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**Financial Development and Growth Volatility:
Time Series Evidence For Mexico
and The United States**

Importante

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Abstract

This paper explores the influences of financial deepening on growth and its volatility. Following a review of the theoretical literature that has attempted to explain these relationships, the paper presents time series evidence for the cases of Mexico and the US. The results suggest that, in the case of the US, financial deepening has been related to the rate of real output growth but that finance has not shown a significant relationship with output volatility. In the Mexican case, financial deepening has reduced the volatility of growth which, in turn, has induced higher output growth rates. Further, higher US growth rates have resulted in higher and less volatile growth rates in the Mexican economy.

Keywords: Financial development, monetary and credit deepening, growth, volatility, VAR models, GARCH models.

JEL Classification: C22, C32, F43, O40.

Resumen

En este trabajo se explora la influencia de la profundización financiera sobre el crecimiento del producto real y su volatilidad. Después de hacer una revisión de la literatura teórica que intenta explicar estas relaciones, se ofrece evidencia de series de tiempo para los casos de México y Estados Unidos. Los resultados sugieren que en el caso de Estados Unidos, la profundización financiera se relaciona con la tasa de crecimiento del producto real, pero no con su volatilidad. En el caso de México, la profundización financiera ha reducido la volatilidad del crecimiento lo cual, a su vez, ha tenido un efecto positivo sobre la tasa de crecimiento. Adicionalmente, se encuentra que mayores tasas de crecimiento del producto en Estados Unidos han resultado no solamente en mayores tasas de crecimiento sino también en una menor volatilidad del crecimiento en México.

Palabras clave: Desarrollo financiero, profundización monetaria y crediticia, crecimiento, volatilidad, modelos VAR, modelos GARCH.

Clasificación JEL: C22, C32, F43, O40.

Introduction

For at least a couple of centuries, the influence of financial development on economic growth has attracted vigorous debate among economists. Despite numerous approaches —within the current consensus— on what circumstances may actually produce these effects, there is growing empirical evidence that financial variables have significantly influenced the rate of economic growth.

On the one hand, the theoretical literature has identified alternative mechanisms through which the performance of the financial system influences the fundamental determinants of economic growth. In particular, the accumulation of physical and human capital and technological innovation are spurred by the role of the financial sector in mobilizing and pooling savings mostly from households (surplus units) and reallocating this purchasing power to investment projects with high marginal rates of return (deficit units) as well as its roles in improving the stock of information about investment opportunities and firm performance, the monitoring of managers and exercise of corporate control, the pooling, exchanging, diversifying and mitigating of idiosyncratic and systemic risk and, in general, its role in.

On the other hand, the empirical literature suggests that a better performance of the financial system leads to higher output growth rates, although the specific channels for these effects are not fully specified (Beck, Levine and Loayza, 2000). Further, both the theoretical and the empirical contributions recognize and discuss issues about reverse causality; indeed, economic growth also influences financial development.

In turn, there is a literature —albeit not as developed— that examines the influence of financial deepening on the volatility of economic growth. Here as well, theoretical contributions have identified mechanisms through which finance may influence volatility. In particular, by diversifying production risks, smoothing responses to liquidity shocks, contributing to the mobilization of savings —as precautionary reserves— and improving the stock of information, the efficient performance of the financial sector may diminish the volatility of output growth. Empirical contributions seem to support the theoretical predictions in this case as well. The more recent papers emphasize that the rate and the volatility of economic growth are influenced, not just by the level of financial development, but also by the structure of the financial sector and, in particular, by the evolution over time of the banking system.

The objective of this paper is to assess the influence of financial deepening on the rate and volatility of output growth in two quite different but closely interconnected economies: Mexico and the United States, using time series methods. First, unit root tests are carried out to determine if the variables do exhibit stochastic trends. Next a VAR approach is used in order to examine Granger-causality between finance and growth. The relationship

between measures of financial development and growth volatility is then investigated using GARCH models. In all cases, diagnostic checks, particularly autocorrelation tests, are implemented to assure that the estimated models are well specified.

The results suggest that, in the case of the United States, financial deepening has been positively related to the rate of economic growth but that it has not been significantly related to the volatility of growth. In turn, in the case of Mexico, the results show that financial deepening has had a positive impact on economic growth through the channel of reducing the volatility of growth. When financial development is approximated by a money deepening variable, the results are stronger. This suggests that the expansion of banking has had a positive effect on economic growth in Mexico. When, instead, the proxy used is domestic credit, the results are ambiguous. These results suggest a potentially negative effect of an ample use of domestic credit to fund government budgets rather than private investment. Finally, this study finds that higher US growth rates have resulted not only in higher growth rates in the Mexican economy, a fact that is well known, but also in less volatile growth. To the best of our knowledge, this last finding, on the effect of US growth on growth volatility in Mexico, is novel in that it explicitly identifies a volatility channel and has important implications for understanding the links between these economies.

The remainder of the paper proceeds as follows. Section 1 reviews the theoretical and empirical literature. Section 2 gives an overview of the historical and current situation of the financial system in Mexico and in the United States. Section 3 describes the time series methodology used in the study. Section 4 presents and discusses the empirical results. The main conclusions are summarized in Section 5.

1. Theoretical Contributions

1.1. Financial Development and Economic Growth

Interest in the relationship between financial institutions and economic growth is not new. Earlier, when exploring the role of institutions, Hamilton (1791) and Bagehot (1873) and then Schumpeter (1934) and Hicks (1969) had looked into this relationship. Attention to the connection between finance and growth increased in the second-half of the last century (Gurley and Shaw, 1955 and 1960; Cameron et al., 1967; Goldsmith, 1969; McKinnon, 1973 and 1976; Shaw, 1973).¹ These authors identified transaction and information

¹ As Levine (1997) highlights, the pioneers analyzed the role of finance in economic growth with models that formalized the financial sector solely in terms of money and introduced a distinction between the financial and real sectors of the economy. Nevertheless, as these more recent contributions have highlighted, the financial sector is “real”. Based on their approach, Fry (1988 and 1995) examines several models of growth with money, including

costs (in the exchange of goods and securities and in enforcing contracts) as the trigger for the emergence of financial markets and intermediaries. In their view, financial tools seek to mitigate the economic consequences of frictions, in order to enlarge market size and arrive at more efficient allocations of resources, which increase factor productivity and accelerate economic growth.

Others, however, have questioned the role of finance in economic growth and have claimed that financial deepening is a consequence, not a cause, of economic growth (Robinson, 1952; Lucas, 1988). In particular, the traditional literature on economic growth (Romer, 1986 and 1990; Lucas, 1988; Aghion and Howitt, 1992) ignored the role of financial institutions as an engine of economic growth. The main reason was that these endogenous growth models were developed in the general-equilibrium framework of Arrow-Debreu and did not allow for frictions and imperfections. Thus, during the blossoming of economic growth models, the role of financial development was overlooked.

Towards the end of the century, however, interest in identifying a positive influence of financial development on economic growth resurfaced. In contrast to the earlier contributions, which focused on the role of money, a growing new literature has developed models that explicitly specify the relationship between financial intermediation and growth and has attempted to empirically verify their implications. These new contributions share a common thread with the pioneers: financial institutions emerge to mitigate the problems that result from the existence of transaction and information costs (which, in turn, induce adverse selection and moral hazard problems) and to facilitate responses to liquidity shocks.

In attempting to address these challenges, the financial sector influences the ultimate determinants of growth, as established by the traditional literature on economic growth: the accumulation of physical and human capital (Lucas, 1988; Romer, 1986) and technological change (Romer, 1990; Grossman and Helpman, 1991; Aghion and Howitt, 1992). Thus, starting from endogenous growth models, these contributions eliminate the assumption of perfect financial markets and thereby manage to incorporate the influence of changes in the efficiency of financial markets on economic growth.² To accomplish this, they generally consider the existence of credit rationing and take this outcome as an indicator of the level of financial development in a given country.

A full review of the theoretical discussion can be found in Levine (2004). The author classifies contributions according to how the different functions of the financial system influence the determinants of economic growth. In

Kapur (1976), Galbis (1977), and Mathieson (1980) as well as the contributions of Spellman and of Gonzalez-Vega, included in McKinnon (1976).

