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Title: 'Intangible Flow Theory, Operating Intangibility and Other Economic Characteristics of Firms'

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This thesis is the result of the author's original research. It has been composed by the author and has not been previously submitted for examination which has lead to the award of a degree.

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Abstract:

Intangible flow theory explains that flows of economic material elements, such as cash or physical goods, are consummated by embedded human related intangible flows, such as services flows, work flows, information flows, knowledge flows or communicational flows, which have properties precluding them to be considered assets or capital. Therefore, mathematical/quantitative research methods are necessary but insufficient to study economy and society.

The theory uses the precision approach to capture tangibility (and its opposite), which enables defining cash flows occurred in an identifiable period as tangible flows. To demonstrate intangible flow dynamics, the thesis suggests that corporations may partially organize themselves according to operating needs associated with the tangibility of product (output) flows used to generate material cash flows through sales to customers. For example, firms producing cars or planes might be required to have distinct economic characteristics to firms selling pure services or software.

The thesis reviews interdisciplinary literature about products and their characteristics, and introduces the concept of operating intangibility based upon intangible flow theory. This concept assists the problem of classifying corporations according to their product flows' intangibility. For approximately identifying a firm’s level of operating intangibility, the methodological framework looks into the absence of its opposite, which can be identified with a certain degree of precision through the accounting proportion that costs of physical goods sold and depreciations of tangible property, equipment and facilities have in total operating expenses.

The empirical findings exhibit that a firm's operating intangibility tends to be reflected in several other economic characteristics: size, investment profile, profitability, market valuation, or capital structure. Furthermore, the results show that the level of operating intangibility framework exempts us from the need of assuming that firms registered in the same industry are either homogeneous or sell homogeneous products, because it can be used to classify firms within an industry, or industries themselves.

The empirical analysis was conducted on a very large international sample of listed firms containing 15 country sub-samples from Australia, Canada, China, France, Germany, Israel, Japan, Malaysia, Singapore, South Africa, South Korea, Sweden, Taiwan, USA, and UK.

Table of Contents

List of Tables

9.5- Results of Fixed Effects and Fama Macbeth tests about the Operating Intangibility Hypothesis around the World.

9.6- Verification of the 5 Operating Intangibility Hypotheses in the Sub Samples of 15 different countries from around the World.

List of Figures

8.5- Distribution of firms and debt leverage in industries allegedly selling durable goods picked by Titman and Wessels (1988) and Banerjee et al (2008).

9.1- Graphical comparisons of the economic characteristics of firms over the period 2000-2009 in the international sample.

9.2- Mean LOI by year in the period 2000-2009 for each country sample.

1- Introduction

This thesis is about flowing intangibility. To put it on another way, it is about the methodological inability of mainstream economics to capture the flows of economic material elements, such as physical goods or cash, because they are consummated by human related intangible flows, such as work flows, service flows, knowledge flows, or information flows. Therefore, the result is that mainstream economics (hereafter referred to as neoclassical economics) could not be sufficiently equipped to address the intangible flow dynamics of phenomena such as growth, profits, investment, inflation, interest rates, debt, market valuation, crisis, etc.

Neoclassical economics tends to define economy by its object of research: the study of utility maximization under conditions of scarcity (Caliskan and Callon, 2009). The behaviour of persons and organizations in nearly every context would be explained by a single concept of instrumental rationality that maximizes utility. The utility and constraint functions are described mathematically, thus quantitatively, which would be in conformity with the concept of homo economicus decision maker (see for instance Thaler, 2000). This framework is quite convenient for neoclassical economics that only accepts mathematical/quantitative methods of reasoning (Leontieff, 1982; Beed and Kane, 1991; Lawson, 2006; Hopwood, 2008; Sutter, 2009).

It must be clear that mathematical/quantitative methods are most important for science, and have contributed to magnificent advances in human knowledge. Nonetheless, the problem arises from the refusal of neoclassical economists to accept other forms of scientific reasoning than mathematical/quantitative instruments, and to establish connections with other social sciences that could go beyond the research instruments accepted in its realm of research.

