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Abstract

This paper empirically and theoretically studies industry or sector diversification as a determinant to financial development. The empirical evidence finds evidence that there is a robust relationship between industry (or sector) diversification and financial development. The theoretical model explains these results by modeling the endogenous development of the financial system as a result of industry (or sector) diversification. An economy with more sectors (industry diversification) imply a greater opportunity for diversifying lending risk and thus a reduction in the aggregate risk of the financial system. This reduction in the aggregate risk of the financial system is what determines financial development. The policy implications are that the government should promote the creation of new industrial sectors by subsidizing R&D and horizontal innovation.

JEL classification: E22; E32; E44; O16; O30; 041

Keywords: vertical innovation; horizontal innovation; industry diversification; financial development; economic growth; imperfect information.

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1 Introduction

Despite the recent financial crisis, the link between financial development and growth has not been challenged. On the contrary, it has been argued that for a financial system to be conductive to growth it has to be as stable as possible, avoiding instabilities generated by endogenous boom/bust cycles a la Minsky (1992). This insight is an invitation for new research that deepens the understandings prevalent before the crisis, not only in terms of the finance and growth nexus but also on the determinants of financial development. Evidently, the suggestion made by Levine (2005) regarding the need for more theoretical work that model the dynamic interaction between the determinants of the financial system and the growth process is more relevant than ever.

Regarding the determinants of financial development, the recent literature points out a wide number of determinants, such as legal systems, institutional and political explanations, trade openness, macroeconomic stability in terms of inflation, cultural, and geographical factors. Most of this literature on the determinants of financial development is based on the financial repression literature of Mckinnon 1973 and Shaw 1973. Specifically, La Porta et al. (1997) claim that countries with poorer investor protections, measured by both the character of legal rules and the quality of law enforcement, have smaller and narrower capital markets. In addition, Rajan and Zingales (2003) argue that incumbent interest groups may oppose financial development in order to block the emergence of new competitors. Further, the endowment theory, put forward by Beck et al. (2003), argues that the disease and geographical environment influence the formation of long-lasting institutions that influence financial development. They distinguish between "settler colonies" that foster private property rights and "extractive states" that empower the elite. Regarding trade openness as a determinant of financial development, both Baltagi et al. (2007) and Huang and Temple (2005) find empirical evidence to claim this statement.

The objective of this paper is to contribute to the research agenda suggested by Levine (2005). Specifically, the role of industry (or sector) diversification as a driver of financial development is studied from both an empirical and theoretical perspective. The hypothesis is that when an economy has only one or few important productive sectors, and there is a negative shock to these sectors, the financial sector that mainly lend to these sectors, will also suffer the consequences of the negative shock. In contrast, when the economy has many important sectors, a negative shock to one of these sectors will not affect the financial system as a whole because there is a diversified loan portfolio. The empirical section confirms the above hypothesis finding that there is a positive relationship between industrial (or sector) diversification and financial development. The empirical investigation uses data from the Financial Development and Structure Dataset, the World Development

Indicators and other sources that covers the period 1970 and 2007 for several industrial and developing countries. Two different estimation strategies are used, namely a cross-section regression and a panel data regression. Five different measures of industrial (or sector) diversification are constructed as well as five different measures of financial development.

In order to put a formal explanation to the empirical results we model the endogenous development of the financial system as a result of industry (or sector) diversification. An economy with more sectors (industry diversification) imply a greater opportunity for diversifying lending risk and thus a reduction in the aggregate risk of the financial system. This reduction in the aggregate risk of the financial system is what determines financial development. The financial system is modeled through a simple micro-founded model with an overlapping generational model of two-period-lived agents (firms, depositors and banks) based on the bank lending model of Brei and Schclarek (2013), which is similar to the consumer liquidity demand model of Allen and Gale (1998) and the firm liquidity demand model of Holmstrom and Tirole (1998) and Holmstrom and Tirole (2000). In the model there are a variable number of productive sectors and each receive a random liquidity shock. Thus, due to the law of large numbers, the more sectors there are in the economy, the less risky is the total lending by banks.