² Classical models of exogenous growth do not offer an appropriate framework, to the extent to which financial variables influence the levels rather than the rates of growth of output (Pagano, 1993).

particular, the financial system generates information on potential investment projects, allocates funds to the most profitable ones, and monitors their performance, thereby improving corporate governance. The financial sector also allows the diversification and management of risk, mobilizes and pools savings and facilitates the exchange of goods and services, assets and factors of production. Levine concludes that, despite the diversity of approaches, there is strong evidence that financial variables have a significant impact on economic growth. Some key contributions are summarized next.

Some of the earlier contributions used the conceptual framework of the *AK* model and showed how financial development influences the accumulation of physical capital (Greenwood and Jovanovic, 1990; Bencivenga and Smith, 1991 and 1993; Levine, 1991 and 1992), either by increasing the savings rate or by reallocating savings to technologies with a higher productivity of capital.

The more recent contributions belong to two sets. On the one hand, there are papers that examine the contribution of the financial system in the process of human capital formation. Access to credit to fund education is constrained by asymmetric information problems between borrowers and lenders and because human capital cannot be pledged as collateral (Galor and Zeira, 1993; Buiter and Kletzer, 1995; De Gregorio, 1996; Jacoby and Skoufias, 1997; De Gregorio and Kim, 2000).

On the other hand, some contributions follow the evolution of economic growth theories and, in recovering the ideas of Schumpeter, focus on showing how the development of the financial sector promotes research and development (R&D) at the firm level, accelerating technological change and growth (King and Levine, 1993; De la Fuente and Marín, 1996; Kower, 2002; Morales, 2003; Acemoglu, Aghion and Zilibotti, 2002; Aghion et al., 2004). Recently, Levine (2009) develops an endogenous growth model in which not only entrepreneurs undertake innovation, but also the financial sector searches for new processes to evaluate entrepreneurs. The conclusion is that technological innovation by firms and economic growth would cease unless the financial sector also innovates.

There is as well an ambitious collection of empirical contributions in the literature. Levine (2004) offers, again, a complete review. These contributions use different techniques and methods: growth regressions for a cross-section of countries (Goldsmith, 1969; King and Levine, 1993; Levine and Zervos, 1998; Levine, Loayza and Beck, 2000; La Porta et al., 1999), time series analysis (Jung, 1986; Demetriades and Hussein, 1996; Arellano et al., 2000; Ang and McKibbin, 2007) and panel techniques (Levine, Loayza and Beck, 2000; Beck, Levine and Loayza, 2000; Loayza and Ranciere, 2002). There are also detailed country studies and recent approaches, based on microeconomics, explore these issues at the industry or firm level (Rajan and Zingales, 1998; Ahlin and Jiang, 2005; Aghion, Fally and Scarpeta, 2006). Using a model to verify the costs levied by governments on financial

intermediation, Greenwood et al. (2010) show, for the United States during 1974 to 2004 first, and then with international data, that most of these countries could increase their output if they had a more efficient financial sector.

In general, all these contributions suggest that countries with a better performing financial sector enjoy higher rates of growth. A better performance of the banking sector would reduce the financial constraints that limit the expansion of firms and industries and this would be one of the channels of influence of the financial sector on economic growth. Levine (2004) also highlights that a common problem with these exercises is that the proxy variables used as indicators of financial development do not directly reflect the functions performed by the financial sector, in the ways claimed by the theoretical contributions.

Several contributions combine the influence of finance with other determinants of growth. Using data from Chinese provinces, Hassan et al. (2009) show that the development of financial institutions, legal regime, property rights, and political pluralism are associated with a stronger growth performance. Using data from 100 countries, Giuliano and Ruiz-Arranz (2009) find that remittances encourage economic growth in countries with a low level of financial development, as they offer an alternative for the funding of investment projects and in overcoming liquidity constraints. Masten et al. (2008) relate financial development to international agreements. In the case of the European Union, they find that financial development and integration among the countries in the Union has had positive effects on growth. In particular, the effect of financial deepening has been greater in the least developed countries, while the integration effect has been greater in the countries with the greatest level of financial development.

A potential challenge for the empirical analysis is reverse causality; the level of economic activity and technological change may, in turn, influence financial development. On the one hand, innovations in telecommunications and data management have reduced transaction costs and have encouraged the development of new financial products (Merton, 1992; Gup, 2003). On the other hand, economic development encourages savers and investors to channel resources to the financial system (Greenwood and Jovanovic, 1990). As Levine (2004) recognizes, however, despite the importance of an analysis of how the structure of the financial system influences and is influenced by economic growth, the corresponding literature has been considerably less developed.

An exception is Fung (2009), who empirically explores the potential convergence of financial development and economic growth and the interaction between them. The results confirm the existence of conditional convergence. Middle-income and high-income countries tend to converge, not only with respect to their per capita GDP, but also with respect to financial

development. The relationship and reciprocal interaction between financial development and economic growth is particularly strong in the early stages of development, and it tends to dilute once countries settle on a steady-state path. Countries with low incomes but with a healthy financial development catch up with middle income countries, while those countries that lack a well-performing financial system are caught in a poverty trap. The empirical section of this paper takes a closer look at the issue of causality and it analyzes the direction of causality between these two processes in the countries under study.

1.2. Financial development and growth volatility

The literature on financial development and economic growth has focused on explaining the influence of the performance of the financial sector on the positive trend of output growth and until recently –mostly now because of the global financial crisis– it had paid scant attention to its impact on output fluctuations. A somewhat less-developed literature thus examines how financial development influences the volatility of economic growth. The existence of persistent oscillations around the trend of output growth is, however, one of the fundamental stylized facts of economic growth. Further, the most recent literature discusses how the current crisis may have been influenced by the extent to which financial intermediaries have been one of the propagating mechanisms, a role that in turn depends on their level of development.

Let's look first at the literature that explores the effects of volatility itself on the rate of economic growth. While the empirical contributions (Ramey and Ramey, 1995; Blattman et al., 2004; Koren and Tenreyro, 2004; Aghion et al., 2004) find a negative correlation between volatility and economic growth, theoretical treatments disagree with these results, claiming that volatility may be either positively or negatively correlated with growth. Jones et al. (2000) conclude that the sign of the relationship between volatility and growth depends on two effects. On the one hand, greater volatility reduces the risk-adjusted returns on investment, thereby discouraging investment and growth. On the other hand, greater volatility increases precautionary savings and, through this channel, it accelerates economic growth. Which one of the two effects dominates depends on the value of the elasticity of inter-temporal substitution.

In the literature on financial development and volatility there are three theoretical strands, which analyze the mechanisms through which the financial system's performance may influence the volatility of growth. They are based on any one of the functions performed by financial intermediaries (Levine, 1997 and 2004). By diversifying portfolios, facilitating the management of production risk and coping with liquidity shocks, mobilizing

the precautionary savings of households, and generating information about the risks and returns of alternative investments (in order to allocate capital more efficiently), the financial sector may diminish the volatility of economic growth.

Portfolio theory is one of these approaches. From this perspective, financial development implies the creation of different instruments for risk diversification, which facilitate investment in more risky but more profitable assets. Diversification not only encourages growth, but it reduces uncertainty (Greenwood and Jovanovic, 1990; King and Levine, 1991; Levine, 1991; Saint-Paul, 1992; Devereux and Smith, 1994; Obstfeld, 1994; Acemoglu and Zilibotti, 1997).

The general framework for these contributions is as follows. Agents in the economy must decide on how to allocate their wealth or savings between two types of projects (i.e., the portfolio decision). The first type of projects are low-return but riskless projects. The second type of projects consists of highly productive investments that suffer from idiosyncratic shocks. Their uncertain returns are imperfectly correlated across projects. The larger the number of risky projects undertaken, the greater the diversification potential and the lower the risk faced by the global economy. In order to implement a larger number of highly productive projects and further diversify portfolios and lower global risk, however, sufficient amounts of capital are required, particularly if there are indivisible projects.

