

Financing technological innovation in global capital markets. 2009-2016*

Financiación de innovación tecnológica en mercados de capitales globales. 2009-2016

Financiamento de inovação tecnológica nos mercados de capitais globais. 2009-2016

Alberto Gómez-Mejía

Economics (Universidad San Buenaventura, Cali, Colombia). M.A Economics (The University of Florida, Gainesville U.S.A.). Ph.D. Technology Management (Universidad de Querétaro, México). Professor of Econometrics, Capital Markets. Universidad Libre, Cali - Colombia
algomezme@hotmail.com; alberto.gomezme@unilibre.edu.co

F. Recepción: Octubre 2 de 2016

F. Aceptación: Diciembre 18 de 2016

Abstract

Cobb-Douglas production function regressions are constructed with a financial focus where machine and labor capital are replaced by capital stock and total debt in order to measure the productivity (impact on sales) of the two financing mechanisms. Information is taken from the Damodaran-Bloomberg database: 40,906 firms whose stocks and bonds are traded on all exchanges in the world, grouped in 97 manufacturing subsectors and services, belonging to nine countries or areas of countries, for the period 2.009-2.014 and subsequent revision for 2.011-2.016. It is concluded that for most sectors worldwide, regardless of the technological level, share capital is more productive than credit and therefore the issuance of shares and other type of capitalization should be promoted.

Keywords

Cobb-Douglas, technology, equity, debt, productivity, econometrics.

Resumen

Se construyen regresiones para la función de producción Cobb-Douglas con un enfoque financiero: capital maquinaria y mano de obra son sustituidos por capital accionario y deuda

* **Cómo citar:** Gómez-Mejía, A. (2017). Financing Technological Innovation in Global Capital Markets. 2009-2016. Revista Libre Empresa, 14(1), 57-83 <http://dx.doi.org/10.18041/libemp.2017.v14n1.27103>

total con el fin de medir la productividad (impacto en ventas) de los dos mecanismos de financiación. De la base de datos de Damodaran-Bloomberg, se toman las ventas de 40.906 firmas cuyas acciones y bonos se negocian en todas las bolsas del mundo, agrupadas en 97 subsectores manufactureros y servicios, pertenecientes a nueve países o áreas de países, para el período 2009-2014 y posterior revisión para 2011-2016. Se concluye que para la mayoría de los sectores a nivel mundial, independientemente del nivel tecnológico, el capital accionario es más productivo que el crédito, por lo que se debe promover la emisión de acciones y otras formas de capitalización

Palabras clave

Cobb-Douglas, tecnología, acciones, deuda, productividad.
Jel: G24, G150, O3

Resumo

Se construyen regresiones para la función de producción Cobb-Douglas con un enfoque financiero: capital maquinaria y mano de obra son sustituidos por capital accionario y deuda total con el fin de medir la productividad (impacto en ventas) de los dos mecanismos de financiación. De la base de datos de Damodaran-Bloomberg, se toman las ventas de 40.906 firmas cuyas acciones y bonos se negocian en todas las bolsas del mundo, agrupadas en 97 subsectores manufactureros y servicios, pertenecientes a nueve países o áreas de países, para el período 2.009-2.014 y posterior revisión para 2.011-2.016. Se concluye que para la mayoría de los sectores a nivel mundial, independientemente del nivel tecnológico, el capital accionario es más productivo que el crédito por lo que se debe promover la emisión de acciones y otras formas de capitalización

Palavras chave

Cobb-Douglas, tecnología, acciones, deuda, productividad.

Introduction

This work is the result of a question being asked by many over years: Why does Latin America not come out of underdevelopment? This question has been answered from several approaches: historical, political, cultural, institutional and financial availability. To these is added the very obvious fact with the passage of the years: technological dependence; ¿Why do not we invent? ¿Why do most of the products we consume have a foreign patent? ¿What are the causes of the lack of invention and technological innovation? ¿Why do not we succeed as a continent or country, to replace exports of raw materials by manufactured products? ¿How did the South-East Asian countries stop being technologically behind and became innovators? ¿Is there not enough financial support from the government or the private sector? We are aware that technological backwardness affects the competitiveness and survival of companies in the international arena, the growth of the national economy in the medium-long term, the formation of human capital and quality of life, perpetuating underdevelopment. ¿What are the most productive financing mechanisms (stocks, credit, etc.) for each specific sector or for each level of technology (high, medium, low)?

1. Theoretical Framework

1.1 Financing: a problem for the generation of technological innovation

Dodgson (cf. 2008: 2) in his book *The Management of Technological Innovation* defines technology and innovation as:

“Innovation is essentially the successful commercial exploitation of new ideas. Innovation includes the scientific, technological, organizational, financial and administrative activities that lead to the commercialization of a new or improved product or service.

Innovation has to be permanent in order to keep companies competitive so it has to become an administrative priority. Technological innovation is mainly radical and incremental, radical if there are abrupt or novel changes in the nature of goods and services capable of producing technological revolutions. The radical requires large levels of investment; on the contrary, incremental innovation means minor improvement or adaptations to the product. Technological development and economics are two sides of the same coin: Joseph Alois Schumpeter (cf. 1939: 132 et seq.) in the 1930s, describes how technological innovations have an impact on economic growth. Innovations are not released to the market continuously over time but disruptively (periodic clusters). According to Schumpeter, since the English industrial revolution one can identify waves of technological change that have produced high rates of economic growth, that is, the cycles of expansion and contraction are the result of technological revolutions. There is no doubt that the engine that drives the innovative company is the profitability for the owners of the company and investors who join it. The role of the investor or Entrepreneur was described by Schumpeter (cf. 1939: 65 et seq.)¹ In the innovation model Mark 1: it is the investors who take advantage of the inventions of the new science and technology that open new companies: The model describes typical financing conditions in small and medium-sized enterprises (SMEs) and is summarized in the following steps:

1. New scientific inventions developed outside the industrial sector.
2. Entrepreneurs decide to make their own investments and raise capital from others.
3. The production of the new product changes the patterns of industry and alters market conditions; Redirection of applicants' preferences towards the new product
4. Obtaining great profits by investors thanks to the innovative product.
5. Bankruptcy of companies producing obsolete products.
6. The great profits of innovation attract new investors who open competing companies.
7. In the medium term, the profits generated by innovation are reduced or stabilized by competition.

Faced with the innovative fever that characterized the capitalist system, especially the United States after the crisis of the 1930s, both the US government and the financial sector responded by making “financial innovations” or new mechanisms aimed at

¹ Schumpeter develops the generalized vision of the investor; small and medium. By the early 1930s, the impact of oligopolies on the US economy had not been fully documented. Throughout the crisis of the 1930s, these will begin to strengthen.

providing capital for innovators, both for small and large entrepreneurs. Allen Franklin and Glenn Yago (cf. 2010: 13 et seq.)² describe the evolution of financial innovations that are common today in countries with market economies: investment bankers who are advisors in the process of issuing stocks and bonds to be sold on stock exchanges; venture capital, made up of experienced professionals in business administration and are willing to provide financial capital to nascent companies and to participate in its management in the early years of the company until they decide to sell their interest for profit. Other participants are private funds, government funds, foundations supporting SMEs.

It is also true that advanced technology, high-tech, requires the investment of large capitals. Schumpeter (cf. 1943: 87 et seq.) developed what is known as the Mark 2 model for oligopolistic firms with the ability to invest in state-of-the-art, highly capital-intensive technology. This can be explained with current examples: Apple³ and Microsoft followed a process similar to that of many companies: they were born as micro-enterprises to become an oligopoly during a short period; a process described by Ross, Westerfield and Jordan (cf. 2008: 471 et seq.)⁴ summarized in the following stages:

1. Initially the company is financed with capital from the owners of the company and friends. The owners developed the innovative idea. They know the know-how but they do not have capital. They have no experience in running a business or marketing a product.
2. Recourse to venture capital funds made up of executives with experience in administration, marketing, finance and accounting, among others who have contributed their own resources to the fund in order to purchase a minority stake in the new company. They will contribute their experience in order to value the company, value its participation, sell it to third parties and obtain profits.
3. They structure sales of stock in stock exchanges specialized in technology companies such as NASDAQ and later in those where they can get bigger capital, NYSE, in order to be able to finance the innovations or inventions that allow them to conquer the market.
4. They use commercial banking to obtain credits for working capital, payable in the short term; credits not oriented towards innovation, but to the administrative operation of the company.
5. The previous sequence indicates that as the first step is passed to the fourth, the original entrepreneurs give up control of the company to third parties. Radical technological innovation and advanced technology require huge amounts of capital that can only be achieved with the participation of many.