Regarding the related literature, the following can be mentioned. Schclarek (2007) presents a theoretical model that studies the incidence of horizontal innovation and vertical innovation on financial development, growth and its volatility. He finds that economies that are more diversified, and thus more financially developed, have higher growth rates and are less volatile. The results are driven by the fact that higher industry diversification improves the chances of banks to finance all the productive sectors. Acemoglu and Zilibotti (1997) model the relationship between cross-sectional risk, diversification, and growth. The variability of growth decreases with economic development, and that productivity endogenously increases as the diversification opportunities improve. Their results are driven by the assumption that less developed countries specialize in low risk and low return sectors. However, this assumption is refuted by the results of the empirical paper by Koren and Tenreyro (2007), who find that the opposite is true. Carranza and Galdon-Sanchez (2004) build a model of financial intermediation that analyze output variability during the development process. They find that output is more volatile in middle-income economies than in both low and high-income economies.

The empirical part of the paper is exposed in section 2. Section 3 presents the theoretical model. The conclusions and policy implications are discussed in section 4.

2 Empirical evidence

2.1 Data

The data used in this study is drawn from various sources, amongst others the Financial Development and Structure Dataset and the World Development Indicators from the World Bank, as described in table 1. The time span covers the period 1970 and 2007 for a panel of 91 industrial and developing countries [1]. Regarding the variables used, the degree of financial development of a country can be approximated by different indicators, each of them having advantages and disadvantages. We follow the existing literature and use the following variables: bank liquid liabilities to GDP, bank credit over bank deposits, private credit lent by banks to GDP and private credit granted by banks and other financial institutions to GDP. We also included an additional variable calculated using the principal components method. The latter variable captures much of the variability of the four pure variables mentioned in the first instance. Regarding the degree of sectoral (or industrial) diversification, we also proceeded to calculate various indicators that are often used in the literature, among them we can mention the Herfindahl index, Hirschman, Theil, and Ogive. Here we also developed an additional index using principal components techniques, where the inputs to it are the four pure indicators listed previously. The construction of the different sectoral diversification indicators is based on the export data for each country obtained from the database developed by Feenstra et al. (2005)[2]. As this database only covers the period 1960-2000, the remaining years used a database developed by the World Bank through the World Integrated Trade Solution (WITS) database. Finally, for each export sector, SITC4 classification codes was used with up to three digits. Bellow is a detailed explanation of the construction of each indicator using the export data.

The Herfindahl concentration index ranges from zero (low concentration)

[1] The countries are: Algeria, Argentina, Australia, Austria, Bangladesh, Belgium, Bolivia, Brazil, Cameroon, Canada, Central African Republican, Chile, China, Colombia, Congo Rep., Congo Dem. Rep., Costa Rica, Cote dIvoire, Cyprus, Denmark, Dominican Republican, Ecuador, Egypt, El Salvador, Ethiopia, Finland, France, Gambia, Germany, Ghana, Greece, Guatemala, Guyana, Haiti, Honduras, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Kenya, Korea, Lesotho, Madagascar, Malawi, Malaysia, Mali, Malta, Morocco, Mauritius, Mexico, Mozambique, Myanmar, Nicaragua, Niger, Nigeria, Norway, Netherlands, New Zealand, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Portugal, Rwanda, Senegal, Sierra Leone, Syrian Arab Republic, Sri Lanka, Sudan, South Africa, Spain, Sweden, Switzerland, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Kingdom, United States, Uruguay, Venezuela RB, Zambia, Zimbabwe.

[2] Robert C. Feenstra, Robert E. Lipsey, Haiyan Deng, Alyson C. Ma, Hengyong Mo (2005) ?World Trade Flows: 1960-2000), NBER Working Paper No. 11040. Available in http://www.nber.org/papers/w11040

to one (high concentration) and is calculated by adding the participation (share) squared of each industry or export sector. The formula is

$$HER = \Sigma_{i=1}^{N}(s_i)^2$$

where s_i is the share of exports of good i in total exports of a country. Meanwhile, the Hirschman index is similar to the Herfindahl index, except that it includes the square root of the sum of the relative shares of each sector to the square. This index is calculated using the following formula

$$HIR = \sqrt{\Sigma_{i=1}^{N}(s_i)^2}$$

where the higher value of HIR, the greater the degree of concentration.