This is one of the key roles of the financial system. If the financial sector is undeveloped, it will not be able to mobilize and pool resources from a sufficiently large number of diverse and numerous savers, in a cost-effective manner, and many productive undertakings will not be possible. A more efficient financial sector would be able to fund a larger number of high productivity projects, despite their riskiness, and in this way reduce the volatility of growth. Aggregate risk declines through portfolio diversification, while the lower risk encourages investors and the higher productivity of the projects enhances economic growth.³

All of these contributions assume that agents are risk-averse. The fact that agents are sufficiently risk-averse is critical for the effect of financial development on economic growth to be positive (Bencivenga and Smith, 1991). Given risk aversion, when financial markets are poorly developed, agents chose to invest most of their wealth in a safe asset and channel only the residual to high-productivity projects. Given limited portfolio

³ Nevertheless, some authors claim that financial development may reduce the rate of growth (Pagano, 1993; Devereux and Smith, 1994). The reason is that, in reducing risk, diversification would allow agents to reduce their precautionary savings, which may decelerate economic growth (Mirman, 1971). If the effect of the reduction in the rate of savings on growth is stronger than the effect of the investment in more productive projects, due to diversification, the rate of growth may diminish. Which effect dominates will depend on the elasticity of inter-temporal substitution.

diversification, the uncertainty related to high productivity projects is high and economic growth is slow.⁴

These theoretical arguments have been used to explain why developed countries have growth rates less volatile than developing countries backed by most empirical work that show a negative correlation between the variability of growth rates and the growth rate (Aizenman and Marion, 1993; Ramey and Ramey, 1995; Blattman et al. 2004; Koren and Tenreyro, 2004; Aghion et al., 2004), although the variability of growth is not explicitly analyzed and formalized in most papers.

Nevertheless, some papers analyze this question in more detail. Acemoglu and Zilibotti (1997) examine the variance of productivity which could depend negatively or positively on the number of projects implemented in the economy. These authors conclude that the variance only diminishes with financial development if productivity of risky projects is high enough and the degree of indivisibility of the projects is also high. Along the same line, Greenwood and Jovanovic (1990) find that the variance of growth rates, depends positively on the rate of return of projects, the inter-temporal discount factor and the amount of funds available for investment. Again, these authors obtain the result that the higher the amount of funds available for investment, more projects will be implemented and risk will diminish, since the portfolio is better diversified.

Lastly, Aghion, Banerjee and Piketty (1999) develop a theoretical model and show that, by mobilizing savings and facilitating the creation of reserves, the financial sector allows the economy to better absorb shocks, particularly negative shocks, which increase the likelihood that investors had difficulties to get additional funding. The idea is that with undeveloped credit markets, the demand and supply of credit become more pro-cyclical, which magnifies the effects of shocks to the economy. González-Vega and Villafani-Ibarnegaray (2007) show, however, that the pro-cyclical behavior of credit portfolios depends on credit technology used as well as the characteristics of producers. In particular, in some developing countries, the credit portfolios of microfinance institutions have been less pro-cyclical than those of the banking sector.

There are a number of purely empirical investigations on this first theoretical strand, based on a portfolio approach. Easterly, Islam and Stiglitz (2000) discuss the importance of financial development on growth volatility. While price and wage rigidities have been advocated to explain output

⁴ While the papers based on a portfolio approach predict that less developed countries tend to invest in secure but less productive sector, Koren and Tenreyro (2004) argue that poor countries concentrate production in a few sectors but with high specific risk (agriculture), thus rejecting the *trade off* between less volatility and higher growth. These authors show, empirically, that as countries develop, they tend to move to less volatile productive activities. Concretely, they defend the thesis that developed economies tend to specialize in sector intensive in human capital, which adapt better to external shocks (Kraay and Ventura, 2001). Further, they show that the degree of development of the financial sector does not reveal a significant effect on volatility of growth.

fluctuations, the aforementioned authors defend the hypothesis that the degree of development of the financial sector determines the stability of the economy, since higher financial development, particular the development of the stock market, permits a better management of risks.

However, more access to financial markets also allows enterprises to increase financial leverage, which could imply higher risks and higher volatility. In their empirical analysis, these authors conclude that the relationship between volatility and financial development is not linear. Thus, although higher financial development could reduce volatility initially, when financial development is high, increases in financial activity could amplify the effect of shocks on the economy. This happens specially during financial crises, when the growth of the credit market is higher than in the stock market. Related to this result, Kunieda (2008) shows, using a dynamic panel data model, that the effect of financial development on volatility is concave; in early development stages output volatility is lower, with more development volatility is higher, while with a mature financial sector volatility is again lower.

The second strand of research studies the effect of the existence of information asymmetries problems and incomplete markets on volatility of product. Some examples are Bernanke and Gertler, 1990; Greenwald and Stiglitz, 1993; Kiyotaki and Moore, 1997; Carlstrom and Fuerst, 1997; Edwards and Végh, 1997; Bernanke, Gertler and Gilchrist, 1999; Jaffee and Stiglitz, 2000; De Meza and Webb, 2006. Ultimately, these problems could lead to credit rationing and inefficiencies that could reduce growth and increase volatility. Also, the financial capacity is the key to determine demand behavior as it is possible that a reduced capacity could reinforce and propagate the effects of real and monetary shocks.⁵ To this respect, Beck et al. (2006) finds some evidence that financial intermediaries could magnify monetary shocks, particularly in countries where firms have very limited access to the capital markets.

Some models have been calibrated for the US economy and reproduce the actual movements of output (Carlstrom and Fuerst, 1997; Bernanke, Gertler and Gilchrist, 1999). In turn, Denizer et al. (2000) find that Banks could have contributed to the reduction of volatility of consumption and investment. Similarly, Jalil (2009), Cecchetti et al. (2006) and Dynan et al. (2005), find evidence that financial development reduced volatility of economic growth.

The third strand of theoretical work starts with Aghion et al. (2004), who argue that due to various market imperfections and restrictions, financial markets become less effective to facilitate the absorption of aggregate shocks

⁵ Some of these papers argue that the financial system was determinant to magnify the Great Depression of 1929. In particular, the lack of confidence in the financial institutions and the insolvency of debtors were determinants of the persistence and severity of the Great Depression. In this regard, the effect of credit restrictions on aggregate demand caused by the financial collapse (Bernanke, 1983).

which leads to higher volatility of growth. Their empirical results for a panel of countries during the period 1960-2000 show that lower financial development is associated with higher exposition to shocks and higher negative effects of volatility on growth.

Aghion and Banerjee (2005), consider the same model and conclude that in closed economies, fluctuations are detonated by the interaction between credit restrictions and interest rates, while in open economies the source of instability is the interaction between the real exchange and interest rates. Farias (2007) shows that, in the case of developed countries, volatility of investment is higher with incomplete financial markets. Also, Aghion et al. (2005), show that flexible exchange rate systems can have negative effects on productivity growth and lead to higher macroeconomic volatility when the financial sector is undeveloped; with more developed financial Systems flexible exchange rates can increase productivity growth. The authors point out the usual view that flexibility of exchange rate systems in developing countries helps to absorb real shocks and to reduce volatility (Broda, 2004; Edwards and Levy-Yeyati, 2003) requires that exchange rate volatility be less than volatility of real shocks.

Empirically, Aghion et al. (2005) find, in a sample of 83 countries from 1960 to 2000, that the effect of exchange rate volatility on economic activity is small and insignificant. More recently, Aghion et al. (2009) find that Exchange rate volatility could have a significant effect on long run productivity in the case of countries with lower levels of financial development. Also, Aghion and Marinescu (2006) argue that counter-cyclical fiscal policies have positive effects on productivity growth, particularly in countries with low degrees of financial development.

Similarly, some papers have shown the effects of liberalization and integration of the financial sector on growth and volatility, depending on the degree of financial development. Federici and Caprioli (2009) find that a high degree of financial development is critical for the existence of transmission effects among countries, following credit crises. Özbilgin (2010) shows, with a standard real business cycle model for an open economy, that financial development and market integration are associated with higher volatility of investment and output. Mallick (2009) finds that the long run variance of real GDP is affected by the degree of financial development.⁶

⁶ A different but related question deals with the effects of liberalization on volatility of economic growth. The first works (Obstfeld, 1994; Devereux and Smith, 1994) defend openness to external markets permits a better diversification of risk and a reduction in volatility. Nonetheless, more recent works show that the previous effect could be ambiguous. The reason is that a higher degree of international openness makes economies less vulnerable but exposes them to external shocks (Easterly, Islam and Stiglitz, 2000). Buch, Döpke and Pierdzioch (2002) show how the effect of government policies can depend on the degree of openness of credit markets. The effect of monetary policies could be magnified if the markets are open; however, the impact of fiscal policies is reduced with more integrated financial markets. Epaulard and Pommeret (2004) show that higher market integration increases volatility of income and consumption, due to more variability of foreign prices. Empirically, Kose, Prasad and Terrones (2003) conclude that the effect of financial integration on volatility is ambiguous.