2 This book shows how the development of mercantile and industrial capitalism would not have occurred without the innovations or risky financial mechanisms, designed to make feasible the great technological advances from the renaissance to the present day.

3 Cases that today are part of popular folklore with biographies and cinema.

4 This book describes the highly developed "Investment Banking" process in the United States and other OECD countries. The objective of the process is to advise the company from its conception until reaching the capital markets.

Similarly, Wilson (*cf.* 2015: 8 et seq.) summarizes the stages of the life cycle of an innovative company and the different financing mechanisms generally used at each stage⁵. From the summary the author has elaborated the table 1-1. It is observed that for the first phase, innovative companies have cash flow deficits while developing the business idea, produce the product and go to the market. From the second phase on, it is characterized by the expansion and issuance of shares on stock exchanges. The final stage for some companies may mean being absorbed or bought by others. As for the financing mechanisms, the company starts with contributions from friends, relatives, government subsidies and incubator companies; The latter support nascent companies by providing them with advice in their initial stages and approaching them to investors such as the “business angel” (sponsor investor) who is an individual who contributes his own money to nascent companies. It also finds support with “venture capital” and credits called “Mezzanine capital” consisting of loans given by banks that in case of not being canceled by the entrepreneur, the debt is convertible into shares as is the case with bonds issued by companies that are convertible into shares and negotiable on the stock exchanges.

Wilson (*cf.* 2015: 3 et seq.) explains how in OECD countries since the recession in 2008, there was a proliferation of financing mechanisms for innovative enterprises; from tax subsidies and government support that includes the purchase of shares by the government, that is, government co-ownership with the entrepreneur; lower participation of government funds compared to that of private funds and increase of mezzanine credits. There has also been a withdrawal from the banking system as a result of the increased risk faced by the small technology company; parallel to the venture capital have been focused on high-risk technological innovation and finally, a growing participation of business angel. With regard to the issuance of shares for small technology companies, the number of companies that have sold shares has been reduced as a result of the fears generated by the crisis. However, it has not been possible to measure the effectiveness or impact of each of the mechanisms, that is, none of the OECD programs has been formally evaluated and there is no empirical research in this respect that allows us to conclude what is the most efficient mechanisms in the financing of technological innovation.

Table 1.1.

Life cycle of a firm and type of financing

Fases	Flujo de efectivo	Tipo de financiación	Inversionistas
Initial	Deficit	Seed capital: Business Idea Business analysis Market analysis	Entrepreneurs Subsidies Friends, relatives Incubators

⁵ Wilson takes the picture of the publication made by Natusch (2003) which is available at <https://www.hitpages.com/doc/6465172562509824/11#pageTop>

(Continúa en pág. 62)

(Viene de pág. 61)

Initial	Deficit	Start-up : Market concept Product development	Venture capital Incubators
Initial	Deficit	First stage: Starting production Going to the market First sales	Venture capital Incubators
Expansion	Surplus	Second stage: Escalamiento Market entry Market leadership	Venture capital Business partners Mezzanine capital Credits Subsidies
Expansion	Surplus	Third stage: Estandarization Internacionalization	Venture capital Business partners Mezzanine capital Credits Subsidies
Expansion	Surplus	Fourth stage: Pre-IPO IPO preparation Selling shares to the public	Venture capital Business partners Mezzanine capital Credits Subsidies
Capital markets: IPO	Surplus		Investment banking Increasing number of shareholders
Privatizacion	Surplus	Coping with absorption by other firms: Comercial valuation Acquisition or Absorption Exit from the market	Private capital: Clusters Mezzanine capital

Source: Table drawn up by the author based on the work of Wilson (*cf.* 2015: 8 et seq.)

It is important to emphasize that financial institutions or legal mechanisms that support the financing of innovation, change from country to country: not all countries have legally instituted venture capital mechanisms, nor do they have equal development of bank credit and capital markets. This can mean the success and failure of innovation.

Funding includes all or part of the processes related to innovation: administrative, planning, operation, marketing and distribution. More broadly, efficient technology financing is related to: technological development, business competitiveness, increase in capital and labor productivity, dynamic processes of invention and innovation, consolidation of clusters or clusters, economic growth and social development, reduction of technological dependence, expansion of related

sectors: universities. In addition, there are cultural patterns related to financial activity that stimulate or restrict innovative activity: private initiative and entrepreneurship in view of the financial viability of doing business, cultural attitude towards risk, preference for family, individual business or public so the latter have greater innovative potential, bank credit culture, disinterest in research: preference for purchase of patents, licenses, franchises, caused by high research costs per se, high financial costs, technological backwardness.

The financing of innovation is determined by a macroeconomic and institutional framework that can stimulate or curb innovative culture. Financial legislation may favor some of the financial mechanisms or be impartial to all (banking, stocks, cooperatives, private funds, venture capital). This depends on the degree of competition between different financing mechanisms (oligopolies, monopolies), accessibility and cost of the resource (interest rates), tax preferences such as tax exemptions or subsidies for certain financing mechanisms. It is also noted that many government policies support innovation in sectors considered strategic to the economy and national security. It is clear that negative collateral can be derived from the relationship between technological innovation and financing, such as: corporate incompetence reflected in a large number of broken companies, technological backwardness and consequent dependence on foreign technology, low economic growth and social development, high unemployment rates.

1.2. Facts on the financing of innovation in SMEs in the world

A worldwide fact is that SMEs are more than 90% of companies in developed and underdeveloped countries. Llanto (*cf.* 2015: 10 et seq.) compiles data on how SMEs are funded to develop innovations in Asia - Taiwan, India, Indonesia, South Korea, Malaysia, the Philippines and Thailand. Despite the large number of government programs that support innovation, funding mechanisms are reduced to:

1. Advice from R & D institutes that are owned by the government or financed between the government and the private sector.
2. Public funds, ie, subsidized government credit.
3. Private funds, usually venture capital.

In reference to Latinamerica, the publications of two Colombian newspapers are cited. The Portfolio newspaper (May 31, 2013) publishes the conclusions reached at the “International Economic Forum Latin America and the Caribbean” organized by the Ministry of Economy and Finance of France, the OECD and the IDB in Paris, May 30. Conclusions were as follows: “The high level of informality in Latin American production and the difficulties that small and medium-sized enterprises (SMEs) face in obtaining credit are the major bottlenecks in the growth of a region that is a pity for integration into the world economy.”

1.3. Technological level of the companies traded in the stock exchanges of the world

The OECD (2011) presents a technological classification for the manufacturing sectors: High, Medium-High, Medium-Low and Low. Service sectors are not cataloged by the OECD therefore these are excluded.

From the Bloomberg-Damodaran database it is known that 40,906 firms are registered in world capital markets of which 7,766 are in the United States; 6,073 in the Euro zone, 3,528 in Japan; 19,083 in the emerging markets including 4,276 in China and 3,215 in India; 4,456 in Australia, Canada and New Zealand. Matching Bloomberg and OECD (2011) Manufacturing classification, it is noted that 8,206 high technology companies are registered worldwide capital markets, 6,122 with medium-high technology, 10,283 with medium-low technology and 4,724 with low technology. The largest group corresponds to the medium-low and the smallest to the low-tech group, however, it is evident that from a medium-low up the number of companies is reduced confirming that at a higher technological level the number of companies is reduced. It is also evident that at a higher technological level it is necessary for companies to turn to the capital markets to obtain financing and remain competitive, but the number of low-tech companies that are inscribed on the stock exchanges destroy the mistaken idea of that the stock issuances are only suitable for high-tech companies. It is important to clarify that the companies registered in stock exchanges have to be formal, which contrasts with the typical informality of SMEs in Latin America and other underdeveloped areas of the world.

The companies listed on the stock exchanges include companies whose products and brands are world leaders such as Johnson & Johnson, Procter & Gamble, Apple, Windows, Google, Facebook, Twitter, IBM, Boeing, Ford, GM, GE, Sony, companies belonging to all manufacturing sectors, whose technological level goes from high to low, originating from different countries with varying degrees of economic development, allowing us to glimpse that the process of investment banking to obtain financing is available for any type of business.

A first approximation to global stock market statistics shows that the magnitude of technological innovation in the most developed countries or geographical areas of the world that are financed by stock issuance is important. Latin American percentage participation is the lowest in all levels of technology among all geographic areas, which suggests that the Latin American capacity to innovate technology in large companies is limited and almost null at the level of SMEs given the informality and credit shortage as documented. This leads us to think of the urgency to redirect economic policies to stimulate innovation in Latin America, specifically to strengthen, simplify and reduce the procedures necessary for the issuance of shares, that is, to imitate those countries that have demonstrated that their policy has had success.

