autocorrelation, normality, and heteroscedasticity which are important for the health of the tests. And most importantly unit root test are done on the residuals. If they are not stationary (having unit roots) we cannot talk about any co-integration because there would mean that there was not a long-run equilibrium relation which had been tried to be kept by the variables (Hamilton, 1994).

Next, as being the second stage of the Engle-Granger two stage estimation method, the correction coefficients are found by using the residuals in the regression of difference values. And Granger-causation is established with the test of all coefficients together for statistical significance (Granger et al. 1998).

Granger and Yoon (2002) said that the co-integration might be between only certain components of the variables, and they call it "hidden co-integration." According to this idea, in this study I defined many variables as measures of monetary, credit, and security quantities in the economy and pre-tested them. I have continued the study with the variables which had highest probabilities during the tests.

The variables that were defined and pre-tested are below:

GDP: Gross domestic product
TMA: Number of Trade Mark Applications
M1 (Narrow Money): Currency and demand deposits
M2 (Intermediate Money): Includes M1, and in addition time deposits
M2F: Includes M2, and in addition deposits in foreign currencies
NTCRDVLM: Net Credit Volume
BNKTTLCRD: Total Credits given by Banking Sector
BNKHSHLD: Household Loans given by Banking Sector
BNKBSNS: Business Loans given by Banking Sector
BNKPBLCCRD: Public Loans given by Banking Sector
FNNBSNSCRD: Business Loans given by other Financial Institutions
CBCRD: Total Credit given by the Central Bank
CBBSNSCRD: Business Loans given by the Central Bank
CBPBLCCRD: Public Loans given by the Central Bank
TTLSCRTY: Total Volume of Securities
PBLCSCRTY: Volume of Public Sector Securities
PRVTSCRTY: Volume of Private Sector Securities
NMNLIR: Nominal Interest Rate

And the variables which are driven from the listed variables are:

BNKPRVTTTLCRD: Sum of Household and Business Loans given by Banking Sector
TTLBSNSCRD: Sum of Business Loans given by both the Banking Sector and the Central Bank

According to the test results the variables which have the highest probability of having a co-integration relation with growth are these: GDP, TMA, M1, M2F, BNKHSHLD, BNKPRVTTTLCRD, TTLBSNSCRD, PBLCSCRTY. The model's variables are determined as GDP, TMA, M1, BNKPRVTTTLCRD.

Similar to Rousseau and Vuthipadaran's study (2005) I got real values of financial variables through deflation of nominal values by GDP deflator, and then reached per capita values through dividing them by population. Alternatively the ratios of financial variables to GDP are often used in the literature.

In the study the level values are the logarithms of the variables. The difference of two consecutive logarithm of a variable's values is approximately equal to the growth rate of the variable. Accordingly the difference values in the model correspond to the growth rates of the variables. To denote the growth rates I put the letter G in front of the notations for the level values. For example, GGDP stands for the growth rate of GDP.

Dummy variables have not been included in estimations because it might affect test distributions. After all dummy variables are especially required when the series are not affected similarly (Hendry and Juselius, 2000).

Data, shown at Table 1 belong to the 1980-2010 period and most of them are taken from the source called " Economic and Social Indicators 1950-2010" which is prepared by State Planning Organization and presented at the Ministry of Development's website.

I found year 1980 as an outlier after pre-tests and excluded it from further estimations.

4.2. Econometric Results and Discussions

After exhaustive tests and assesments I determined the co-integration model's variables. Three different unit root tests are conducted. Five different co-integration tests are done. Then I estimated the relation by DOLS single equation estimation method. The residuals from this estimation are tested to see they have no unit root because it would make co-integration analysis meaningless. After confirming that residual is stationary I used them to find the error correction coefficients. Finally I tested the result's robestness through Wald test. The results have shown that there is a co-integration relation which has been kept by GDP. Other variable are found weakly independent and driving economic growth.