One may ask, but how could intangibility pose a challenge to neoclassical economics?

Tangibility, which defines the opposite of intangibility, is related either with the sense of touch or faculty of being identified with precision; that is, the capability of being identified or realized precisely in one’s mind and of being appraised at an actual or approximate value (Bateson, 1979; Flipo, 1988; Bienlens and Sempels, 2003; Merriam Webster’s Dictionary). Thus, mathematical/quantitative methodologies would already face adversity in addressing the non measurable static non-tangibility, such as the intangibility of a still asset, or a still resource (as described by Wernerfelt, 1984; and Barney, 1991).

Nonetheless, this thesis reminds us that intangibility does not necessarily remain still. On the contrary, it moves frequently, as the performer's music reaches the cognition and affectivity of people in the audience, or the restaurant's clients learn the options on the menu. Therefore, as neoclassical economics refuses to accept other scientific methods of inquiry than mathematical/quantitative methods of reasoning (Leontieff, 1982; Beed and Kane, 1991; Lawson, 2006; Hopwood, 2008; Sutter, 2009), it risks presenting itself as an obstacle for advancing our understanding of economic phenomena.

A provident starting point could be to follow the ancient advice from the Greek philosopher Socrates, and recognize that we know very little on the subject of the intangible elements that influence economic phenomena. Thus, we should move with small and firm steps, looking for intangible implications that might be scientifically demonstrated. Furthermore, we should be aware of Plato's allegory of the cave: some light thrown to persons who live in the darkness of a cave should be used to see more than the shadows of themselves.

After the advent of the serious economic crisis that we are experiencing in Europe and the United States after 2007, the lack of communication between neoclassical economics and other social sciences has been more severely criticized. Hopwood (2008) accuses some neoclassical economists of exhibiting crude prejudice against other social sciences. Benzemer (2010) argues that an accounting approach based on flows of funds would have helped to anticipate the credit crisis and economic recession. The major question he poses is, ‘why have accounting approaches been kept outside mainstream economics?’. Benzemer (2010) further argues that the recurrent claim that no one saw this economic crisis coming (e.g.: Greenspan, 2008; Krugman, 2009) is a concrete manifestation of the refusal of neoclassical economists to consider the relevance of accounting and regulation in their studies. Carruthers (2011) sustains that the recent crisis stimulated an already growing sociological interest in finance. Sociological research may reveal the importance of politics for many financial market developments, and contribute to several issues that are very relevant for financial economics such as implications of corporate governance, continuing significance of social factors, and the role of theoretical and material devices in shaping financial practices.

However, this thesis is not about predicting or explaining economic crises, though it cannot be isolated from the societal context in which it was written. The object of study is much more restrictive. The aim is to develop the embeddeness critique, suggested by Granovetter (1985) and Callon (1998). This critique supports the notion that economic action is embedded in structures of social relations, and therefore contends that social relations must be considered in order to understand economic actions. Neoclassical economics is directly questioned because it undermines the importance of social relations and their structures. The dynamics of social relations can, indeed, be relevant to our understanding of economies and societies.

Before introducing intangible flow theory, let us describe its intrinsic nature. First of all, intangible flow theory is a grounded theory, which was formulated with the support of a collection of facts, and formalized for the subsequent testability of its predictions, an ultimate goal of the grounded theory method (see Goulding, 2002; and Charmaz, 2006). Furthermore, this theory is a practice oriented theory because it intends to understand practices observed in economy and society, assuming that social life is an ongoing production, and thus emerges through the recurrent actions of people (as described by Feldman and Orlikowski, 2011). Moreover, intangible flow theory is also classifiable as a heterodox economic theory (see Lawson, 2006).

Thus intangible flow theory is a grounded, practice oriented, and heterodox economic theory. It studies the dynamics of social relations in economy and society, and explains that flows of economic material elements are consummated by human-related intangible flows (e.g.: work flows, service flows, information flows, or communicational flows) that cannot be appraised precisely at an actual or approximate value and have properties that preclude their being classified as assets or capital. In intangible flow theory, the term intangible (i.e. not tangible) is defined through the precision approach to tangibility, and the term flow is defined as the movement of an element deriving from a source. Therefore, an element that is not flowing should be considered static.