The information is presented for groups of countries, but for work purposes, data from the 97 sectors are organized for nine countries or groups of countries (areas from now on) that are known to have institutional structures related to the two financial models dominant in the world:

1. Stock model: United States, United Kingdom, ACNZ (Australia, Canada and New Zealand).
2. Debt model: Europe (Euro Zone, Switzerland and Scandinavia), Japan, India, Latin America, China and Emerging. The latter includes all the remaining countries of the

world located in Africa, the Middle East (e.g. Israel, Saudi Arabia, Qatar) and the Far East (e.g. South Korea, Thailand, Singapore) Eastern Europe (e.g. Russia, Poland).

All information from Bloomberg comes in the form of an annual cross-section from December 2009 to December 2013. 60 indicators are presented for varying amounts of companies for 97 sectors. There are sectors with 10 companies and others with 200 for companies from different countries. For the econometric models, all the variables of each company were weighted with respect to the market capitalization (market price of the share of each company multiplied by its respective number of shares in circulation) of the sector in each geographical area, that is, for each variable of each company, is its percentage share, dividing its capitalization by the total total capitalization of the sector (each area). Based on the above, we find the weighted average of all variables for all 97 sectors in the 9 geographic areas. The data have been organized in panels by sector and by country. The application of the panel model can be justified in the case of the current globalization: technological developments in one area are quickly copied or adapted in the other areas with the same speed that occurs between companies belonging to the same sector and country.

2. Methodology. Financial approach of the Cobb-Douglas Production Function

In the neoclassical economic theory, Gujarati and Porter (*cf.* 2010: 526 et seq.) it is customary to express the Cobb-Douglas function in exponential or logarithmic terms as:

$Y = A K^\alpha L^\beta$, equivalent to: $\text{Ln}Y_t = C + \alpha (\text{Ln}K_t) + \beta (\text{Ln}L_t)$, where

1. $\text{Ln}Y_t$ = natural logarithm (Production) for period t ;
2. $\text{Ln}K_t = \ln$ (Capital). Capital is the sum of fixed asset accounts and net investment
3. $\text{Ln}L_t = \ln$ (labor). Labor is the sum of wages and social benefits.
4. Coefficients (α , β) measure the productivity of capital and labor respectively expressed in terms of elasticity, i.e. “ α ” measures the change in output against a change of 1% in capital and β “Measures the change in production given a 1% change in labor costs.

The main problem in the econometric solution of the Cobb-Douglas function is the multicollinearity: capital and labor have a very high positive correlation between them, superior to 0.90, being 1.0 the maximum value of the scale. In practical terms, both variables behave almost as if they were the same, making it impossible to solve the model. This is solved by replacing one of the two with a third variable that is poorly correlated with them or finally running a regression for each of them: $Y = A K^\alpha$ or $Y = AL^\beta$.

For purposes of the present study, it is proposed:

$Y = A D^\alpha E^\beta$, i.e. $\text{Ln}Y_t = C + \alpha (\text{Ln}D_t) + \beta (\text{Ln}E_t)$, where:

1. $\text{Ln}Y_t$ = natural logarithm of sales for period t .
2. $\text{Ln}D_t = \ln$ (Total financial debt); D = total amount of private and public bank credits as well as bond issues made by the firm.
3. $\text{Ln}E_t = \ln$ (Equity), equity of the firm that includes issues of both public (made by stock exchange) and private.

4. Coefficients (α , β) measure the productivity of credit and equity respectively. That is, “ α ” measures the change in sales before a change of 1% in total debt; “ β ” measures the change in sales given a 1% change in equity.
5. Complementary to the previous ones is the financial relation DER (Debt-equity ratio) or financial debt divided by the total amount of countable equity.

Here the same problem of multicollinearity is presented again, so in most cases it was necessary to run two regressions for each subsector:

$$Y = AD^\alpha, \text{Ln}Y_t = C_0 + \alpha (\text{Ln} D)_t$$

$$Y = AE^\beta, \text{Ln}Y_t = C_1 + \beta (\text{Ln} E)_t$$

3. Results of the Cobb-Douglas function with financial approach

The panel models to run the regressions (period 2009-2013) were those of fixed and random effects. Detailed regressions are presented in Appendix 1. The series of tables from 1-1 to 3-10 lists the productivity indicators of equity and debt for each sector at each level of technology, the sector's DER, percentage weight of total financial debt and equity (Equity), weighted yields of debt and equity. The sectors are ranked, from highest to lowest, based on the coefficient productivity (equity / debt) in the last column. It is important to clarify that all the regressions published in this chapter have met the theoretical homoscedasticity requirement of the residues, but there are regressions that do not have strictly distributed residues which is not a problem: empirical studies such as Minitab (*cf.* 2014: 2 et seq.) have demonstrated that the non-normality of the residues is disposable for regressions with more than 15 observations since they produce residues with distributions very similar to normal. The regressions of this work have at least 50 observations, which is why the normality requirement of the residues is considered satisfied.

As an example of the results obtained, we present the regressions of the Advertising sector, based on data from 243 companies in 9 economic areas of the world:

(1) Equity regression:

$$\text{LogSales}_t = 5.64 + 0.22 * (\text{LogEqu})_t ; R^2 = 0.97; F = 102.00; n = 243$$

(t-student: 1.48),

(2) Debt regression:

$$\text{LogSales}_t = 7.20 - 0.06 * (\text{LogDebt})_t ; R^2 = 0.97; F = 94.73; n = 243$$

(t-student: -0.68),

DER average = 0.555, which means that financial debt and equity have a share of 35.67% and 64.33% respectively, that is, companies in this sector, registered in the world's stock exchanges, are financed mainly by issuance of shares.

Equity productivity = 0.22%

Weighted equity productivity = $0.22 * (64.33\%) = 0.1415\%$

Debt productivity = -0.06%

Weighted debt productivity = $-0.06 \times (35.67\%) = -0.0214\%$

This is one of the few sectors with negative debt productivity. Of the 97 sectors, only 13 have higher debt productivity than equity productivity, while 21 out of 97 have weighted debt productivity higher than weighted stock productivity; Among these are those whose structure is financed by credit mainly as the financial sector (deposits of savers); banks, banks (regional), thrifts, real estate companies and government companies that offer services (utilities) of water and energy.

The high-tech companies, Table 1.1, presumably have higher equity productivity than the debt. The green sectors are financed mainly by debt, however, the productivity of the equity is greater than that of the debt; the sectors colored with blue are financed mainly with debt and the productivity of this is greater than the equity. The final result, independent of the technological level, indicates that out of a total of 97 sectors, in 62 the productivity of the equity is higher than that of the debt, even in cases where the amount of debt is greater than the equity; in 23 sectors, the debt level is higher than the equity, however, the productivity of the equity is greater than that of the debt and finally, in 12 sectors, the productivity of the debt is higher than that of the equity including some cases in that the debt is less than the equity.

In addition, the series of tables 1-6 through 1-8 shows all sectors in order from highest to lowest according to the behavior of equity productivity with respect to the productivity of debt (eqt / debt prodvty) located in the last column of the table. There is clear evidence of a direct relationship between equity productivity and sales of high technology intensive sectors. Among the 20 sectors with higher equity productivity (E) than debt, natural gas, railways, semiconductor equipment, machinery, automotive, rubber and tires, environmental services, footwear, mining, entertainment, shipbuilding and engineering. The conclusion of this point favors the hypothesis that the greater shareholding in the financing of the company obtains a better performance in the sales since the injection of equity capital is more productive than the debt for the majority of the 97 sectors analyzed.

The Cobb-Douglas applied to nine countries or economic areas for the period 2.009-2.013, was initially run with the banking, thrifts, investment banking and brokerage subsectors, but it was noted that their inclusion skewed the result in favor of the debt (the financial sector is a judge and part) and therefore excluded from the regressions; The results are detailed in Tables 1-9 to 1-11. Table 1-9 regressions showed that countries can be organized into three groups:

1. China, ACNZ, India, Latin America and Emerging: in these it is observed that the companies registered in the exchanges:
 - 1.1. They tend to be financed mainly by equity
 - 1.2. Equity productivity is higher than debt productivity
 - 1.3. Weighted equity productivity is greater than weighted debt productivity.