4.2.1. Variables of the model and unit root tests

LogGDP: Log of real GDP per capita
LogTMA: Log of number of trade mark applications by firms resident in Turkey
LogM1: Log of real M1 money supply per capita
LogBNKPRVTTTLCRD: Log of real banking sector private credits per capita

Looking at Figure 1, it is seen that GDP and TMA have a relatively more linear stochastic trend. In the period M1 monetary measure first was in a recession until 1996 and then began a linear upside trend. It might be the case that when these downward and upward trends occur other financial variables closed the gap and supplied necessary funds.

For the health of the analysis, especially the method I use here, it is extremely important that the variables have unit roots. According

to the test results there is nothing to invalidate co-integrating analysis. Levin, Lin & Chu unit root test results are shown at Table 2. Phillips-Perron test and GDF Fisher test which were done for confirmation of unit root in level values also support the result. They may be provided on request.

4.2.2. Co-integration test

Both the Johansen test at Table 3 and Engle-Granger test at Table 4 point to the existence of a co-integration relation. Phillips-Ouliaris test which is done but not presented here also indicated that there is a co-integrating relation and it is continued by GDP and TMA variables. Furthermore while Hansen test confirmed the results of previous three tests Park test indicated a very low probability of co-integration. Engle-Granger test and Phillips-Ouliaris test showed that error correction exists for only two variables, GDP and TMA.

4.2.3. Estimation of single equation co-integration and error correction coefficients

Estimated equation:

$$\text{LogGDP} = C(1)*\text{LogTMA} + C(2)*\text{LogM1} + C(3)*\text{LogBNKPRVTTTLCRD} + C(4)$$

$$\text{LogGDP} = 0.18*\text{LogTMA} - 0.12*\text{LogM1} + 0.15*\text{LogBNKPRVTTTLCRD} + 4.85$$

The variable's t-statistics are quite high as seen at Table 5. Except the coefficient of LogM1 all coefficients are positive. These coefficients are interpreted as explaining how a long-term change in one variable affects other variables' long-term values (Johansen, 2002). Unit root tests on the residuals show that there are no problem for continuing the research (Table 6).

To see the difference I specified two different regression models: One that involves all of the variables (Table 7), and the other one that has only the resduals as the explanatory variable which had showed statistical significance in the tests (Table 8).

In this second regression the coefficients of residual are found important both in terms of absolute value and statistical significance. Furthermore the results of Wald test confirm the model's expalanatory success, shown at Table 9.

5. CONCLUSION

Romer's model shows that the problem of diminishing marginal product of capital can be solved and growth can be sustained through continuous introduction of new goods and opening of new sectors.