The paradox of quantifying intangible entities is that previously intangible dimensions can become tangible when researchers find the means by which they can be precisely identified. That is, when scientists develop quantitative methods for ascribing actual or approximate values to previously intangible elements, these now quantifiable elements acquire properties of tangibility, while other still non-quantifiable dimensions remain intangible. Observe that although this formulation could describe natural intangible flows, intangible flow theory focuses on human-related intangible flows deriving from a person or group of persons. Furthermore, notice that this theory makes a concrete separation between human beings and human related intangible flows, and addresses intangible elements that consummate economic phenomena.

As explained in more detail in chapter 2, intangible flow theory proposes also that i) associated with the occurrence of the economic material flows, there can be a very vast and complex conjunct of intangible flows, in which, inclusively, some of those intangible flows can be very difficult to identify (first corollary); ii) It is not necessary for a temporal coincidence to exist between intangible flows and economic material flows for intangible flows to impact economic material flows (second corollary); iii) The non-occurrence of economic material flows can also be a consequence of intangible flows that have a negative effect on their consummation. Similarly, intangible flows exist that might worsen the cash flows of an interested person or group (third corollary); iv) the tangibility of cash flows refers to cash flows that occur within a precise interval of time. Not yet verified cash flows cannot be considered already materialized (fourth corollary); and v) Although mathematical/quantitative research tools can be used to precisely measure economic material flows, they are insufficient for researching and capturing intangible flows and their relationships with the material flows (fifth corollary). If there is, indeed, such a thing as a human-related intangible flow, and if that flow is necessary to consummate the flows of economic material elements, its existence could have great implications for our understanding of economy and society. Because neoclassical economics only accepts mathematical/quantitative methods of reasoning (Leontieff, 1982; Beed and Kane, 1991; Lawson, 2006; Hopwood, 2008; Sutter, 2009), the intangible flow dynamics of economic phenomena are beyond the methodological capacity of neoclassic economics.

Therefore, intangible flow theory can be offered as an alternative to formulations derived from neoclassical economics, which describe organizations as homogeneous black boxes, or human beings as assets or capital (e.g.: Becker, 1962; Ditman et al, 1973; Ciccone and Peri, 2006; Barro, 2001;Argyres, 2011; Ployhart et al, 2011). Intangible flow theory defends the stance that there is no scientific evidence demonstrating that organizations are homogeneous black boxes, or that human beings are assets or capital. Such comparisons are employed by the assumptions of neoclassical economics, not because of any previous demonstration. These ‘solutions’ are supposed to conveniently accommodate the study of organizations and human beings with the research methods accepted by neoclassical economics, which are restricted to mathematical/quantitative instruments. However, those flawed comparisons are similar to performative operations (as described by Mackenzie, 2007) because they intervene in the production of the reality they claim to represent. Furthermore, these comparisons sabotage the study of well delimited research questions by scientific approaches outside the realm of neoclassical economics.

Organizational phenomena that comprise both economic and social processes may demonstrate the intangible flow dynamics of economic phenomena. For this motive, the current thesis focuses its attention on the case of product sales to customers, which are the principal mechanism through which organizations must generate material cash in-flows. To advance intangible flow theory, one could reach the theoretical prediction that *corporations partially organize themselves according to the operating needs associated with the tangibility of the flows of products used to generate material cash flows through sales to customers.* If this association between operating needs and economic characteristics occurs, we can no longer ignore the fact that the characteristics of firms cannot be dissociated from the way they are organized, as is often done by neoclassical economics.

For the robustness of the argument, chapter three reviews literature in management and economic sociology on the subject of product intangibility. In this thesis, a product is understood to be an output from an organization. Products may include services, physical goods, and other outputs that are a mixture of services and physical goods, or outputs that are hybrid products themselves. Products can be classified according to their intangibility (Schostack, 1977), ranging from the ‘most tangible’ (e.g.: salt or pencils) to the ‘most intangible’ (e.g.: pure services, such as consulting or teaching). In the middle of the scale are products that are combinations of tangible and intangible components. For example, meals in restaurant chains mix tangible food and drinks with intangible services and marketing. Services, in particular, which are present in every industry, have characteristics that distinguish them from physical goods. That is, though both goods and services are products, services are not goods.