China, for example, has: equity productivity (0.48%), debt productivity (0.27%), with declining yields of financing and weighted equity productivity (0.3055%), weighted debt productivity (0.0981%). In Latin America, companies have: equity productivity (0.47%), debt productivity (0.28%), with decreasing returns on financing and weighted equity productivity (0.1374%), weighted debt productivity (0.0901%). In all cases the companies go to the stock exchanges to get shareholders mainly, while the vast majority of companies in these countries are listed on the stock market are financed by bank debt or self-financed with retained earnings. In the general context, the listed companies of this group of countries conform to the stock model.

2. EURO and UK: the countries of the Euro zone
 - 2.1. They are financed mainly by debt
 - 2.2. Productivity debt is higher than equity productivity.
 - 2.3. Weighted debt productivity is higher than weighted equity productivity

UK presents: equity productivity (0.30%), debt productivity (0.34%), with decreasing returns to finance and weighted equity productivity (0.0488%), weighted debt productivity (0.1384%). Surprisingly, the United Kingdom does not seem to follow the equity model: it is mostly financed by credit, although its productivity is lower than the stock.

3. JAPAN and USA: In the Japanese case, the weight of the debt (51.9%) is slightly higher than the equity (48.1%) but the equity productivity (0.0914%) is higher than that of the debt (0.0882%). It is surprising that the difference between the weight of the debt and the equity is insignificant, that is, balanced, but with better management of equity capital. In the case of the United States, there is a balance, however, the productivity of equity (0.2761%) is much higher than that of debt (0.0456%). Apparently, Japan has moved into the equity model in the period studied (2009-2013).

Table 1-10 summarizes information in table 1-9. Column (6), weighted equity productivity is organized in descending order. With the exception of EURO, there is a direct relationship with the areas with dominant stock productivity (column 1)

The previous regressions, at the area level, were updated in January of 2,017 including the information of 2,014, 2,015 and 2,016. The results are shown in Table 1-11. The big difference is that the Damodaran database includes the United Kingdom into the European area and the Emerging area does not detail Latin America. The regressions for 2011-2010 show a trend towards the inclusion of equity financing in all manufacturing sectors in all geographic areas: in the five areas, on average, the equity component is larger than debt and equity productivity is higher than of the debt.

4. Conclusions

1. Econometric results. The Cobb-Douglas model let us obtain conclusions at a global level. It was possible to corroborate at the level of companies listed on stock exchanges around the world, based on the performance of the companies' sales for the period

2009-13 and the update for countries 2,011-2,016, the significant importance of the type of financing, that is, the difference between debt and equity finance on corporate productivity is remarkable. In short, “the degree of productivity of equity capital is greater than that of bank credit and corporate bonds” has been demonstrated for most sectors worldwide: the injection of equity capital is more productive than debt for most of the 97 sectors analyzed, thus improving business competitiveness.

2. Empirical evidence on funding mechanisms. Wilson’s (2013) study was also confronted, which concluded that, given the numerous alternatives available in OECD countries to finance technology companies from the outset, there is a paradoxical lack of a study to conclude on the impact of each one of financing mechanisms, in other words, it is not possible to elucidate which one or which are the most efficient ways of financing technological innovation; on the contrary, this study, despite the limitations, allows an approximate response. However, Wilson acknowledges the importance of the issue of shares, although this has been reduced as a result of the crisis of 2008, which is in agreement with one of the arguments supported in this work: that companies that manage different levels of technology, from the lowest to the highest, access the stock exchanges in order to obtain financing and not as it is generally believed that this is only viable for large and high tech companies. It was also stated how, in the world of events, the lack of innovation in most SMEs in the underdeveloped world is evident as a result of informality, insufficient government support and a lack of credit, a problem that is difficult to tackle given the lack of statistics on SMEs.

5. Economic Policy recommendations

From the work done, the following recommendations can be made taking into account that the proposals to stimulate technological innovation are highly related to the proposals to stimulate business activity in general: it is impossible to achieve innovative entrepreneurs if there are no incentives to do business of any kind. Some of the proposals presented below are based on the experience gathered on the Doing Business⁶ page.

1. **Tax incentives** for companies that prove to be technological innovators. Innovation requires capital and several years usually because the stimuli are needed.
 - a. Eliminate or reduce the tax on the profits of the company.
 - b. Eliminate any type of tax for several years to the company that is in its initial phase.
 - c. The level of taxes should be gradual according to the type of technology of the sector (high, medium, low).
 - d. Tax stimuli to business angels and incubator companies: the most effective is the exemption and reduction in income tax.
2. **Incentives to the issuance of shares of companies**
It has been seen that the support of incubators, investors, proven or public funds and

6 www.doingbusiness.org.com

mezzanine capital is not necessarily efficient. The objective should be to shorten the time and processes for a company to achieve massive capital capture through stock market actions.

- a. Eliminate double taxation: corporate income tax and income tax on dividends paid to shareholders. In case you pay the first do not pay the second.
- b. Deduct from income taxes the dividend originated by the capital that captures the company by issuing shares in a similar way to the tax deductibility that exists for the interest payments generated by bank credits. Traditionally entrepreneurs are indebted to the justification that the interests are tax deductible without taking into account that the cash flows are affected when the interests that are a fixed cost are paid since they have to be canceled thus the company produces profits or losses. On the other hand, if the same treatment is given to dividend payments, cash flow would not be affected in case of losses since there is no obligation to pay the dividend; the dividend is not a fixed cost. This would reduce the weighted average cost of capital for the entrepreneur and improve liquidity.
- c. Reduce paperwork, documentation and costs for SMEs to enter stock exchanges directly from the first phase, according to Wilson (2013).
- d. Reduce the requirements of minimum levels or amounts of stock issuance on stock exchanges. Stock exchanges should be accessible to the needs of micro-enterprises.
- e. Create specialized stock exchanges in NASDAQ-style technology companies in the United States and similar in the United Kingdom.

3. Institutional reforms

3.1. Financial system

- a. Reduction of the costs of bank credit: it is up to the government to generate legislation that obliges banks to be efficient and competitive at an international level so that they can offer companies the same interest rates as those obtained in international markets. This is achieved by increasing the number of banks and financial institutions competing in Latin American markets.
- b. Establish legislation to expedite the procedures for buying and selling companies, ie, acquisition and merger of companies. Venture capital that has bought stakes in small businesses needs a quick sell process when they want to do so.
- c. It is proposed to develop the cooperative system which is nothing more than a savings or self-financing mechanism of the company that allows the inflow of resources to equity without increasing financial liabilities.

3.2. Labor market

- a. Flexibility in the hiring of workers. Workers must be hired for a fixed term and not for an indefinite term. A nascent company can not assume the salary and payload as if it were a fully established company. It takes a deadline for the company once it positions itself in the market, fully assume those labor obligations.

3.3. Requirements for national and foreign investment

- a. Reduce costs and the number of procedures in the opening of companies. It is necessary that the companies can be established so that it is necessary to give them possibilities of survival.
- b. Rules for protection of both domestic and foreign private investment.
- c. Efficient legislation on copyright protection: patents, licenses and franchises. If this does not work and unfair competition takes place, innovators will take their products to others that provide guarantees.

3.4. Educational system

- a. Education with an emphasis on technology from basic or primary education. Deepening in the areas of mathematics and science.
- b. Encourage entrepreneurship for children and adolescents.
- c. Opening of technological and university education centers specializing in science and engineering. Linking educational institutions to companies in order to implement joint research. Businesses benefit from the low cost of employing apprentices and universities develop research capabilities applied to business needs.
- d. Programs of education for investors oriented to stimulate the activity of business angels and incubators.

Recognition

Thanks to all the professors of the Doctorate in Technology Management and Innovation (DGTI) of the Universidad Autónoma de Querétaro, Mexico. Thesis director: Professor Lorena Álvarez-Castrillón; professors Alberto Pastrana, Juan José Méndez, Clara Escamilla, Julia Hirsch, Enrique Kato and Michael Demmler. Thanks to Professor Aswath Damodaran of the Stern School, New York University, for his clarifications on his database.

Conflict of interests

The authors declares that he has no conflicts of interest.