Table 1: Data used in the econometric model

Years	Population	SPO				TMA
	World bank	Deflator	Nominal, TL			World bank
			GDP	M1	BNKPRVTTTLCRD	
1981	45.130.008	0.000371663	10.620.920	972.043	1.157.900	1986
1982	46.198.027	0.000476569	14.104.074	1.341.911	1.632.500	3496
1983	47.285.732	0.000601709	18.692.826	1.940.982	2.192.200	NA
1984	48.360.679	0.000891956	29.569.564	2.252.668	2.928.000	4015
1985	49.399.630	0.001365174	47.176.942	2.778.000	4.860.100	3558
1986	50.393.538	0,001856733	68.663.151	3.406.000	8.456.500	3740
1987	51.349.154	0.002480818	100.444.611	5.422.000	13.079.700	3790
1988	52.278.499	0.004201259	173.709.458	7.854.000	18.428.900	4051
1989	53.200.802	0.007372053	305.579.273	13.761.000	30.757.000	6359
1990	54.130.268	0.011667011	528.369.362	23.786.000	55.173.700	8143
1991	55.068.880	0.018531752	847.031.883	36.246.000	87.101.300	8616
1992	56.012.109	0.030340324	1.469.755.064	55.073.000	168.157.400	9743
1993	56.959.988	0.050902098	2.664.115.907	92.941.000	312.325.900	12251
1994	57.911.273	0.085398678	5.200.118.494	162.779.000	528.429.000	11675
1995	58.864.649	0.1763095	10.434.646.573	309.045.000	1.277.943.500	12815
1996	59.821.978	0.313555003	19.857.342.512	536.438.000	3.029.299.000	15860
1997	60.783.217	0.56921935	38.762.505.879	1.086.169.000	6.959.949.000	16118
1998	61.742.674	1	70.203.147.000	1.890.002.000	10.774.212.000	14632
1999	62.692.616	1.5417901	104.595.916.000	3.199.510.000	15.390.632.000	18277
2000	63.627.862	2.30074969	166.658.021.000	5.833.606.000	25.561.979.000	21188
2001	64.544.914	3.516708556	240.224.083.000	9.238.299.000	30.776.161.000	20289
2002	65.446.165	4.832831106	350.476.089.000	12.415.844.000	31.971.146.000	28534
2003	66.339.433	5.957445886	454.780.659.000	17.540.350.000	48.889.710.000	30507
2004	67.235.927	6.696161431	559.033.026.000	25.457.219.000	76.602.464.000	38524
2005	68.143.186	7.17053706	648.931.712.000	33.550.545.000	118.799.132.000	48981
2006	69.063.538	7.839610408	758.390.785.000	42.438.117.000	167.287.175.000	54788
2007	69.992.754	8.32730724	843.178.421.000	45.314.273.000	212.649.743.000	58713
2008	70.923.730	9.326119446	950.534.250.000	54.039.683.000	260.234.146.000	60597
2009	71.846.212	9.819876011	952.558.579.000	62.242.416.000	285.453.287.000	59819
2010	72.752.325	10.4385282	1.103.749.801.055	79.153.235.000	389.854.978.000	NA

Source: SPO: State Planning Organization. The organization has newly been evolved as the Ministry of Development, before it was working under the Prime Ministry. http://www.dpt.gov.tr/PortalDesign/PortalControls/WebIcerikGosterim.aspx? (25 April 2012), World Bank: http://www.data.worldbank.org/country/turkey (01 May 2012)

Table 2: Levin, Lin and Chu unit root test results of the model

Null hypothesis: Unit root (common unit root process)		
Series: LogGDP, LogTMA, LogM1, LogBNKPRVTTTLCRD		
Exogenous variables: Results are for individual effect, individual intercept and trend, and none of them respectively		
Method	**Statistic**	**P***
Levin, Lin & Chu t	0.3983	0.6548
Levin, Lin & Chu t	0.5278	0.7012
Levin, Lin & Chu t	4.4744	1.000

*Probabilities are computed assuming asymptotic normality

Table 3: Johansen co-integration test summary

Series: LogGDP, LogTMA, LogM1, LogBNKPRVTTTLCRD					
Selected (0.05 level*) number of co-integrating relations by model					
Data trend	**None**	**None**	**Linear**	**Linear**	**Quadratic**
Test type	**No Intercept No trend**	**Intercept No trend**	**Intercept No trend**	**Intercept Trend**	**Intercept Trend**
Trace	1	1	1	1	1
Max-Eig	1	1	1	1	1

*Critical values based on MacKinnon-Haug-Michelis (1999)

Table 4: Engle-Granger co-integration test

Series: LogGDP, LogTMA, LogM1, LogBNKPRVTTTLCRD				
Null hypothesis: Series are not co-integrated				
Co-integrating equation deterministics: C				
Dependent	**tau-statistic**	**P***	**Z-statistic**	**P***
LogGDP	−4.664035	0.0404	−25.96013	0.0179
LogTMA	−4.657575	0.0409	−24.14314	0.0343
LogM1	−3.335385	0.3173	−13.57027	0.4563
LogBNKPRVTTTLCRD	−2.869967	0.5197	−14.59505	0.3856