The Ogive index measures the deviation from an equal distribution of participation (share) of exports in goods and is calculated as follows

$$OGV = N\Sigma_{i=1}^{N}(s_i - \tfrac{1}{N})^2$$

where N is the total number of goods exported while $1/N$ is supposed to be the ideal participation of each good. The closer the index OGV is to 0, the more diversified the economy is. In contrast, a higher value of the index OGV imply a lesser degree of diversification.

Regarding the Theil entropy index, it measures the diversification or distribution gap. This indicator is calculated based on the following formula

$$THEIL = \Sigma_{i=1}^{N}(s_i log_2(\tfrac{1}{s_i}))$$

where the maximum value of this indicator is achieved when all the s_i are equal. A lower value of $Theil$ imply a greater degree of industry concentration.

Finally, the last index of sectoral diversification (Div) was obtained using the technique of principal components. This technique constructs a new variable using as inputs all the existing indicators. Since the four indices described in the previous paragraphs have advantages and disadvantages to capture the degree of diversification of a sector, the principal component strategy allows to develop a new index that captures some of the variability of the other indicators.

2.2 Econometric Methodology

To study the relationship between sectoral or industrial diversification and the degree of financial development, we used two econometric models widely used in the literature on this subject. First, we worked with a cross section model[3], where the dependent variable is a measure that approximates the

[3]This strategy is used by Huang and Temple (2005)

Table 1: Data Sources for the different variables used

Variable	**Source**
Financial Development	Financial Structure Dataset
GDPcp	WDI
Inflation	WDI
Trade openness	WDI
Financial openness	Chinn-Ito Index (2010)
Institutional quality	ICRG and Polity IV Database (Marshall and Jaggers, 2009)
Legal origin	Shleifer
Exports	Feenstra et al.(2005)

degree of financial development of a country while the dependent variables are the degree of trade openness of a country, the inflation rate, GDP per capita, financial openness and some measure of sectoral diversification and institutional variables. All variables are in logs. To perform this regression, we take the average of the values of these variables for selected countries between 2000 and 2007 and use the method of ordinary least squares (OLS). The equation to estimate is the following:

$$lnFin_i = \alpha + \alpha_1 lnTO_i + \alpha_2 lnInf_i + \alpha - 3lnGDPcp_i + \alpha_4 lnDiv_i + \alpha_5 lnInst_i + \alpha_6 LO_i + \mu_i \quad (1)$$

where $lnFin$ is the dependent variable financial development, $lnTO$ is the logarithm of trade openness, $lnInf$ is the logarithm of the inflation rate, $lnGDPcp$ is the logarithm of the gross domestic product valued at constant prices, $lnDiv$ is the logarithm of industrial (or sectorial diversification, which is the variable we are specially interested in, $lnInst$ is the logarithm of institutional quality variable, LO is the legal origin variable. The null hypothesis is that there is a positive relationship between financial development and industrial (or sector) diversification. This means that α_4 takes a negative value when using the Herfindahl index, the Hirschman index, the Ogive index or the principal component indicator.[4] The opposite is true when we use the Theil index.