References

1. Allen, F. & Yago, G. (2010). *Financing the Future. Market-based innovations for growth*. New Jersey: Prentice Hall. Milken Institute.
2. Cobb C. W. & Douglas, P. H. (1928) "A Theory of Production", *American Economic Review*, núm. 18, pp. 139-165.
3. Dodgson, M., Gann, D., & Salter, A. (2008). *The Management of technological innovation*. Oxford: Oxford University Press.
4. Gómez-Mejía, A. (2015). "Efecto de diferentes mecanismos de financiación en la productividad. Enfoque Financiero tipo Cobb-Douglas, 2009-2014". *Revista Libre Empresa*. 12(1), 63-93. <http://dx.doi.org/10.18041/libemp.v23n1.23104>
5. Gujarati, D. & Porter, D. C. (2010). *Econometría*. Quinta edición. México: McGraw-Hill Interamericana.
6. Llanto, G. M. (2015). *Financial Inclusion, Education, and Regulation in the Philippines*.

- ADBI Working Paper 541. Tokyo: Asian Development Bank Institute. Available: <http://www.adb.org/publications/financial-inclusion-education-and-regulation-philippines>
7. Minitab (2014). Minitab 17. Minitab Assistant White Paper. Extraído de http://support.minitab.com/en-us/minitab/17/Assistant_Multiple_Regression.pdf, en Febrero 2015.
 8. Modigliani, F. & Miller, M. H. (1958). "The cost of capital, corporation finance and the theory of investment". *The American Economic Review*. Pp. 261-296.
 9. Modigliani, F. & Miller, M. H. (1963). "Corporate income taxes and the cost of capital: a correction". *The American Economic Review*. pp. 433-443.
 10. Miller, M. H. (1988). "The Modigliani-Miller Propositions After Thirty Years", *The Journal of Economic Perspectives*, vol. 2, n° 4, pp. 99-120.
 11. OECD. (2009). *Policy Responses to the Economic Crisis: Investing in Innovation for Long-Term Growth*.
 12. Ross, S., Westerfield, R. & Jordan, B. (2001). *Fundamentos de Finanzas Corporativas*. México: McGraw-Hill.
 13. Schumpeter, J. A. (1934). *The Theory of Economic Development*. Cambridge: Harvard University Press.
 14. Schumpeter, J. A. (1939). *Business Cycle. A Theoretical, Historical and Statistical Analysis of the Capitalist Process*. New York: McGraw-Hill Book Company.
 15. Schumpeter, J. A. (1943). *Capitalism, Socialism and Democracy*. New York: Editorial Harper.
 16. Wilson, K. E. (2015), "Policy Lessons from Financing Innovative Firms", *OECD Science, Technology and Industry Policy Papers*, No. 24, OECD Publishing, Paris. <http://dx.doi.org/10.1787/5js03z8zrh9p-en>

Newspapers

- "Informalidad y financiación, los retos de las pymes latinas". (Mayo 31 de 2013). *Portafolio*. Recuperado de <http://www.portafolio.co/negocios/pymes-latinoamerica>.
- "Falta de financiación y poca innovación, problemas de pymes en América Latina". (Julio 29 de 2014). Recuperado el 20 de Agosto de 2015 de <http://www.elspectador.com/noticias/economia/falta-de-financiacion-y-poca-innovacion-problemas-de-py-articulo-507383>.

Databases

1. Damodaran, Aswath: <http://www.damodaran.com>
2. Bloomberg: www.bloomberg.com.
3. Doing business: www.doingbusiness.org

Appendix

Table 1-1.Equity and debt productivities for high-tech (H) firms.⁷

Subsector	Technol level	debt prodvty	eqt prodvty	Higher prvty	DER	Debt weight	Equity weight	w debt prodvty	w equt prodvty	equ/debt prodvty
Semiconductor Equip	H	0,07	0,68	E	0,31	23,78%	76,22%	0,017%	0,518%	9,714
Healthcare Products & Services	H	0,13	0,30	E	0,58	36,74%	63,26%	0,048%	0,190%	2,308
Educational Services	H	0,38	0,61	E	0,33	24,65%	75,35%	0,094%	0,460%	1,605
Telecom (Wireless)	H	0,42	0,64	E	1,16	53,73%	46,27%	0,226%	0,296%	1,524
Pharma & Drugs	H	0,48	0,65	E	0,72	41,69%	58,31%	0,200%	0,379%	1,354
Telecom. Equipment	H	0,15	0,20	E	0,28	21,73%	78,27%	0,033%	0,157%	1,333
Healthcare Equipment	H	0,36	0,48	E	0,57	36,45%	63,55%	0,131%	0,305%	1,333
Semiconductor	H	0,24	0,31	E	0,54	35,18%	64,82%	0,084%	0,201%	1,292
Internet software & services	H	0,23	0,29	E	0,24	19,36%	80,64%	0,045%	0,234%	1,261
Office Equipment & Services	H	0,39	0,45	E	0,50	33,42%	66,58%	0,130%	0,300%	1,154
Telecom. Services	H	0,55	0,63	E	1,44	59,08%	40,92%	0,325%	0,258%	1,145
Computers/Peripherals	H	0,22	0,24	E	1,67	62,56%	37,44%	0,138%	0,090%	1,091
Healthcare Services	H	0,74	0,80	E	1,03	50,81%	49,19%	0,376%	0,393%	1,081
Healthcare Facilities	H	0,60	0,64	E	1,34	57,20%	42,80%	0,343%	0,274%	1,067
Aerospace/Defense	H	0,32	0,34	E	0,84	45,70%	54,30%	0,146%	0,185%	1,063
Healthcare Information & Technology	H	0,45	0,37	D	0,33	24,72%	75,28%	0,111%	0,279%	0,822
Computer Software	H	0,14	0,09	D	0,25	19,82%	80,18%	0,028%	0,072%	0,643
Cable TV	H	0,09	0,05	D	1,33	57,01%	42,99%	0,051%	0,021%	0,556
Computer Services	H	1,11	0,53	D	0,47	31,88%	68,12%	0,354%	0,361%	0,477
Biotechnology	H	0,83	0,38	D	0,31	23,48%	76,52%	0,195%	0,291%	0,458
Air Transport	H	0,10	0,03	D	2,53	71,63%	28,37%	0,072%	0,009%	0,300
Business & Consumer Services	H	-0,01	0,56	E	0,60	37,37%	62,63%	-0,004%	0,351%	-56,000

Source: Author's calculations based on Bloomberg and Damodaran OECD.

7 The color in the pictures seeks to highlight the results analyzed in the text.

Table 1-2.
Equity and debt productivities for Medium-High (MH) technology firms

Subsector	Technol level	debt prodvty	eqt prodvty	Higher provty	DER	Debt weight	Equity weight	w debt prodvty	w equt prodvty	equ/ debt prodvty
Railroad	MH	0,02	0,35	E	1,22	54,87%	45,13%	0,011%	0,158%	17,500
Machinery	MH	0,02	0,10	E	0,53	34,79%	65,21%	0,007%	0,065%	5,000
Auto & Truck	MH	0,16	0,42	E	0,80	44,44%	55,56%	0,071%	0,233%	2,625
Auto Parts	MH	0,30	0,54	E	0,60	37,37%	62,63%	0,112%	0,338%	1,800
Electronics	MH	0,38	0,63	E	0,35	26,12%	73,88%	0,099%	0,465%	1,658
Trucking	MH	0,32	0,52	E	1,51	60,20%	39,80%	0,193%	0,207%	1,625
Chemical (Diversified)	MH	0,60	0,89	E	0,56	35,96%	64,04%	0,216%	0,570%	1,483
Transportation	MH	0,25	0,31	E	1,64	62,10%	37,90%	0,155%	0,117%	1,240
Electrical Equipment	MH	0,35	0,42	E	0,47	32,17%	67,83%	0,113%	0,285%	1,200
Chemical (Basic)	MH	0,73	0,86	E	0,65	39,21%	60,79%	0,286%	0,523%	1,178
Chemical (Specialty)	MH	0,63	0,71	E	0,57	36,48%	63,52%	0,230%	0,451%	1,127
Electronics (Consumer & Office)	MH	-0,33	0,07	E	0,58	36,63%	63,37%	-0,121%	0,044%	-0,212

Source: Author's calculations based on Bloomberg and Damodaran. OECD.

Table 1-3.