Finally, it is worth mentioning the paper by Aysan (2006) that focuses on the effect of volatility on financial markets and the effect of these on economic growth, using an overlapping generations model. The author finds that higher volatility increases the costs associated with financial market imperfections, which induces higher interest rates charged by financial intermediaries and higher costs of loans; which in turn induces enterprises not to choose the more productive technologies (because they become more expensive) which leads to lower economic growth.

1.3 Banking sector, growth and volatility

The more recent literature points out that the way in which financial markets evolve (their structure and type of development) is also important to explain growth and volatility. Using a panel of 70 countries from 1956 to 1998 and controlling for fixed effects, Denizer et al. (2000) show that those countries with a more developed financial sector have less fluctuations in real product, consumption and investment. They also show that the share of banks in the financial system is the more robust explanation of consumption and investment volatilities, while credit offered to the private sector explains volatility of output and consumption. Although the mechanisms through which the development of the financial sector affects volatility are not clearly specified, the previous results suggest that risk management and the generation of information are particularly important to reduce volatility of consumption and investment, while the availability of credit to the private sector helps to smooth consumption and production.

Dehejia et al. (2007) argue that the institutional mechanisms that impulse financial development are important to determine its consequences on economic growth and volatility. The United States from 1900 to 1940 provides an ideal study case since during that period State banks experimented various regulations.⁷ The financial expansion induced by the expansion of bank branching contributed to an accelerated process of mechanization of agriculture and stimulated growth of the manufacturing sector. However, the financial expansion induced by State deposit insurance had negative consequences for both sectors, since deposit insurance not only reduced the cost of loans and increased credit but also created moral hazard problems by reducing the costs of riskier credits. In fact, the State banks granted risky loans to the farming sector during the boom, previous to 1920. However, when agricultural prices collapsed during 1919 and 1920, the loans were not sustainable and this sector entered into a crises, which was rapidly propagated to the manufacturing sector.

⁷ In particular, the Glass-Steagall Act of 1933 which will be commented in the next section.

Mitchener et al. (2010) examine the relationship between the structure of the banking system and economic growth using data on the manufacturing industry and concentration of the banking sector during 1899 and 1929. This period was characterized by a rapid expansion of the manufacturing sector and the establishment of laws that restricted interstate banking, which resulted in a geographic segmentation of the banking sector and promoted concentration. These authors find that the high concentration of the banking industry affected growth of the manufacturing sector positively. A higher number of bank branches and per capita banks increased growth of those industries that depend on external financing or had more access to external sources of financing. Deposit insurance, however, depressed growth the manufacturing sector.

The previous results contrast with those in the recent literature on the effects of banking structure on economic growth, where most works show that a concentrated banking sector depresses economic growth (Cetorelli and Gambera, 2001; Clarke, 2004; Freeman, 2002; Garret et al. 2007); while more competition in this sector boosts economic growth (Claessens and Laeven 2005).⁸

The arguments are that higher concentration reduces credit supply and increases costs affecting growth negatively. However, the contradiction is only apparent. In general, there is agreement that concentration of banking affects positively the average growth of the economy; but different industries are affected differently depending on their requirements of external sources of funding.

Beyond the structure of the banking system, Beck et al. (2006) show that instability of macroeconomic policies increases growth volatility in countries with limited access to stock markets.

2. The Financial Systems in Mexico and the United States

This section presents a brief description of the financial systems in Mexico and the U. S., including an overview of their history, which was determinant of their current structure. The literature on financial development and growth attempts to explain how the financial institutions, by reducing transaction and information costs through their different functions, can affect the ultimate determinants of economic growth (investment in human and physical capital and technological change) and reduce poverty and inequality across nations

⁸ It is worth mentioning Cetorelli and Gambera (2001), who analyze data of 35 industries in 41 countries, with different degrees of economic development. These authors as well as most of the Studies in this literature agree in general that higher concentration affects positively to industries that heavily depend on external sources of funding.

(Levine, 1997). Thus, understanding the differences in the financial systems could help to understand differences in growth performance.

Most of the literature on the history of financial development points out that the enormous differences on the financial systems across countries are related to the political institutions developed in each country. The starting point is that financial development is the result of specific laws and regulatory policies in a context of conflicting interests. On the one hand, the growth of financial institutions is not possible without a government that is able to establish property rights and enforcement of financial contracts. On the other hand, governments rely on financial institutions in order to meet their financing requirements.

Thus, in the absence of institutions that could regulate governments, they will have incentives to develop financial systems that favor the flow of financial services to governments rather than to the private sector. In other words, governments can have a great influence on the development of financial systems, with consequences on economic growth. In what follows it will be seen the extent to which the previous point of view explains the enormous differences of the financial systems, particularly the banking systems, between Mexico and the US. Concretely, those differences were created by institutions that limited the power of politicians and governments.

Approximately, two centuries ago, the financial system in the US was very similar to that of Mexico. It was, essentially, a monopolized industry that generated rents for the government. However, the growing competition among the States produced, in a few decades, the emergence of hundreds of financial intermediaries all over the country. Each State had the power to grant licenses for the creation of new banks, which increased competition and reduced any tendency to monopolization. Some attempts to stop competition failed because they were not consistent with the growing competitive nature of the American political system defined by a federal system, separation of powers, electoral vote and competition among political parties.

The US decentralized system created competition among different jurisdictions and levels of government. In turn, politicians, trying to maximize profits in the financial system, created more competition in the system.⁹ The net effect was a sort of political and financial equilibrium. This structure, together with the leadership of private agents, leaded to the development of the actual US financial system.

As a result of competition, in the actual US financial system coexist different types of financial intermediaries, including banking and non-banking institutions; and the participation of the securities markets and investment

⁹ It should be mentioned, though, that the evolution of the financial system in the US had some ups and downs. The first and second Central banks were abandoned until they disappear. The State governors incremented licenses for new banks to obtain easy funding thus avoiding application of unpopular policies and favoring political partners with profitable monopolistic activities.

funds is, nowadays, among the highest in the world. The penetration of the system (measured by the ratio of Credit to GDP) is also among the highest in the world. Further, the presence of banks at the local level is very high; actually, there are more than ten thousand institutions among commercial banks and credit unions.

The banking system has been regionally fractional since the MacFadden Act in 1927 and became specialized under the Glass-Steagall Act in 1933. The MacFadden Act prohibited banking services beyond State boundaries. The goal was to incentive competition by putting on the same ground small State banks and important national banks and allowing them to operate in a single State. As a result, the US banking industry consisted of a large number of relatively small banks.

The Glass-Steagall Act did not allow banks to offer commercial banking services, investments and insurance under the same roof. This Act was created in response to the Stock crash in 1929 and the great depression, events that lead to the crash of nine thousand banks (about a third of the existing banks in the US), representing an effort to re-establish stability and confidence on the banking system.

With the regionalized system most banks had a clear regional demarcation and with the specialization there was a strict separation among commercial banking, investment banking and insurance. However the de-regulation initiated by the end of the 1990's relaxed the previous restrictions. In particular, the Gramm-Leach Bliley Act (1999), also known as the Financial Services Modernization Act, abolished the Glass-Steagal Act and opened the doors to competition among banks, investment companies and insurance companies, allowing them to offer different services under the same roof and without restrictions.

Currently, after a sustained growth of about six years, a period of rapid consolidations, growth of bank branching and increased investment in technology, the US financial industry is stagnated as a result of the mortgage crisis that produced the collapse of leading firms and whose consequences have extended to all sectors of the economy. Pushed by growing losses, the financial institutions are concentrated in reducing costs and improving operative efficiency.¹⁰ The dominant tendencies of the actual US financial system are consolidation, increased bank branching, small banking approach, strict requirements for risk management, and intermediary elimination.