The second model to be estimated employ the technique of dynamic panel data proposed by Arellano and Bond (1991) and used in Baltaghi (2009). Here, the degree of financial development of a country in a year t depends on the degree of financial development of the country in the previous period plus the control variables used in the cross-sectional model. To eliminate possible cases of endogeneity of the variables, we used the GMM

[4]The higher the value of these indexes, the greater the degree of industry concentration.

estimator proposed by Arellano and Bond. The data used spans from 1970 to 2007. The equation to estimate is the following

$$\begin{aligned} lnFin_{i,t} = \alpha + \alpha_1 lnTO_{i,t-1} + \alpha_2 lnInf_{i,t-1} + \alpha_3 lnGDPcp_{i,t-1} \\ +\alpha_4 lnDiv_{i,t-1} + \alpha_5 lnInst_{i,t-1} + \alpha_6 Kopen_{i,t-1} + \mu_{it} \end{aligned} \quad (2)$$

where $Kopen$ is capital account openness and the rest of the variable are the same as in equation 1. Again, the null hypothesis states that α_4 takes a negative value when using the different sectoral diversification indices, except for the Theil index where the opposite is true.

2.3 Estimation results

The estimation results for the cross section model are presented in tables 2 and 3. Table 2 presents the results when the dependent variable is bank credit to the private sector as a percentage of GDP. It also presents five columns where each column represents one of the five different measures of industry diversification. Note that HER is the Herfindahl index, HIR is the Hirschman index, $THEIL$ is Theil index, OGV is the Ogive index and Div is the principal component variable. In table 3 the results for the other four financial development measures are presented, also using the five different industrial diversification measures.[5] The results seem to suggest a significant positive relationship between sectoral diversification and financial development. Note that the coefficients have a negative value, with the exception of the THEIL index, because the different diversification indexes report a higher value when there is less diversification. For the THEIL index a higher value imply more diversification. For the first dependent variable specification, all the diversification coefficients are significant, with the exception of the estimation using the Theil index. When analyzing the results using the other definitions of the dependent variable similar results are found, with the exception of the Bank credit/Deposits measure, where it is only significant for the Herfindahl index and Hirschman index, and the Credit to Private/GDP measure, where it is only insignificant for the Theil index and the Ogive index. The conclusion is that the results strongly support the hypothesis that there is a positive relationship between industrial diversification and financial development. In addition, the econometric estimates indicate that greater trade openness and higher per capita income have a positive effect on the degree of financial development of a country. The opposite occurs with the inflation rate.

Table 4 presents the results obtained through the technique of dynamic panel data proposed by Arellano and Bond (1991) when the dependent variable is bank credit to the private sector as a percentage of GDP. Note that

[5]Note that only a sum up of the results are presented due to space considerations. The detailed results are available from the authors upon request

Table 2: Cross Section Estimation - Dependent Variable Bank Credit to Private Sector as a percentage of GDP

Variables	HER	HIR	THEIL	OGV	Div
Trade openness	0.56***	0.56***	0.52***	0.52***	0.54***
Inflation	-0.27***	-0.27***	-0.26***	-0.26***	-0.26***
Diversification	-0.25***	-0.25***	0.42	-0.17*	-0.16**
GDPcp	0.39***	0.39***	0.43***	0.41***	0.41***
Institutional	0.54	0.54	0.52	0.75	0.57
Legal-UK	0.48**	0.48**	0.54**	0.52**	0.49**
Legal-FR	0.35	0.35	0.39	0.43	0.37
Legal-GE	0.27	0.27	0.36	0.35	0.29
Constant	-7.77***	-7.77***	-4.94***	-8.1	-7.44
R2	0.81	0.81	0.81	0.8	0.81
Note:***; **; * imply significance at 1, 5 and 10%, respectively.					

Table 3: Cross Section Estimation - Other Dependent Variables

Variable	HER	HIR	THEIL	OGV	Div
Liquid Liabilities/GDP	-0.12*	-0.24*	0.23	-0.09*	-0.08**
Bank credit/Deposits	-0.13*	-0.26*	0.15	-0.09	-0.08
Credit to Private/GDP	-0.25***	-0.49***	0.44	-0.16	-0.16**
Principal Component	-0.39***	0.79***	0.65	-0.26*	-0.25**
Note:***; **; * imply significance at 1, 5 and 10%, respectively.					