Previous research identified dissimilarities between physical goods and intangible services, and specific properties of service trading. These distinctive service related features include: i) intangibility, ii) heterogeneity, iii) perishability, iv) non separation of production and consumption (Zeithaml et al, 1985; see also Parasuraman et al, 1985, and Wilson et al, 2008), v) non-ownership of services (Lovelock and Gummeson, 2004), vi) less clearly defined boundaries between the firm and the exterior, as the service providers do also span the boundaries of the organization by linking the organizational interior with the outside world (Schneider and Bowen, 1993; Bowen et al, 1999; Harris and Ogbonna, 2002; Wilson et al, 2008; Lovelock and Wirtz, 2011), vii) customer-service provider dynamic integration in the service outcome, and viii) active participation of the customer in the production of many services, contrary to what happens with the physical goods (Hubert, 1995; Meuter and Bitner, 1998; Meutner et al, 2000).

Furthermore, the intangibility of products is not restricted to the previously acknowledged intangibility of services. As suggested by a neo schumpeterian theory of the organization, innovation, knowledge, information and capabilities are integral components of a firm's productive system (see Nelson and Winter, 1982; Winter, 2006; Levinthal, 2006). Observe, for instance, the knowledge and capabilities necessary to produce and sell a product to a customer. Contrary to neoclassical economists, mathematicians and statisticians such as Soofi (1994), or

Cover and Thomas (2005) are aware that they cannot use quantitative methods to reach semantical dimensions of information and knowledge. An only apparently simple distinction between data, information, and knowledge already poses many difficulties (e.g.: Davenport and Prusack, 1998; Boisot and Canals, 2004). Polanyi (1969) explained that it is not a straightforward task to divide tacit and codified knowledge. While tacit knowledge can be implicit by itself, codified knowledge must rely on being tacitly understood and applied. As noted by Blacker (1995) knowledge is multifaceted and complex, being both situated and abstract, implicit and explicit, distributed and individual, physical and mental, developing and static, verbal and encoded. Innovation is also known to be both a process and an outcome (Crossan and Apaydin, 2010). The transfers of intangible knowledge, or intangible innovation processes are concrete situations involving human related intangible motions. Moreover, such flows are not restricted to the organization's internal staff. They may involve complex networks of internal and external persons that were previously identified in management and economic sociology literature (e.g.: Mitchell, 1969; Allen, 1977; Tushman, 1977; Barnes, 1979; Law and Callon, 1992; Bouty, 2000; Mckinlay, 2000; Burt, 2005; Conway and Steward, 2009)

Chapter three also shows that previous neoclassical economical research puts under a large umbrella of 'intangible intensity' a variety of different methods for classifying firms. Prior mainstream literature describes three methods, none of which is based on a firm's products: (a) intangible/tangible asset intensity (e.g.: Rajan and Zingales, 1995;Claessens and Laeven, 2003; Baker and Wurgler, 2004; Wyatt, 2005); (b) R&D intensity (e.g.: Chambers et al, 2001; Kothari et al, 2002; Frazen et al, 2007; Darrough and Ye, 2007); and (c) industry classification (e.g.:

Collins et al, 1997; Francis and Schipper, 1999; Core et al, 2003; Armstrong et al, 2007). Although these neoclassical methods are eventually interrelated, they capture different aspects of a firm's life. None of the three previous groups of indicators, namely, intangible asset intensity, R&D intensity, and industry classification was specifically conceptualized to identify the intangibility of a firm's flows of products. Therefore, to identify and develop an economic method that is able to classify organizations according to the tangibility of their flows of products is a contribution in itself.