*MacKinnon (1996), P values, GDP: Gross domestic product

Table 5: Co-integration equation estimate

Dependent variable: GDP				
Method: DOLS				
Variable	**Coefficient**	**SE**	**t-statistic**	**P**
LogTMA	−0.169316	0.042077	−4.023960	0.0013
LogM1	0.210290	0.029875	7.039102	0.0000
LogBNKPRVTTTLCRD	0.187023	0.017244	10.84546	0.0000
C	5.877322	0.106468	55.20272	0.0000
R^2	0.992169	Mean dependent var		6.905955
Adjusted R^2	0.985456	SD dependent var		0.240315
SE of regression	0.028982	Sum squared resid		0.011759
Durbin-Watson statistics	2.261355	Long-run variance		0.000580

SE: Standard error, DOLS: Dynamic ordinary least squares, SD: Standard deviation, GDP: Gross domestic product

Table 6: Unit root tests on the residuals

Null hypothesis: RESID has unit root		
	Adjusted t-statistics	**P***
Exogenous: Constant		
Phillips-Perron test statistic	−4.031024	0.0049
Test critical values		
1% level	−3.724070	
5% level	−2.986225	
10% level	−2.632604	
Exogenous: Constant, linear trend		
Phillips-Perron test statistic	−3.949877	0.0247
Test critical values		
1% level	−4.374307	
5% level	−3.603202	
10% level	−3.238054	
Exogenous: None		
Phillips-Perron test statistic	−4.130194	0.0002
Test critical values		
1% level	−2.660720	
5% level	−1.955020	
10% level	−1.609070	

*MacKinnon (1996) one-sided P values

A well-functioning financial system makes the flow of capital from a firm or a sector which has relatively low level of marginal productivity to the opening of new industries and introduction of new goods (especially to the sectors which require long-term commitment and high level of minimum scale) possible, efficient and faster. By this way it contributes to sustained economic growth.

If we take into account the fact that in the real world returns from different products, firms and industries are not as certain as assumed in the model and they are fluctuating and risky we can appreciate that introduction of new ones will reduce overall risk by providing more diversification and make income (micro and macro) more regular. With this another means of risk reduction there will be increase in investments in risky but high return promising areas. A well-developed financial system boosts investments by enabling individuals and firms to be better exposed to the risks with all its instruments and practices (such as easing change of ownership and derivative products).

I think that the waging effect which is explicitly defined for the first time will be important in the relationship between financial development and economic growth. It reminds us that in the process of development many new subtle interactions may appear. Policy makers and regulators should take them into account in modernizing the system.

In the empirical part of the study I defined and worked with many monetary, credit and security variables. After initial tests I continued only with the variables which had highest probabilites. The final model specification involved only GDP, TMA, M1 (Narrow Money), BNKPRVTTTLCRD (Banking sector's total private credits).

Both from the supplier of and the user perspective private credits are found much more important than public counterparts. Our results shows that only private credits are co-integrated with GDP and trade mark applications. They deserve special attention in shaping our financial policies.

On the direction of causation we see that the adjusting variable that keep the cointegration relation has been the GDP. Others are weakly independent and drive economic growth.

To be more concrete the results have supported the hypothesis that financial development is very important for and has long-term equilibrium relation (co-integration) with economic growth.