Table 4: Dynamic Panel Data Estimation - Dependent Variable Bank credit to the private sector as a percentage of GDP

Variables	HER	HIR	THEIL	OGV	Div
Fin_{t-1}	0.67***	0.67***	0.67***	0.64***	0.66***
Trade openness	-0.017	-0.018	-0.016	-0.014	-0.016
Inflation	-0.019***	-0.019***	-0.019***	-0.019***	-0.019***
Diversification	-0.032***	-0.064***	0.064***	-0.035***	-0.028
GDPcp	0.66***	0.66***	0.66***	0.68***	0.66***
Kopen	0.019**	0.019**	0.018*	0.022**	0.019**
Constant	-6.01***	-6.01***	-5.58***	-6.29***	-6.23***
Note:***; **; * imply significance at 1, 5 and 10%, respectively.					

each column uses a different measure of industrial diversification. Note also that the coefficients have a negative value, with the exception of the THEIL index, because the different diversification indexes report a higher value when there is less diversification. For the THEIL index a higher value imply more diversification. The results show robust evidence of a significant positive relationship between financial development and sectoral diversification, confirming the results obtained by the cross section estimations.

3 Theoretical model

3.1 Introduction

The economy is characterized by a simple overlapping generation model of two-period-lived agents. It is populated by two types of agents: firms/entrepreneurs and banks. There is a continuum of firms with unit mass, where each firm is indexed by i, has access to an investment project that belongs to a certain industry j with constant returns to scale, have no endowments of funds and which requires an initial variable investment in period 1 and generates a variable pay off in period 2.[6] The total number of different industries (or sectors) existing in the economy is J. Each generation is indexed by t, which is the moment of time when the agents are born. In addition, there are continuums of banks with unit mass, where each bank is endowed with an initial amount of liquid funds in period 0 and no endowments in periods 1. Banks maximize their profits by choosing their investment portfolio composed of credit to entrepreneurs and liquid funds. All agents are risk-neutral with an additively separable utility function over undiscounted consumption streams.

[6]The basic model setup is based on bank lending model by Brei and Schclarek (2013), the consumer liquidity demand model by Allen and Gale (1998) and the firm liquidity demand model by Holmstrom and Tirole (1998).

3.2 Firms

Each firm i has an investment project that for an initial investment I in the first period has a stochastic return $R_j I$ in the second period, where R_j is the stochastic gross rate of return of the projects belonging to industry j. Note that all firms i belonging to industry j face the same stochastic return. Note that the economy has J different gross returns, i.e. one specific gross return for each industry j. All the gross returns R_j are independently and identically distributed with finite mean and variance. In addition, each gross return R_j has a continuous distribution function $F(R_j)$ on $[0, \infty]$, with a probability density function $f(R_j)$. Note that the gross returns are also independently and identically distributed across generations t. Regarding the total number of industries J available in generation t, we will assume that it is exogenous, but in section xx it will be determined endogenously. Another assumption of the model is that each firm has no endowment of cash. Thus, in order to implement a project of scale I, the firm must borrow I from banks. The firm uses the project's return in the second period as collateral to obtain these loans. For simplicity reasons, and without affecting our results, we assume that entrepreneurs get no return from the project in period 2, being the banks that get all the proceeds.

3.3 Banks

We assume that banks are risk averse and have initial funds of A. Banks utilize their funds to give credit to the firms and/or hold them liquid. While liquid assets are risk-free, the investment in firms' projects are subject to risk. Furthermore, we assume that banks keep the whole proceeds of the investment projects, i.e. the interest rate given firms is zero. Note that as there are J types of projects, banks invest in a portfolio of projects and thus this portfolio has a stochastic return R_P, with expected return of $E(R_P)$ and variance $V(R_P)$.