Nonetheless, before moving in the direction of suggesting a methodology for that purpose, this thesis exemplifies a concrete block of neoclassical economic literature, ignoring the intangible flow dynamics of economic phenomena. Chapter 4 dedicates its pages to the neoclassical economical framework for a firm's capital structure, at a time when several surveys show that organizational practitioners do not believe, and/or do not follow the dominant mainstream theories on the subject (e.g.: Graham and Harvey, 2001; Beattie et al, 2006). By capital structure we mean the firm's decision over its financial sources, that can be obtained either through shareholders' investments in shares and other securities, or through debt holders who finance the firm with bonds, commercial paper, bank loans or other securities.

The neoclassical capital structure theory descends from the introductory work of Modigliani and Miller (1958; see also Miller, 1988) who base their theoretical framework on Fisher's concept of the firm. Within the Fisherian perspective, firms are treated as black boxes full of intangible elements that could not be quantified. To facilitate such an analysis, neoclassical economists assume that a firm's operating decisions can be considered to be independent from its financing and investing decisions. In this thesis, such an assumption is called separability assumption. Chapter 4 demonstrates that the separability assumption is deeply entangled in neoclassical economical formulations such as trade-off theory, pecking order theory, market timing theory, product-market studies, or agency studies.

Thus, chapter 4 suggests that neoclassical economists may enter themselves into a paradoxical ground. They focus on a firm's underlying net cash flows but decide to neglect the operating activities through which those same cash flows are generated. Hence, the separability assumption has important implications for research and practice: Firstly, the neoclassical theoretical framework would implicitly advise the financial decision maker to neglect the operational management of the firm, because, allegedly, financial and operating decisions could be taken separately. Accordingly, it would be possible to make correct financial decisions without considering specific operational needs. In this sense, the operating management would be considered deterministically to be something that happens inside the black box which describes the firm. Secondly, this separability assumption promotes the negligence of accounting information, in the sense that the reporting of a firm's operating activities would be inconsequential for financial economics.

Hence, chapter 4 exemplifies a concrete aspect of economy and society where intangible flow theory has a direct dispute with neoclassical economics. For neoclassical economics, organizational operating decisions can be isolated from their financing and investing decisions. Alternatively, intangible flow theory suggests that *corporations partially organize themselves according to the operating needs associated with the tangibility of the flows of products used to generate material cash flows through sales to customers* and, therefore, given that decisions over operating products are concrete operating decisions, operating decisions are not independent from financing and investing decisions; and vice-versa. If intangible flow theory can be employed to understand the problem and create economic methodologies capable of producing indicators that describe operating decisions, then, intangible flow theory can be used to test one of the most important assumptions of neoclassical financial economics: the separability assumption.

A method of addressing the tangibility of product flows at the firm level is presented in Chapter 5. Note however that it was a complicated problem to solve. Industry classification could not be employed to address the intangibility of product flows at the firm level because the industry method assumes homogeneity of firms and/or products within each industry. Therefore, the industry method cannot be used to classify firms within an industry, nor it can be used to classify industries themselves. Intangible asset indicators could not be employed because intangible flow theory explains that there are distinctions between assets and products, capital and products, and resources and products. Intangible asset methods would fail to identify intangible products such as services, or other intangible products, and would fail to regard important intangible related expenses that have properties precluding their being considered balance sheet items. The same applies to R&D based methods, to which one should add another problem. When constructing R&D probability distributions in manufacturing industries, Cohen and Klepper (1992) found that the largest concentration of R&D intensity occurred near the zero value. This occurs because many firms have missing or zero value observations in R&D values. Therefore, researchers must decide whether to eliminate missing value firms from their sample or assume that the missing values are equal to zero. Thus, researchers must either disregard valuable information or risk erroneously classifying many firms that do not engage in or report R&D or intangible assets.