Equity and debt productivities for Medium-Low (ML) technology firms

Subsector	Technol level	debt prodvty	eqt prodvty	Higher prodvty	DER	Debt weight	Equity weight	w debt prodvty	w eqt prodvty	equ/debt prodvty
Gas natural	ML	0,01	1,11	E	0,69	40,85%	59,15%	0,004%	0,657%	111,000
Oil/Gas Distribution	ML	0,14	0,82	E	1,79	64,16%	35,84%	0,090%	0,294%	5,857
Rubber& Tires	ML	0,04	0,19	E	0,75	42,76%	57,24%	0,017%	0,109%	4,750
Oil/Gas (Production and Exploration)	ML	0,14	0,51	E	0,54	35,17%	64,83%	0,049%	0,331%	3,643
Metals & Mining	ML	0,25	0,67	E	0,56	35,92%	64,08%	0,090%	0,429%	2,680
Engineering	ML	0,09	0,23	E	0,92	48,01%	51,99%	0,043%	0,120%	2,556
Shipbuilding & Marine	ML	0,17	0,42	E	0,80	44,53%	55,47%	0,076%	0,233%	2,471
Oilfield Svcs/Equip.	ML	0,13	0,32	E	0,84	45,52%	54,48%	0,059%	0,174%	2,462
Household Products	ML	0,08	0,19	E	0,48	32,44%	67,56%	0,026%	0,128%	2,375
Construction	ML	0,46	0,86	E	0,70	41,06%	58,94%	0,189%	0,507%	1,870
Heavy Construction	ML	0,51	0,94	E	0,89	47,22%	52,78%	0,241%	0,496%	1,843
Precious Metals	ML	0,36	0,65	E	0,26	20,63%	79,37%	0,074%	0,516%	1,806
Steel	ML	0,46	0,76	E	0,85	45,96%	54,04%	0,211%	0,411%	1,652
Power	ML	0,17	0,25	E	1,29	56,33%	43,67%	0,096%	0,109%	1,471
Furniture/Home Furnishings	ML	0,25	0,36	E	0,46	31,54%	68,46%	0,079%	0,246%	1,440
Building Materials	ML	0,09	0,12	E	0,90	47,37%	52,63%	0,043%	0,063%	1,333
Oil/Gas (Integrated)	ML	0,54	0,65	E	0,37	27,19%	72,81%	0,147%	0,473%	1,204
Homebuilding	ML	0,40	0,48	E	1,26	55,78%	44,22%	0,223%	0,212%	1,200
Utility (Water)	ML	0,27	0,32	E	3,26	76,54%	23,46%	0,207%	0,075%	1,185
Coal & Related Energy	ML	0,94	1,03	E	0,45	31,26%	68,74%	0,294%	0,708%	1,096
Utility (General)	ML	0,48	0,36	D	1,52	60,25%	39,75%	0,289%	0,143%	0,750

Source: Author's calculations based on Bloomberg and Damodaran. OECD.

Table 1-4.
Equity and debt productivities for Low (L) technology firms

Subsector	Technol level	debt prodvty	eqt prodvty	Higher provty	DER	Debt weight	Equity weight	w debt prodvty	w equt prodvty	equ/debt prodvty
Business & Consumer Services	L	-0,01	0,56	E	0,60	37,37%	62,63%	-0,004%	0,351%	-56,000
Environmental & Waste Services	L	0,02	0,29	E	0,78	43,70%	56,30%	0,009%	0,163%	14,500
Shoe	L	0,08	0,30	E	0,31	23,61%	76,39%	0,019%	0,229%	3,750
Food Wholesalers	L	0,13	0,28	E	0,67	40,16%	59,84%	0,052%	0,168%	2,154
Publishing & Newspapers	L	0,11	0,20	E	0,72	41,89%	58,11%	0,046%	0,116%	1,818
Beverage (Alcoholic)	L	0,13	0,21	E	0,63	38,70%	61,30%	0,050%	0,129%	1,615
Farming/Agriculture	L	0,30	0,42	E	0,62	38,17%	61,83%	0,114%	0,260%	1,400
Beverage	L	0,61	0,82	E	1,26	55,77%	44,23%	0,340%	0,363%	1,344
Paper/Forest Products	L	0,81	0,92	E	0,93	48,13%	51,87%	0,390%	0,477%	1,136
Food Processing	L	0,51	0,57	E	0,62	38,45%	61,55%	0,196%	0,351%	1,118
Apparel	L	0,39	0,39	BOTH	0,49	33,01%	66,99%	0,129%	0,261%	1,000
Packaging & Container	L	0,43	0,25	D	0,96	49,10%	50,90%	0,211%	0,127%	0,581
Tobacco	L	-0,28	0,09	E	0,98	49,55%	50,45%	-0,139%	0,045%	-0,321

Source: Author's calculations based on Bloomberg and Damodaran. OECD.

Table 1-5.
Equity and debt productivities for Services firms

Subsector	Technol level	debt prodvty	eqt prodvty	Higher provty	DER	Debt weight	Equity weight	w debt prodvty	w equit prodvty	equ/debt prodvty
Real Estate (Development)	S	0,05	0,31	E	0,98	49,61%	50,39%	0,025%	0,156%	6,200
Entertainment	S	0,10	0,56	E	0,96	48,92%	51,08%	0,049%	0,286%	5,600
Retail (Distributors)	S	0,01	0,04	E	0,99	49,64%	50,36%	0,005%	0,020%	4,000
Investment Co.	S	0,25	0,66	E	1,70	63,02%	36,98%	0,158%	0,244%	2,640
Reinsurance	S	0,41	0,99	E	0,22	17,83%	82,17%	0,073%	0,814%	2,415
Insurance (Life)	S	1,26	2,66	E	0,68	40,54%	59,46%	0,511%	1,582%	2,111
Insurance (General)	S	0,41	0,85	E	0,50	33,31%	66,69%	0,137%	0,567%	2,073
Restaurant	S	0,42	0,84	E	0,73	42,18%	57,82%	0,177%	0,486%	2,000
Retail (General)	S	0,10	0,20	E	1,19	54,31%	45,69%	0,054%	0,091%	2,000
Banks (Regional)	S	0,40	0,78	E	3,05	75,31%	24,69%	0,301%	0,193%	1,950
Brokerage & Investment Banking	S	0,41	0,79	E	3,16	75,99%	24,01%	0,312%	0,190%	1,927
Thrift	S	0,21	0,40	E	6,03	85,77%	14,23%	0,180%	0,057%	1,905
Information Services	S	0,19	0,35	E	0,58	36,67%	63,33%	0,070%	0,222%	1,842
Broadcasting	S	0,25	0,45	E	1,48	59,63%	40,37%	0,149%	0,182%	1,800
Bank	S	0,56	0,88	E	1,69	62,85%	37,15%	0,352%	0,327%	1,571
Financial Svcs. (Non-bank & Insurance)	S	0,67	1,02	E	2,86	74,10%	25,90%	0,496%	0,264%	1,522
Retail (Grocery and Food)	S	0,64	0,95	E	0,79	44,20%	55,80%	0,283%	0,530%	1,484
R.E.I.T.	S	0,23	0,33	E	1,01	50,13%	49,87%	0,115%	0,165%	1,435
Retail (Automotive)	S	0,55	0,75	E	0,90	47,37%	52,63%	0,261%	0,395%	1,364
Recreation	S	0,67	0,80	E	0,67	40,20%	59,80%	0,269%	0,478%	1,194

(Continúa en pág. 78)

(Viene de pág. 77)

Diversified	S	0,67	0,78	E	1,03	50,83%	49,17%	0,341%	0,384%	1,164
Hotel/Gaming	S	0,58	0,61	E	0,86	46,28%	53,72%	0,268%	0,328%	1,052
Real Estate	S	0,27	0,28	E	1,09	52,18%	47,82%	0,141%	0,134%	1,037
Real Estate (Operations & Services)	S	0,41	0,42	E	1,28	56,05%	43,95%	0,230%	0,185%	1,024
Retail (Internet)	S	0,14	0,08	D	0,77	43,36%	56,64%	0,061%	0,045%	0,571
Insurance (Prop/Cas.)	S	0,51	0,17	D	0,32	24,50%	75,50%	0,125%	0,128%	0,333
Retail (Special Lines)	S	0,39	0,08	D	1,02	50,44%	49,56%	0,197%	0,040%	0,205
Retail (Building Supply)	S	0,08	-0,01	D	0,62	38,42%	61,58%	0,031%	-0,006%	-0,125
Financial Svcs.	S	0,06	-0,02	D	2,93	74,57%	25,43%	0,045%	-0,005%	-0,333
Advertising	S	-0,06	0,22	E	0,55	35,67%	64,33%	-0,021%	0,142%	-3,667

Source: Author's calculations based on Bloomberg and Damodaran. OECD.

Table 1-6.