Figure 1: Model's variables versus time

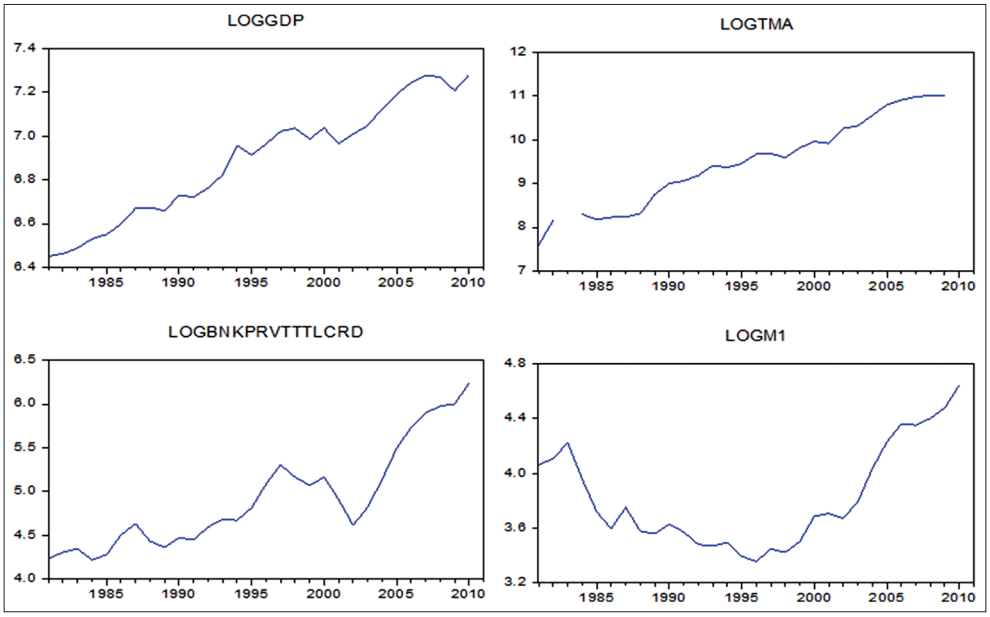

Table 7: First estimates of error correction coefficients for GGDP

Dependent variable: GGDP				
Method: DOLS				
Variable	**Coefficient**	**SE**	**t-statistic**	**P**
GGDP_1	−0.091469	0.246402	−0.371220	0.7144
GTMA_1	0.039158	0.065577	0.597124	0.5571
GM1_1	−0.052457	0.092316	−0.568234	0.5762
GBNKPRVTTLCRD_1	0.081407	0.066938	1.216152	0.2381
RESID (−1)	−0.563165	0.320361	−1.757907	0.0941
C	0.021861	0.012039	1.815854	0.0844
R^2	0.377748	Mean dep. var		0.029095
Adjusted R^2	0.222185	SD dependent var		0.049201
SE of regression	0.043392	Akaike info criterion		−3.237917
Durbin-Watson statistics	0.037657	Schwarz criterion		−2.947588
Log likelihood	48.09293	Hannan-Quinn criterion		−3.154313
F-statistic	2.428266	Durbin-Watson statistics		1.767537
P (F-statistic)	0.071029			

SE: Standard error, GGDP: Growth rate of gross domestic product, SD: Standard deviation, DOLS: Dynamic ordinary least squares

Table 8: Second estimates of error correction coefficients for GGDP

Dependent variable: GGDP				
Method: Least squares				
Variable	**Coefficient**	**SE**	**t-statistic**	**P**
C	0.028456	0.007809	3.644036	0.0012
RESID (−1)	−0.718383	0.209071	−3.436080	0.0021
R^2	0.320775	Mean dep. var		0.028769
Adjusted R^2	0.293606	SD dependent var		0.048275
SE of regression	0.040574	Akaike info criterion		−3.500206
Durbin-Watson statistics	0.041156	Schwarz criterion		−3.404218
Log likelihood	49.25278	Hannan-Quinn criterion		−3.471663
F-statistic	11.80665	Durbin-Watson statistics		1.603663
P (F-statistic)	0.002072			

SE: Standard error, SD: Standard deviation, GGDP: Growth rate of gross domestic product

Table 9: Wald test for GGDP

Test statistic	Value	Df	P
t-statistic	−3.436080	25	0.0021
F-statistic	11.80665	(1, 25)	0.0021
Chi-square	11.80665	1	0.0006

Null hypotesis: C(2)=0. GGDP: Growth rate of gross domestic product

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