Chapter 5 starts by defending the case that accounting information can provide highly valuable information regarding product tangibility. However, once again, the direct appraisal of sale values, as registered in the income statement or cash flow statement, would not be a good option because these rubrics may aggregate an intricate mixture of physical-goods, semi intangible and intangible products values. In order to identify the tangibility of product flows at the organization level, chapter 5 introduces the concept of 'operating intangibility' which consists of: 'the dynamic set of intangible flows integrated into a firm's operating productive system that is necessary to generate material cash flows through sales to customers'. This theoretical framework measures the 'level of operating intangibility' (LOI) as the proportion of intangible-related expenses among total operating expenses. Therefore, we have a solution for our problem of identifying product tangibility at a firm level because, although intangible flows cannot be measured with precision due to their inherent properties, the material expenses related to the production and consumption of intangible flows can be quantified. Hence, LOI does not quantify intangible flows, but intangible related expenses, which include: i) the production of services for sale. ii) the production of services for internal consumption (e.g.: accounting, security, etc.); iii) the conception, improvement, and marketing of product (output) features (e.g.: development, marketing); and, iv) the consumption of other intangible-related expenses (e.g.: communications, royalties, externally acquired services, etc.).

Subsequently, a proxy for measuring the level of operating intangibility is discussed and exemplified with several well known corporations and a few industries with observations contained in the primary sample. Moreover, by the end of Chapter 5, actual financial statements of the firms Shell, Wal Mart, and Coca Cola, and Microsoft are used to illustrate and discuss the level of operating intangibility proxy. For instance, Shell has a business model that can be classified as a physical good intensive, and Microsoft's business model classifiable as intangible product intensive. However, although Wal Mart, the supermarket chain, could be considered a service retail firm, it has a business model classifiable in the physical-goods intensive side of the LOI scale, because its material physical goods component is relatively substantial. On the other hand, the LOI method can detect that Coca-Cola's business model is based not only on the tangibility of the bottles, liquid drinks, and food sold, but also on notable intangible related expenses, such as branding, customer outreach campaigns, and service production. These aspects of Coca Cola's operating activities attribute a relatively high LOI value for this firm.

A methodological strategy with testable hypotheses is formulated in chapter 6. The hypotheses examine the theoretical prediction that firms partially organize themselves according to operating needs associated with the tangibility of the flows of products (outputs) sold to customers. The hypotheses of this thesis are also explained to be derived primarily from intangible flow theory because the concept of operating intangibility requires the previous concepts of human related intangible flow and intangible flow dynamics, which are integral components of intangible flow theory, and were not captured by previous theoretical frameworks.

To identify economic indicators that could describe how firms are organized, the chapter suggests the characteristics studied in Rajan and Zingales (1995): i) size of the cash flow generated through sales; ii) capital expenditures in property, equipment, and facilities; iii) profitability; iv) stock market valuation of equity (market-to-book); and v) debt as proportion of the capital structure. Rajan and Zingales (1995) is one of the key references for control variables in neoclassical financial economics studies involving a firm's capital structure (e.g.: Baker and Wurgler, 2004; Alti, 2006; Lemmon et al, 2008). The neoclassical conceptualization of the firm as a black box does not seem specially prepared to predict and study associations between these economic characteristics and the operating activities of firms. Intangible flow theory can contribute by providing foundations for the formulation of new hypotheses.

Concretely, the hypotheses empirically test whether a decrease in the tangibility of a firm's flows of products, which corresponds to an higher LOI, is associated with five expected characteristics of intangible-product-intensive firms: i) smaller size of the cash flow generated trough sales; ii) lower capital expenditure on property, equipment, and facilities; iii) lower profitability; iv) higher stock market valuation of equity (market-to-book); and v) less debt as proportion of the capital structure

The empirical tests were conducted on two different samples: a primary sample, with observations from firms listed in three major American exchanges, namely, NYSE, AMEX and NASDAQ; and the international (secondary) sample, with observations from firms listed in other countries. The results over hypothesis testing in the primary sample are presented in Chapter 7. The observations for this sample were obtained from the merged CRSP-COMPUSTAT database. The final sample has 107,070 observations, from 10,162 different firms, over 41 years (1966-2006), after outlier observations were eliminated.