Equity productivity, from highest to lowest, for 97 sectors

Subsector	debt prodvty	eqt prodvty	Higher provty	DER	Debt weight	Equity weight	w debt prodvty	w eqt prodvty	equ/debt prodvty
Gas natural	0,01	1,11	E	0,69	40,85%	59,15%	0,004%	0,657%	111,000
Railroad	0,02	0,35	E	1,22	54,87%	45,13%	0,011%	0,158%	17,500
Environmental & Waste Services	0,02	0,29	E	0,78	43,70%	56,30%	0,009%	0,163%	14,500
Semiconductor Equip	0,07	0,68	E	0,31	23,78%	76,22%	0,017%	0,518%	9,714
Real Estate (Development)	0,05	0,31	E	0,98	49,61%	50,39%	0,025%	0,156%	6,200
Oil/Gas Distribution	0,14	0,82	E	1,79	64,16%	35,84%	0,090%	0,294%	5,857
Entertainment	0,10	0,56	E	0,96	48,92%	51,08%	0,049%	0,286%	5,600
Machinery	0,02	0,10	E	0,53	34,79%	65,21%	0,007%	0,065%	5,000
Rubber& Tires	0,04	0,19	E	0,75	42,76%	57,24%	0,017%	0,109%	4,750
Retail (Distributors)	0,01	0,04	E	0,99	49,64%	50,36%	0,005%	0,020%	4,000
Shoe	0,08	0,30	E	0,31	23,61%	76,39%	0,019%	0,229%	3,750
Oil/Gas (Production and Explorat	0,14	0,51	E	0,54	35,17%	64,83%	0,049%	0,331%	3,643
Metals & Mining	0,25	0,67	E	0,56	35,92%	64,08%	0,090%	0,429%	2,680
Investment Co.	0,25	0,66	E	1,70	63,02%	36,98%	0,158%	0,244%	2,640
Auto & Truck	0,16	0,42	E	0,80	44,44%	55,56%	0,071%	0,233%	2,625
Engineering	0,09	0,23	E	0,92	48,01%	51,99%	0,043%	0,120%	2,556
Shipbuilding & Marine	0,17	0,42	E	0,80	44,53%	55,47%	0,076%	0,233%	2,471
Oilfield Svcs/Equip.	0,13	0,32	E	0,84	45,52%	54,48%	0,059%	0,174%	2,462
Reinsurance	0,41	0,99	E	0,22	17,83%	82,17%	0,073%	0,814%	2,415
Household Products	0,08	0,19	E	0,48	32,44%	67,56%	0,026%	0,128%	2,375
Healthcare Products & Services	0,13	0,30	E	0,58	36,74%	63,26%	0,048%	0,190%	2,308
Food Wholesalers	0,13	0,28	E	0,67	40,16%	59,84%	0,052%	0,168%	2,154
Insurance (Life)	1,26	2,66	E	0,68	40,54%	59,46%	0,511%	1,582%	2,111
Insurance (General)	0,41	0,85	E	0,50	33,31%	66,69%	0,137%	0,567%	2,073
Restaurant	0,42	0,84	E	0,73	42,18%	57,82%	0,177%	0,486%	2,000
Retail (General)	0,10	0,20	E	1,19	54,31%	45,69%	0,054%	0,091%	2,000
Banks (Regional)	0,40	0,78	E	3,05	75,31%	24,69%	0,301%	0,193%	1,950
Brokerage & Investment Bankin	0,41	0,79	E	3,16	75,99%	24,01%	0,312%	0,190%	1,927
Thrift	0,21	0,40	E	6,03	85,77%	14,23%	0,180%	0,057%	1,905
Construction	0,46	0,86	E	0,70	41,06%	58,94%	0,189%	0,507%	1,870
Heavy Construction	0,51	0,94	E	0,89	47,22%	52,78%	0,241%	0,496%	1,843
Information Services	0,19	0,35	E	0,58	36,67%	63,33%	0,070%	0,222%	1,842
Publshing & Newspapers	0,11	0,20	E	0,72	41,89%	58,11%	0,046%	0,116%	1,818
Precious Metals	0,36	0,65	E	0,26	20,63%	79,37%	0,074%	0,516%	1,806
Auto Parts	0,30	0,54	E	0,60	37,37%	62,63%	0,112%	0,338%	1,800
Broadcasting	0,25	0,45	E	1,48	59,63%	40,37%	0,149%	0,182%	1,800

Table 1-7.

Equity productivity, from highest to lowest, for 97 sectors

Electronics	0.38	0.63	E	0.35	26,12%	73,88%	0,099%	0,465%	1,658
Steel	0.46	0.76	E	0.85	45,96%	54,04%	0,211%	0,411%	1,652
Trucking	0.32	0.52	E	1,51	60,20%	39,80%	0,193%	0,207%	1,625
Beverage (Alcoholic)	0.13	0.21	E	0.63	38,70%	61,30%	0,050%	0,129%	1,615
Educational Services	0.38	0.61	E	0.33	24,65%	75,35%	0,094%	0,460%	1,605
Bank	0.56	0.88	E	1,69	62,85%	37,15%	0,352%	0,327%	1,571
Telecom (Wireless)	0.42	0.64	E	1,16	53,73%	46,27%	0,226%	0,296%	1,524
Financial Svcs. (Non-bank & Ins)	0.67	1.02	E	2,86	74,10%	25,90%	0,496%	0,264%	1,522
Retail (Grocery and Food)	0.64	0.95	E	0.79	44,20%	55,80%	0,283%	0,530%	1,484
Chemical (Diversified)	0.60	0.89	E	0.56	35,96%	64,04%	0,216%	0,570%	1,483
Power	0.17	0.25	E	1,29	56,33%	43,67%	0,096%	0,109%	1,471
Furniture/Home Furnishings	0.25	0.36	E	0.46	31,54%	68,46%	0,079%	0,246%	1,440
R.E.I.T.	0.23	0.33	E	1,01	50,13%	49,87%	0,115%	0,165%	1,435
Farming/Agriculture	0.30	0.42	E	0.62	38,17%	61,83%	0,114%	0,260%	1,400
Retail (Automotive)	0.55	0.75	E	0.90	47,37%	52,63%	0,261%	0,395%	1,364
Pharma & Drugs	0.48	0.65	E	0.72	41,69%	58,31%	0,200%	0,379%	1,354
Beverage	0.61	0.82	E	1,26	55,77%	44,23%	0,340%	0,363%	1,344
Telecom. Equipment	0.15	0.20	E	0.28	21,73%	78,27%	0,033%	0,157%	1,333
Healthcare Equipment	0.36	0.48	E	0.57	36,45%	63,55%	0,131%	0,305%	1,333
Building Materials	0.09	0.12	E	0.90	47,37%	52,63%	0,043%	0,063%	1,333
Semiconductor	0.24	0.31	E	0.54	35,18%	64,82%	0,084%	0,201%	1,292
Internet software and services	0.23	0.29	E	0.24	19,36%	80,64%	0,045%	0,234%	1,261
Transportation	0.25	0.31	E	1,64	62,10%	37,90%	0,155%	0,117%	1,240
Oil/Gas (Integrated)	0.54	0.65	E	0.37	27,19%	72,81%	0,147%	0,473%	1,204
Homebuilding	0.40	0.48	E	1,26	55,78%	44,22%	0,223%	0,212%	1,200
Electrical Equipment	0.35	0.42	E	0.47	32,17%	67,83%	0,113%	0,285%	1,200
Recreation	0.67	0.80	E	0.67	40,20%	59,80%	0,269%	0,478%	1,194
Utility (Water)	0.27	0.32	E	3,26	76,54%	23,46%	0,207%	0,075%	1,185
Chemical (Basic)	0.73	0.86	E	0.65	39,21%	60,79%	0,286%	0,523%	1,178
Diversified	0.67	0.78	E	1,03	50,83%	49,17%	0,341%	0,384%	1,164
Office Equipment & Services	0.39	0.45	E	0.50	33,42%	66,58%	0,130%	0,300%	1,154
Telecom. Services	0.55	0.63	E	1,44	59,08%	40,92%	0,325%	0,258%	1,145
Paper/Forest Products	0.81	0.92	E	0.93	48,13%	51,87%	0,390%	0,477%	1,136
Chemical (Specialty)	0.63	0.71	E	0.57	36,48%	63,52%	0,230%	0,451%	1,127
Food Processing	0.51	0.57	E	0.62	38,45%	61,55%	0,196%	0,351%	1,118
Coal & Related Energy	0.94	1.03	E	0.45	31,26%	68,74%	0,294%	0,708%	1,096
Computers/Peripherals	0.22	0.24	E	1,67	62,56%	37,44%	0,138%	0,090%	1,091
Healthcare Services	0.74	0.80	E	1,03	50,81%	49,19%	0,376%	0,393%	1,081
Healthcare Facilities	0.60	0.64	E	1,34	57,20%	42,80%	0,343%	0,274%	1,067

Source: Author's calculations based on Bloomberg and Damodaran. OECD.