On the other hand, the Mexican financial system has been characterized through history by persistent financial concentration and very limited financial inclusion. About two centuries ago, the dictator Porfirio Diaz was able to reduce and eliminate the power of State governors, making sure that congressmen candidates were their own supporters thus eliminating or

¹⁰ It is important to mention that, as it has always happened historically, the US financial system continues with the practice of rapidly adopting the technological advances.

limiting the power of local governments. As a consequence, the power of States to grant licenses for the creation of banks, the root of competition, was eliminated. The result was a very concentrated banking system that served the needs of the political and financial elites, repressing the development of industry in Mexico.

Despite the relatively large demand for financial services, the financial system was very small. Only a reduced group of enterprises had access to virtually unlimited funds, while the rest of economic agents faced a permanent situation of credit scarcity. The lack of institution building policies and effective protection to property rights gave rise to a financial system in Mexico, characterized by a reduced number of financial institutions that granted credits among themselves;¹¹ exactly opposite to the US system.

Differently than the US, Mexico did not develop a political structure and the institutions needed to regulate and control the power of government in the financial sector. The governments that followed Porfirio Diaz, continued exerting a tight control of the financial sector and it was not until the end of the 1990's when Mexico started to promote a more open financial sector.

The financial system in Mexico has been fundamentally a banking system, with a stock market relatively small. Until 1975 Mexico had a specialized system, somehow in the same spirit of the US Glass-Steagall Act. Later on, however, the system became more oriented to universal banking, creating financial groups with some restrictions, similar to the ones of the Glass-Steagal Act. However, differently than in the US, in Mexico there was nothing similar to the MacFadden Act, that could have imposed regional restrictions.

During most of the twentieth century this sector has suffered various financial repressions.¹² Besides, the sector was expropriated by government in 1982, re-privatized in 1990, crashed in 1995 and, since 1998, had increased participation of global banks. Despite the measures taken during the financial liberalization by the end of the 1980's and early 1990's, the Mexican banks have reduced loans in recent years because of liquidity constraints, legal restrictions that difficult the repayment of debts, higher risks and the consequent no-payment culture.

The penetration of the banking system in Mexico, of about 17% on average, is relatively low when compared with various similar economies. Despite its technology, which has international standards, the banking sector is small. There are approximately 40 banks, out of which only 5 concentrate more than 80% of total assets. On the other hand, 65% of the labor force does not have access to financial services of commercial banks; that is, at least 25 million

¹¹ By the end of the XIX century, for example, existed two banks, with networks at the national level, which controlled more than 60% of total assets.

¹² These repressions have been diverse and included the orientation of credit to specific sectors, interest rate ceilings, credit rationing, subsidies, absence of property rights and negative real interest rates during inflationary periods.

people out of the total labor force, do not have formal financial services. The formal financial sector, constituted by banks, stock market and other intermediaries, only reaches about 35% of people in the labor force.¹³

According to the Financial Culture Survey,¹⁴ only 40% of the Mexican population owns a bank account, 69% does not have information on the availability of financial products and services, and 8 out of 10 Mexicans prefer to have cash in hand rather than a credit or debit card. The total savings operated by formal financial intermediaries represent less than 60% of GDP, while the total formal credit represents only 15% of GDP. Thus, the formal financial sector in Mexico is not well developed and a relatively small fraction of the population uses formal financial services.

There have been some attempts to expand the financial sector by promoting the expansion of small financial entities, such as credit and savings unions and other microfinance institutions. However, the so called semi-formal financial sector, has not grown as expected and has had a limited penetration in the economy, basically through cooperatives that offer some financial services to the poor in rural areas. The development of financial services in rural areas can be characterized by having excessive costs, a large number of condonance programs, excessive regulation and a regressive effect on income distribution. As a result, government transfers to the rural sector diminished during the 1990's.

In the past, the Mexican cooperatives did not have legal support or formal mechanisms to promote their development under certainty. However, in June 2001, Congress passed on the new Law of Popular Savings and Credit (LACP) and the statutory Law of the National Bank of Financial Services (BANSEFI). The LACP establishes a monitoring system for the Popular Savings and Credit Sector through the National Commission of Banking and Stocks (CNBV) and BANSEFI, both of which are government institutions. This law consolidated the popular savings and credit sector by generating scale economies and facilitating the channeling of transfers from government programs through these institutions.

According to popular savings and credit institutions, an important problem faced by them is the great difficulty to operate under the legal framework. In this sense, the microfinance institutions have to look for sources of funding in order to assure their functioning and to be authorized by second level institutions, federations and the CNBV, thus sacrificing their operative sustainability. Another problem, from the point of view of the microfinance institutions is the lack of coordination among the existing government

¹³ See "La Banca Popular como un instrumento para incorporar a los beneficios de la globalización a quienes se encuentran ajenos a éstos". Series of Conferences at Universidad La Salle, "Globalización en el Siglo XXI". México, DF. April, 2002.

¹⁴ The survey was carried out by the National Bank of Mexico (BANAMEX) and the Autonomous National University of Mexico (UNAM), in 2008.

programs. As a result, since the 1980's several informal mechanisms of savings and credit have been developed for the people excluded from the formal financial sector but they also have been used by non excluded population. These mechanisms include a variety of financial transactions that do not have any regulation.

As a conclusion, it can be inferred from the previous discussion that the US financial sector is characterized by a high degree of development and penetration as well as a high level of competition along history, despite of the concentration of State banks in some periods. However, in the case of Mexico, the formal financial system, despite the support of public policies has not been able to reach most of the population and the informal financial sector has been more successful. Nowadays, high concentration and financial exclusion of a large sector of the population still presist, as in most developing countries.

3. Empirical Time Series Approach

Differently than most empirical papers in the related literature, this paper focuses on two specific countries, Mexico and the US using time series models. The empirical approach includes the following aspects. First, it proceeds to characterize the dynamics of the relevant variables. Next, it models output growth and financial development as a VAR process and performs causality tests and impulse-response analysis. Finally, a relevant GARCH model is estimated in order to examine the relationship between financial development and growth volatility. In what follows each of these aspects is briefly described.

3.1. Characterization of the variables

First of all, it will be determined if the dynamics of the growth rates of output and measures of financial development, is consistent with stationary processes by applying unit root tests. This aspect is fundamental in order to avoid potentially misleading inferences. Four unit root tests will be used, namely, the augmented Dickey-Fuller (Dickey and Fuller, 1979, 1981), Dickey-Fuller GLS (Elliot, Rothenberg and Stock, 1996), MS-t (Ng and Perron, 2001) and the KPSS (Kwiatkowsky, Phillips, Schmidt and Shin, 1992) tests. As it is well known, the null hypothesis for the first three tests is that the process has a unit root, while the last test considers stationarity as the null hypothesis. Since the empirical analysis focuses on growth rates, the tests will include a constant only in the estimated test equations in all cases.

3.2. VAR model, causality and impulse-response functions

A controversial aspect in the empirical literature on financial development and growth is on the direction of this relationship. In this paper, neither output growth nor financial development is assumed exogenous but rather it is assumed that there is a dynamic inter-relationship between the two processes. For this reason, the following VAR model is specified:

$$\begin{bmatrix} y_t \\ x_t \end{bmatrix} = \begin{bmatrix} \alpha_{11} \\ \alpha_{22} \end{bmatrix} + \sum_{j=1}^p \begin{bmatrix} \beta_{11,j} & \beta_{12,j} \\ \beta_{21,j} & \beta_{22,j} \end{bmatrix} \begin{bmatrix} y_{t-j} \\ x_{t-j} \end{bmatrix} + \begin{bmatrix} u_{yt} \\ u_{xt} \end{bmatrix} \quad (1)$$

Where y represents the growth rate of real GDP and x is a measure of financial development.¹⁵ The coefficients $\beta_{12,j}$ capture the effect of financial development on growth, while the coefficients $\beta_{21,j}$ indicate the opposite effect, that from growth to financial development. The parameters α_{11} and α_{22} can be interpreted as the autonomous components of both processes respectively. The terms u_{yt} and u_{xt} are random shocks which satisfy the conventional assumptions of zero mean, constant variance and constant contemporaneous covariance. The sub-index $j=1, \dots, p$ indicates the lag number and its maximum p will be determined using optimal lag criteria and assuring that the estimated residuals do not exhibit any significant autocorrelation pattern. In this way, we will avoid potential miss specification problems.