We assume that the expected utility of banks depends on the mean and the variance of their portfolio returns given by $E(U) = E(R_P) - \frac{\gamma}{2} V(R_P)$, where R_P is the stochastic return of the portfolio and γ is a positive risk aversion parameter.[7] Lets consider an economy with only one sector, then

[7] This utility function has been used in, amongst others, Levy and Markowitz (1979), Kreps and Proteus (1978) and Mondria (2010). The framework requires that preferences of agents can be described as a quadratic utility function and returns are normally distributed. Note also that $\gamma = 0$ implies that banks are risk neutral and $\gamma > 0$ that banks are risk averse.

banks' maximization problem in period 1 is

$$\begin{aligned} \max_{I} \; & E(R)I + S \\ & - \frac{\gamma}{2} I^2 V(R) \\ \text{s.t.} \\ & I + S \leq A \end{aligned} \tag{3}$$

where $E(R)I$ is the expected output of the investment project, S are the liquid funds holdings by the bank in period 0, $V(R)$ is the variance of R and $-\frac{\gamma}{2}I^2V(R)$ is the disutility caused by the risk of the investment project. Note that the condition imply that the banks' funds may be lent to entrepreneurs and/or kept liquid to the next period.

4 Concluding remarks

This paper presents empirical and theoretical arguments claiming that industry (or sector) diversification is an important determinant of financial development. The argument is that when an economy has only one or few important productive sectors, and there is a negative shock to these sectors, the financial sector that mainly lend to these sectors, will also suffer the consequences of the negative shock. In contrast, when the economy has many important sectors, a negative shock to one of these sectors will not affect the financial system as a whole because it has a diversified loan portfolio. The policy implications are that the government should promote the creation of new industrial sectors by subsidizing R&D and horizontal innovation.

References

Acemoglu, D. and Zilibotti, F. (1997). Was prometheus unbound by chance? risk, diversification, and growth. *Journal of Political Economy*, 105(4):709–51.

Allen, F. and Gale, D. (1998). Optimal financial crises. *The Journal of Finance*, 53(4):1245–1284.

Baltagi, B. H., Demetriades, P. O., and Law, S. H. (2007). Financial development, openness and institutions: Evidence from panel data. Discussion Papers in Economics 07/05, Department of Economics, University of Leicester.

Beck, T., Demirguc-Kunt, A., and Levine, R. (2003). Law, endowments, and finance. *Journal of Financial Economics*, 70(2):137–181.

Brei, M. and Schclarek, A. (2013). A theoretical model of bank lending: does ownership matter in times of crises? Economics Working Papers, Department of Economics and Finance, Universidad Nacional de Cordoba.

Carranza, L. and Galdon-Sanchez, J. (2004). Financial intermediation, variability and the development process. *Journal of Development Economics*, 73:27–54.

Holmstrom, B. and Tirole, J. (1998). Private and public supply of liquidity. *Journal of Political Economy*, 106(1):1–40.

Holmstrom, B. and Tirole, J. (2000). Liquidity and risk management. *Journal of Money, Credit and Banking*, 32(3):295–319.

Huang, Y. and Temple, J. (2005). Does external trade promote financial development? CEPR Discussion Papers 5150, C.E.P.R. Discussion Papers.

Koren, M. and Tenreyro, S. (2007). Volatility and development. *The Quarterly Journal of Economics*, 122(1):243–287.

Kreps, D. M. and Proteus, E. L. (1978). Temporal resolution of uncertainty and dynamic choice theory. *Econometrica*, 46(1):185–200.

La Porta, R., de Silanes, F. L., Shleifer, A., and Vishny, R. W. (1997). Legal determinants of external finance. *Journal of Finance*, 52(3):1131–50.

Levine, R. (2005). Finance and growth: Theory and evidence. In P. Aghion and S. Durlauf, eds., *Handbook of Economic Growth*, North-Holland, 2005.

Levy, H. and Markowitz, H. M. (1979). Approximating expected utility by a function of mean and variance. *American Economic Review*, 69(3):308–317.

Minsky, H. (1992). the financial instability hypothesis. The Jerome Levy Economics Institute Working Paper No. 74.

Mondria, J. (2010). Portfolio choice, attention allocation, and price comovement. *Journal of Economic Theory*, In Press, Corrected Proof.

Rajan, R. and Zingales, L. (2003). The great reversals: The politics of financial development in the 20th century. *Journal of Financial Economics*, 69(1):5–50.