Table 1-8.

Equity productivity, from highest to lowest, for 97 sectors

Aerospace/Defense	0.32	0.34	E	0.84	45.70%	54.30%	0.146%	0.185%	1.063
Hotel/Gaming	0.58	0.61	E	0.86	46.28%	53.72%	0.268%	0.328%	1.052
Real Estate	0.27	0.28	E	1.09	52.18%	47.82%	0.141%	0.134%	1.037
Real Estate (Operations & Servis	0.41	0.42	E	1.28	56.05%	43.95%	0.230%	0.185%	1.024
Apparel	0.39	0.39	BOTH	0.49	33.01%	66.99%	0.129%	0.261%	1.000
Healthcare Information and Tech	0.45	0.37	D	0.33	24.72%	75.28%	0.111%	0.279%	0.822
Utility (General)	0.48	0.36	D	1.52	60.25%	39.75%	0.289%	0.143%	0.750
Computer Software	0.14	0.09	D	0.25	19.82%	80.18%	0.028%	0.072%	0.643
Packaging & Container	0.43	0.25	D	0.96	49.10%	50.90%	0.211%	0.127%	0.581
Retail (Internet)	0.14	0.08	D	0.77	43.36%	56.64%	0.061%	0.045%	0.571
Cable TV	0.09	0.05	D	1.33	57.01%	42.99%	0.051%	0.021%	0.556
Computer Services	1.11	0.53	D	0.47	31.88%	68.12%	0.354%	0.361%	0.477
Biotechnology	0.83	0.38	D	0.31	23.48%	76.52%	0.195%	0.291%	0.458
Insurance (Prop/Cas.)	0.51	0.17	D	0.32	24.50%	75.50%	0.125%	0.128%	0.333
Air Transport	0.10	0.03	D	2.53	71.63%	28.37%	0.072%	0.009%	0.300
Retail (Special Lines)	0.39	0.08	D	1.02	50.44%	49.56%	0.197%	0.040%	0.205
Retail (Building Supply)	0.08	-0.01	D	0.62	38.42%	61.58%	0.031%	-0.006%	-0.125
Electronics (Consumer & Office	-0.33	0.07	E	0.58	36.63%	63.37%	-0.121%	0.044%	-0.212
Tobacco	-0.28	0.09	E	0.98	49.55%	50.45%	-0.139%	0.045%	-0.321
Financial Svcs	0.06	-0.02	D	2.93	74.57%	25.43%	0.045%	-0.005%	-0.333
Advertising	-0.06	0.22	E	0.55	35.67%	64.33%	-0.021%	0.142%	-3.667
Business & Consumer Services	-0.01	0.56	E	0.60	37.37%	62.63%	-0.004%	0.351%	-56.000

Source: Author's calculations based on Bloomberg and Damodaran. OECD.

NOTES	
12 sectors	Debt productivity higher than that of equity even some cases in which debt lower than equity
23 sectors	Debt higher than equity, however, equity productivity higher than debt productivity
62 sectors	Stock productivity higher than debt productivity even in cases in which debt higher than equity

Table 1-9.

Equity-debt productivity of nine geografic areas without financial sectors, 2.009-2.013

PAIS	Panel	Debt-equity	inter	Debt	t-Stud.	Equity	t-Stud.	R2	F-Stat	Higher	DER	Debt	Equity	wgtd debt	wgtd eqt
AREA	Model	Correlation	cept	prodvty	95%	prodvty	0,95		0,95	prodvty	Mean	weight	weight	prodvty	prodvty
ACNZ	Fixed	0.90	4.21			0.46	15.20	0.93	48.84	Equity	0.867	46.44%	53.56%	0.181%	0.246%
	Fixed		5.00	0.39	13.06			0.93	43.24						
CHINA	Fixed	0.90	3.91			0.48	14.94	0.93	46.84	Equity	0.571	36.35%	63.65%	0.098%	0.306%
	Fixed		5.59	0.27	9.99			0.91	36.45						
EMERG	Fixed	0.90	5.68			0.27	7.64	0.94	50.93	Equity	0.676	40.32%	59.68%	0.093%	0.161%
	Fixed		6.16	0.23	8.77			0.94	53.68						
EURO	Fixed	0.90	4.02			0.60	19.63	0.95	67.85	Debt	1.106	52.52%	47.48%	0.320%	0.285%
	Fixed		4.11	0.61	26.79			0.97	101.10						
INDIA	Fixed	0.84	5.19			0.14	6.22	0.96	67.55	Equity	0.494	33.06%	66.94%	0.020%	0.094%
	Fixed		6.05	0.06	5.02			0.95	63.15						
JAPAN	Fixed	0.89	7.14			0.19	7.67	0.97	101.43	Equity	1.079	51.90%	48.10%	0.088%	0.091%
	Fixed		7.40	0.17	6.83			0.97	98.09						
LATINAM	Fixed	0.76	3.91			0.47	8.91	0.89	25.88	Equity	0.820	45.06%	54.94%	0.090%	0.137%
	Fixed		5.32	0.28	7.45			0.87	20.94						
	Fixed		4.17	0.20	4.23	0.25	3.50	0.90	27.25						
UK	Fixed	0.84	5.52			0.30	10.41	0.94	48.11	Debt	1.051	51.24%	48.76%	0.138%	0.049%
	Fixed		5.52	0.34	13.20			0.94	56.13						
	Fixed		5.23	0.27	7.56	0.10	2.73	0.95	56.50						
USA	Fixed	0.58	4.07			0.58	6.27	0.78	9.13	Equity	1.029	50.71%	49.29%	0.046%	0.276%
	Fixed		7.01	0.25	5.63			0.74	7.23						
	Random		3.53	0.09	2.26	0.56	7.13	0.17	41.36	Equity					

Source: author's calculations based on Bloomberg and Damodaran. OECD.

Table 1-10.

Areas clasification according to weighted equity productivity, without financial sector, from highest to the lowest. 2.009-2.013

COUNTRY	Higher prodvty	DER mean	Debt weight	Equity weight	wgtd debt prodvty(%)	wgtd eqt prodvty(%)
CHINA	Equity	0,571	36,3%	63,7%	0,098	0,306
EURO	Debt	1,106	52,5%	47,5%	0,320	0,285
USA	Equity	1,029	50,7%	49,3%	0,046	0,276
ACNZ	Equity	0,867	46,4%	53,6%	0,181	0,246
EMERG	Equity	0,676	40,3%	59,7%	0,093	0,161
LATINAM	Equity	0,820	45,1%	54,9%	0,090	0,137
INDIA	Equity	0,494	33,1%	66,9%	0,020	0,094
JAPAN	Equity	1,079	51,9%	48,1%	0,088	0,091
UK	Debt	1,051	51,2%	48,8%	0,138	0,049

Source: Author's calculations based on Bloomberg and Damodaran. OECD.

Table 1-11.

Equity-debt productivity of nine geographic areas without financial sectors. 2.011-2.016

PAIS	Panel	Debt-equity	inter	Debt	t-Stud.	Equity	t-Stud.	R2	F-Stat	Higher	DER	Debt	Equity	wtd debt	wtd eqt
AREA	Model	Correlation	cept	prodvty	95%	prodvty	0,95		0,95	prodvty	Mean	weight	weight	prodvty	prodvty
CHINA	None	0,92	1,62			0,80	33,88	0,77	1148,2	Equity	0,40	28,40%	71,60%	0,21%	0,57%
	Random		3,07	0,73	38,60			0,81	1490,9						
EURO	None	0,69	2,79			0,66	16,49	0,34	272,0	Debt	0,69	40,70%	59,30%	0,33%	0,39%
	Random		2,65	0,80	51,18			0,83	2581,3						
INDIA	None	0,87	2,97			0,64	25,18	0,62	634,2	Equity	0,53	34,60%	65,40%	0,17%	0,42%
	None		4,86	0,48	18,48			0,47	341,4						
JAPAN	None	0,89	2,78			0,69	22,00	0,49	484,0	Equity	0,48	32,65%	67,35%	0,22%	0,46%
	None		3,59	0,66	23,65			0,53	559,2						
USA	None	0,88	3,98			0,52	13,27	0,25	176,0	Debt	0,78	43,90%	56,10%	0,24%	0,29%
	None		3,85	0,55	14,19			0,28	201,4						