Once an appropriate VAR model has been established, the inter-dependence between both variables will be evaluated through causality tests in the sense defined by Granger (1969) and Sims (1972). Specifically, it will be evaluated if the coefficients $\beta_{12,j}; j=1, \dots, p$ are jointly equal to zero, in which case financial development will not affect (or Ganger-cause) growth. On the other hand, if the coefficients $\beta_{21,j}; j=1, \dots, p$ are jointly equal to zero, output growth will not affect (or Granger-cause) financial development.

Lastly, impulse-response functions of growth of real GDP to orthogonal shocks to financial development will be presented. It is important to mention that, in both cases, test for possible seasonality effects will be carried out, and in the cases where they are found significant, will be controlled for by including seasonal dummies.¹⁶ Also, in the case of Mexico, the model will

¹⁵ As we will see later, these are the ratios of Domestic Credit and Money Supply (M2), both in nominal terms, to nominal GDP.

¹⁶ This aspect is particularly important since we will use quarterly data in both cases.

include the growth rate of US's real GDP as an exogenous variable in order to capture the well known link between the US and Mexican economies.

3.3. Time series model of growth and volatility

In order to evaluate the dynamics of growth and its volatility the following univariate time series model will be considered:¹⁷

$$y_t = \alpha_{11} + \sum_{j=1}^m \beta_{11,j} y_{t-j} + \sum_{j=1}^n \beta_{12,j} x_{t-j} + \phi \sigma_t + u_{yt} \quad (2)$$

$$\sigma_t^2 = \mu + \gamma \sigma_{t-1}^2 + \lambda u_{t-1}^2 + \psi y_{t-1} + \varphi x_{t-1} \quad (3)$$

Where equation (2) is the conditional mean of the growth process and is, essentially, the first equation of the VAR model described in previous subsection, augmented by a GARCH-in-mean effect. The coefficients $\beta_{12,j}$ capture the effect of financial development on growth.

The parameter ϕ measures the extent to which volatility of growth affects the average growth rate. As mentioned before, although most empirical papers find a negative correlation between volatility and growth, from a theoretical point of view this relationship could be positive or negative. On the one hand, higher volatility reduces the risk-adjusted return of investment which has a negative effect on growth; on the other, higher volatility of growth increases growth by increasing precautionary savings and investment. Another possible mechanism is worth mentioning since this study uses short run data. A positive value of the parameter ϕ would also be consistent with Black's (1987) hypothesis, according to which investment in more specialized and risky technologies could lead to higher but more volatile growth rates.

The values of m and n are the number of lags for the growth and financial development processes respectively and they may not be equal nor do they necessarily refer to consecutive sequences of lags.

Equation (3) models the conditional variance of u_{yt} as a GARCH (1, 1) process.¹⁸ This process will characterize the dynamics of growth volatility.¹⁹

¹⁷ The justification for using a single equation approach is that, as we will see in the next section, the measures of financial development used in this study, despite their variability, do not show ARCH effects. Preliminarily, we proceeded to characterize the dynamics of real GDP growth as well as the measures of financial development and to evaluate if they exhibit a volatility pattern through LM tests for ARCH effects. ARCH effects were found only for the growth of real GDP processes but not for the financial development measures. The exception was the ratio Domestic Credit to GDP for the US case.

¹⁸ It makes justice to mention that these models initiate with the pioneering work by Engle (1982) and Bollerslev (1986).

¹⁹ This specification will turn out to be appropriate for the case of the US. For the Mexican case, volatility of growth will be modeled as an ARCH (1) process only.

The parameter φ will measure the effect of financial development on volatility of real GDP growth. Based on the literature previously discussed, in general, a more developed financial sector could reduce growth volatility since economic agents would have more information and better capacity to diversify productive risks and to deal with liquidity shocks. The parameter ψ will indicate, if positive, that higher growth rates in the economy will become more volatile, implying a feedback effect of growth on its own volatility.

In the case of Mexico, the growth rate of real GDP of the US economy will be included as a possible determinant of volatility of Mexican growth. It should be remarked that this is a novel issue investigated in this study. The fact that the Mexican economy is closely related to the US economy in terms of economic activity and other important macroeconomic variables, such as interest and exchange rates, makes it reasonable to postulate, empirically, that the growth rate of the US economy could also affect volatility of growth in Mexico.

Econometrically, the most appropriate GARCH model will be determined as follows. First, the appropriate specification for the conditional mean equation will be found by considering a maximum value of 24 for m and n , and selecting those lags that are statistically significant. Then, the specification is considered satisfactory if the estimated residuals do not show any significant patterns of autocorrelation. With this specification at hand, the possible presence of conditional heteroskedasticity will be evaluated, using the LM test for ARCH effects. After finding evidence on these effects, the ARCH(1) and GARCH (1, 1) specifications will be considered the more plausible specifications since the study uses quarterly data and, therefore, it is not expected to find too much persistence in the variance processes.

The model given by equations (2) and (3) is qualitatively different to the one used in some growth regressions with cross-country data, where growth volatility is approximated by the variance or standard deviation of growth rates of a group of economies at each period of time. Although this measure of volatility is accepted in the empirical literature for practical reasons, it is certainly limited to represent the inherent uncertainty or volatility of the growth process over time. This can be illustrated with the following example. Suppose two economies with highly volatile but identical growth rates. If we consider the standard deviation of this group of two economies as a measure of volatility, we would conclude that there is no volatility since the standard deviation of growth rates will be zero. On the other hand, suppose two economies with constant growth rates but very different to each other. In this case, the standard deviation will indicate that there is (high) volatility when in fact there is none.

The time series approach used in this study will allow us to get around the previous problem, since it makes possible to measure the variance of the process at each period of time, conditional on all previous information, to

evaluate if this process changes over time; and, if this is the case, to select the appropriate ARCH/GARCH specification. In addition it will be possible to model volatility effects on the mean of the process by allowing for GARCH-in-mean effects as well as by considering possible determinants of the volatility process itself, as it will be done in the present study. As it was mentioned before, this study concentrates on two economies only, thus avoiding the need of imposing *a priori* restrictions on equality of coefficients across economies.

The approach, however, could have some limitations. First, it uses a bivariate model which could be subject to the critique of under specification. More importantly, this model is not derived from a structural dynamic model, which would allow more proper evaluation of shocks to the economy. A related shortcoming is that the econometric results could be consistent with different mechanisms. Secondly, since the study uses quarterly data, the model may capture mainly short run effects, which may differ from long run effects, more related to the growth process. Finally, the time span of the study is not very large, particularly, in the case of Mexico, which can produce potentially biased and inefficient results. For all these reasons, this study should be considered a first approximation and the results should be taken with caution.

4. Empirical Results

This section first describes the variables used in the study as well as the data sources; then, the main findings are presented and discussed, following the empirical methodology outlined in the previous section.

4.1. Data sources and variables

This study uses quarterly data obtained from the International Monetary Fund's *International Financial Statistics* CD's. The data is available for the period 1957:01-2009:04 for the United States and for the period 1981:01-2009:03 for Mexico. The primary variables are Nominal Domestic Credit, Money Supply (M2), Nominal Gross Domestic Product and GDP Implicit Deflator.

With the previous variables the growth rate of real GDP (GREALGDP) has been constructed and will be taken here as an indicator of economic growth. Also, two indicators of financial development have been obtained. One of them is defined as the growth rate of the ratio of Nominal Domestic Credit to nominal GDP (GDCRGDP). The other indicator of financial development is the growth rate of the ratio of Nominal Money Supply to nominal GDP (GM2GDP). In the related empirical literature these indicators are considered measures of

credit and monetary deepening respectively and are accepted measures of financial development.

4.2 Unit root tests

Table A-1, shown in the Appendix, shows the unit root testing results. For the case of the US all tests show that GREALGDP and GM2GDP are consistent with stationary processes. For the variable GDCRGDP all tests but the ADF indicate stationarity. For practical reasons this process will be considered stationary.

For the Mexican case, there is strong evidence to conclude that GM2GDP is stationary. For the variables GREALGDP and GDCRGDP there is one test in each case that indicates that the process has a unit root. However, in all cases the KPSS test indicates that the variables are stationary. Although the evidence is not as strong as it would have been desirable, we consider that it is sufficient to characterize all three variables (expressed in annualized growth rates) as stationary.²⁰

4.3 VAR model, Granger-causality tests and impulse-response functions

Table 1 below reports the results on causality tests. These tests were performed using estimation results of the VAR models reported in table A-2, shown in the Appendix. It is important to remark that these specifications were considered satisfactory after making sure that the estimated residuals did not show any significant autocorrelation patterns.

As it can be seen, in the case of US the results support mutual causality between growth of the ratio domestic credit to GDP (GDCRGDP), that is growth of credit deepening, and growth of real GDP (GREALGDP). Regarding the relationship between growth of the ratio M2 to GDP (GM2RGDP), that is growth of monetary deepening, and growth of real GDP there is evidence on unidirectional causality only, from GREALGDP to GM2RGDP. Thus, in the case of US, the growth of real GDP could have been affected by credit deepening but not by monetary deepening.

²⁰ Based on purely economic considerations, it would be very hard to justify, for example, that the growth rate of real GDP could have a unit root. Besides, the data does not seem to exhibit such a behavior. Looking at the autocorrelation and partial autocorrelation functions, the apparent unit root behavior of the series (in growth rates) seems to be a consequence of seasonality and big fluctuations observed in the data.

TABLE 1. GRANGER-CAUSALITY TESTS

NULL HYPOTHESIS	VAR ORDER	SEASONAL DUMMIES	TEST (D. O. F)	P-VALUE
UNITED STATES (1957:01 – 2009:04)				
GDCRGDP does not Granger-cause grealgdp	4	Yes	24.52 (4)	0.0001***
GREALGDP does not Granger-cause gdcrsgdp	4	Yes	16.64 (4)	0.0023***
GM2GDP does not Granger-cause GREALGDP	12	No	14.65 (12)	0.2609
GREALGDP does not Granger-cause GM2GDP	12	No	24.27 (12)	0.0187**
MÉXICO (1981:01 – 2009:03)				
GDCRGDP does not Granger-cause GREALGDP	11	Yes	16.58 (11)	0.1210
GREALGDP does not Granger-cause GDCRGDP	11	Yes	53.72 (11)	0.0000***
GM2GDP does not Granger-cause GREALGDP	6	Yes	11.74 (6)	0.0679*
GREALGDP does not Granger-cause GM2GDP	6	Yes	21.40 (6)	0.0016***

In the case of the US 205 observations were used in the first two tests and 191 in the other two. In the case of Mexico the two first tests used 102 observations while the other two tests used Only 89 observations. Numbers in parenthesis in the fourth column (d. o. f.) indicate the degrees of freedom of the Chi-square distribution of the corresponding test.

In the case of Mexico, in contrast, the evidence suggests that credit deepening does not seem to affect growth of real GDP; on the contrary, growth of real GDP seems to have affected growth of credit deepening. It should be remarked that this study uses total domestic credit to measure financial development. Considering credit to the private sector could lead to different results.

Also, it is important to consider that, in the case of Mexico, the public debt represents an important fraction of the total bank's assets compared to credit to the private sector; and that an important part of the financing of private investment is done through foreign banks. Further work, that takes into account the previous distinctions, could shed more light about the role of growth of credit supply on economic growth.

As far as the second indicator of financial development, namely monetary deepness, approximated here by the growth of the ratio of money supply (M2) to GDP (GM2GDP), there is evidence of a bi-directional relationship between this indicator and growth of real GDP. However, it should be pointed out that the relationship from GM2GDP to output growth is statistically weak, while the opposite relationship (reverse causality) is statistically strong.

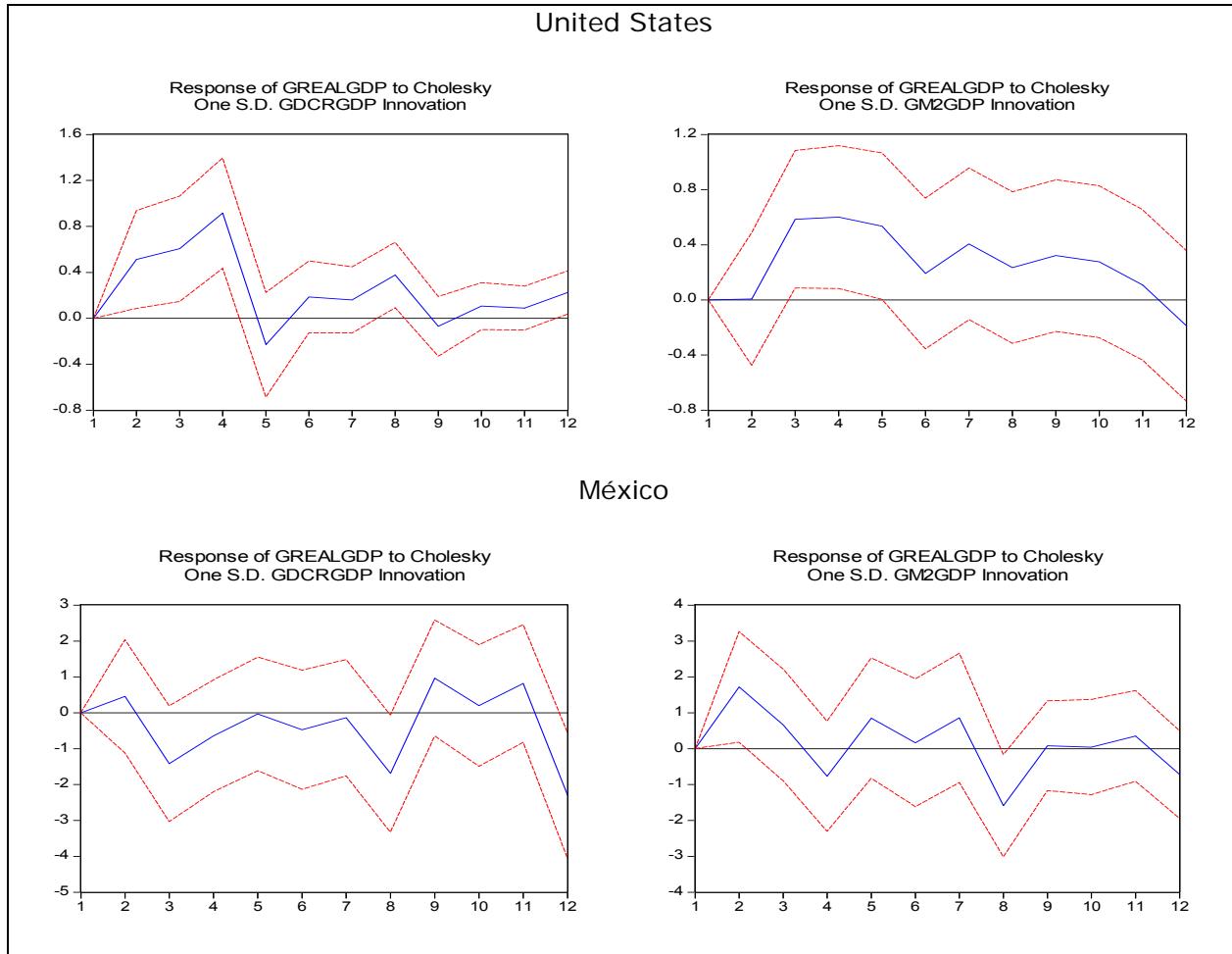
In order to have a better understanding of the previous relationships we next turn to impulse-response analysis. Figure 1 shows the impulse-response functions of real GDP growth to orthogonal shocks of one standard deviation on financial development measures. While in the case of US positive shocks to both indicators of financial development seem to affect positively the growth of real GDP for as long as one year; in the case of Mexico, a positive shock to growth of credit deepening does not seem to affect real GDP growth and a positive shock to growth of monetary deepening seems to have a positive effect on output growth, but it lasts for one quarter only.

Thus, in a country such as Mexico where monetary deepening seems to be particularly low, improvements on the monetization of the economy could have positive effects on the growth rate of real GDP, although these effects would not be persistent. A possible explanation for the fact that credit deepening does not seem to affect output growth could be a crowding-out effect resulting from the allocation of credit to the public sector.

4.4 Financial development and growth volatility

Table 2 below presents estimation results of the model described in section 3.3, equations (2) and (3), for the cases of US and Mexico. It is important to make some considerations. First, the time spans are not the same in both cases. Approximately, the number of observations for the case of US doubles that of Mexico. Thus, in the Mexican case, the econometric results could be subject to some biases and inefficiencies.

FIGURE 1. IMPULSE-RESPONSES OF GROWTH TO SHOCKS ON FINANCIAL DEVELOPMENT



These are impulse-response functions to one orthogonal innovation to measures of financial development. The results are based on the VAR estimation results shown in the appendix, Table A-2.

Second, in the case of Mexico we observed seasonality and, therefore, seasonal dummies were included in the estimation. Third, in the case of Mexico, the growth of US's real GDP is included explicitly as a possible determinant of volatility, a novel aspect of this paper. Finally, while in the case of the US it was found a conditional heteroskedasticity pattern, consistent with a GARCH (1, 1) process, in the case of Mexico an ARCH (1) was sufficient to capture the dynamics of conditional variance.²¹

²¹ Following the methodology described in the previous section, in all cases the residuals of the final specification chosen for the conditional mean do not exhibit any correlation patterns. Nevertheless, there is evidence of ARCH effects. The results are not presented here but they are available upon request.

TABLE 2. GARCH-M ESTIMATION RESULTS

	MODEL 1:		MODELO 2:	
	GROWTH OF REAL GDP		GROWTH OF REAL GDP	
	UNITED STATES	MEXICO	UNITED STATES	MEXICO
(CONDITIONAL MEAN)				
Constant	1.734 (0.0274)	-8.768 (0.0154)	2.861 (0.0030)	-1.730 (0.6626)
Lags of Y	0.061 (0.0650)	-0.042 (0.0086)	0.075 (0.0376)	-0.025 (0.0662)
Lags of X	-0.029 (0.0503)	0.009 (0.0735)	0.032 (0.5523)	n. a.
ϕ	0.186 (0.4761)	0.433 (0.2117)	-0.249 (0.3678)	-0.688 (0.0514)
Growth of US	n. a.	1.215 (0.0001)	n. a.	0.719 (0.0405)
(Conditional Variance)				
Constant	0.619 (0.2458)	27.995 (0.0144)	1.549 (0.0409)	50.148 (0.0000)
ARCH (1)	0.169 (0.0360)	0.668 (0.082)	0.231 (0.0259)	0.263 (0.0261)
GARCH(1)	0.806 (0.0000)	n. a.	0.728 (0.0000)	n. a.
ψ	-0.122 (0.3593)	0.001 (0.9986)	-0.292 (0.1365)	-0.362 (0.2638)
φ	0.094 (0.2010)	0.012 (0.9606)	0.083 (0.5244)	-1.137 (0.0010)
Growth of US	n. a.	-3.949 (0.0457)	n. a.	-3.366 (0.1336)
Adjusted R^2	0.19	0.83	0.14	0.81
Log-likelihood	-449.05	-277.49	-445.18	-306.61
F-test (p -value)	4.18 (0.0000)	22.43 (0.0000)	3.17 (0.0002)	32.23 (0.0000)
Seasonal Dummies	No	Yes	No	Yes
# of obs.	186	92	182	94

All models were estimated by maximum likelihood using the numerical optimization algorithm Marquardt, with the software EViews 6.0. Numbers in parenthesis are p -values. To save space, rows "Lags of Y " and "Lags of X " we report the average coefficients on all lags included in the conditional mean equation, as well as their corresponding average p -values.

In all cases, after estimating the full model the standardized residuals and their squares were examined, finding no evidence of autocorrelation and

therefore the estimated models could be considered well specified. In what follows, the most relevant aspects of the estimation results are discussed.

In the first place, Mexican growth is directly related to US growth, a fact that is very well known. It is important to point out that this pulling effect that the US economy has on the Mexican economy, is quite robust and appears virtually in any specification considered.

Secondly, for the case of US, the parameter ϕ is not statistically significant, which could imply that the effects of volatility on investment returns and precautionary savings cancel out. Alternatively, Black's (1987) hypothesis that higher volatility will be positively related to average growth rates of the economy is not confirmed. However, in the case of Mexico, the parameter ϕ was found significant (model 2) but negative, which contradicts the hypothesis of Black, pointing more to the interpretation that the negative effect of volatility on return to investment dominates, so that higher volatility implies lower average growth rates in the Mexican economy.

Third, although volatility of growth is much less persistent in Mexico than in the US, in terms of level it is much higher in Mexico than in the US. Taking into account the estimated parameters of the conditional variance processes, the unconditional variances of US growth rates are approximately 24.8 and 37.8, in models 1 and 2 respectively; in the case of Mexico these magnitudes are 84.3 and 68.0 respectively.

Fourth, in all cases the parameter ψ was not statistically significant implying that the average growth rates of real GDP do not affect volatility of growth in the subsequent periods. Thus, we find no evidence of feedback effects from output growth to volatility.

Fifth, regarding the effect of financial development on volatility of growth of real GDP, captured by the parameter φ , while in the case of US there is no evidence on this effect, in the case of Mexico we find a negative and statistically significant value for this parameter in the case of model 2. Thus, we find some evidence that financial development (measured with the indicator of monetary deepening) reduces volatility of growth in the case of Mexico.

Interestingly, the findings $\phi < 0$ and $\varphi < 0$ taken together imply a virtuous circle between financial development and volatility of growth: higher financial development reduces volatility of growth and, given that ϕ is negative, lower volatility of growth would produce a higher growth rate of real GDP, this last effect being consistent with the hypothesis that less volatile growth will produce higher investment rates, which would lead to higher growth rates of output.

Finally, the last row of the conditional variance results suggest that the growth rate of US's real GDP could also have a benign effect on Mexican growth through volatility. In both models, US growth has a negative effect on

volatility of Mexican growth and in Model 1 this effect was found significant at the 5% (in Model 2 the *p*-value is of 0.13 and, therefore, the estimated effect could be considered marginally significant).

Thus, higher growth in the US not only increases Mexican growth directly, a fact that is very well known, but also by reducing its volatility, which is negatively related to Mexico's real GDP growth. Certainly, in the opposite case, a reduction in US's growth will lead to lower growth, an effect that could be amplified by the subsequent increased in volatility.

Conclusions

This paper has investigated empirically, using time series methods, the effect of financial development on growth of real GDP and its volatility in the cases of Mexico and the United States. The theoretical literature suggests that financial development could affect not only the average growth rate of real output but also its volatility, although the literature on this last link is not vast. In general, a better functioning of the financial sector could reduce volatility of growth by promoting better diversification of productive risks, improving the capacity to face liquidity shocks, mobilizing savings, mainly precautionary, and allocating capital to more efficient investments. The paper also explores the possible effect of US's output growth on volatility of Mexican growth, a channel that is worth investigating given the enormous influence of the US economy on Mexico's economic performance.

The Granger-causality results suggest that both in the US and Mexico there is a bi-directional relationship between real GDP growth and one measure of financial development in each case, although the evidence is not quite strong. Certainly, further work is necessary to clarify this issue, perhaps in the context of structural models.

Regarding the effects of finance on growth and volatility this study has found that, in the case of the US, financial development is related to output growth but does not affect growth volatility. On the other hand, growth volatility does not seem to affect the average growth rate of this economy. In the case of Mexico, however, it was found that growth of the financial sector is associated with lower levels of growth volatility, and that there is a negative relationship between growth volatility of growth and the average growth rates of real output.

Finally, this study has also found that higher growth in the US not only affects positively Mexico's average growth rate, a fact that is very well known, but also it reduces growth volatility which, given the aforementioned negative relationship between growth volatility and average growth, will increases the average growth rate of this economy. The study thus explicitly finds a new channel from US growth to Mexican growth by reducing Mexican growth volatility.

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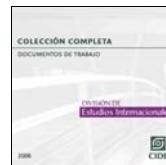
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