The empirical results regarding the testable hypotheses proposed in Chapter 6 demonstrate that the increase in a firm's level of operating intangibility, which corresponds to a decrease in the tangibility of its product flows, is strongly associated with several economic characteristics that would be expected from intangible product intensive firms: smaller size; fewer investments in property, equipment and facilities; less profitability; less debt in the capital structure; and higher market valuation. Therefore, the hypothesis testing demonstrates the non empirical verification of the separability assumption that sustains many neoclassical theoretical frameworks. Decisions about products are concrete organizational operating decisions, and the five hypotheses demonstrate that operating decisions are not independent from investing and financing decisions. Furthermore, given that product transactions are eminently social processes, these empirical results provide a solid argument for using scientific approaches outside the realm of neoclassical economics to investigate economic phenomena.

The principal inferences were extracted from Fama and Macbeth's (1973) regressions with standard errors corrected by the Newey-West (1983) procedure.

Moreover, for robustness, other econometric procedures were implemented, such as computing the regressions with the outlier observations included, models computing for previous indicators of intangible intensity used in neoclassical economics, models controlling for the fixed effects by firm and year, models controlling for random effects either with general least squares or maximum likelihood estimators, models eliminating the missing observations, and other robustness procedures.

The primary sample is used again in chapter 8 to study the industry homogeneity assumption, often employed in neoclassical economics, which commonly presupposes that firms registered under the same industry code are homogeneous, and/or sell homogeneous products. Along many robustness procedures, chapter 8 also introduces another perspective of analysis: the implementation of LOI deciles, where the 10,162 firms of the primary sample were distributed by 10 sets according to their mean LOI in the sample. The LOI-decile analysis permits understanding the evolution of the five hypotheses tested in Chapter 7 through different levels of operating intangibility. Moreover, the LOI-decile approach enables the demonstration of a relatively high stability of the variable LOI by firm, in clear contrast to a very high LOI heterogeneity by industry.

The industry-homogeneity assumption is pervasive in neoclassical research. In Modigliani and Miller (1958: 266), widely considered to be the starting point of contemporary corporate financial economic theory, the authors refer to '*the familiar concept of the industry in which it is the commodity produced by the firms that is taken as homogeneous*'. The level of operating intangibility, on the other hand, offers an alternative for classifying firms and industries according to the intangibility of the products sold to customers, based on the public information of companies. Using it to classify organizations, chapter 8 illustrates two cases where assuming industry homogeneity may mislead researchers: i) studies claiming to have selected intangible intensity industries (Core et al, 2003; Collins et al, 1997; Francis and Schipper, 1999) picked quite heterogeneous samples, that included several physical-good-intensive firms along with semi-intangible and intangible–product-intensive firms; and ii) the prediction that firms selling durable goods have less leverage than the others (Titman, 1984; Titman and Wessels, 1988; Banerjee et al, 2008) can be contradicted by inspection of the industries chosen to empirically support the claim, because the physical good intensive firms with those industry codes are far fewer than the intangible product intensive firms. Therefore, chapter 8 contributes toward refuting the dominant industry-homogeneity assumption of neoclassical economics.

Nonetheless, a question could be put about the previously mentioned empirical findings: would the empirical results associating the tangibility of a firm's flows of products, as measured by its level of operating intangibility, and other economic characteristics of firms be phenomena verified only in USA's economy, or even societies where the western culture is dominant? To address this possible doubts, chapter 9 studies an international sample containing firms from 13 different countries over the first decade of the twenty first century.

The countries studied were Australia, Canada, China, France, Germany, Israel, Japan, Malaysia, Singapore, South Africa, South Korea, Sweden, Taiwan and UK. The criteria for choosing these countries were that these were the countries with larger firm constituents list in Worldscope/Datastream database. The size of firm constituent list was decided as the major criteria for country sub sample selection, because, as it is well known, larger samples provide higher robustness of findings. Furthermore, larger country sub samples could offer larger degree of heterogeneity amongst the firms studied because smaller economies could be focused on fewer regional business clusters (see Porter, 1998; and Romanelli and Khessina, 2005) and their interactions could interfere by reducing the heterogeneity of firms in the countries sub samples, a question that would be interesting to study in the future.

As occurs to the USA's sample, the results of the tests about the operating intangibility hypothesis in the international sample are also empirically very strong and significant. The empirical findings on the international sample show that operating intangibility is an organizational economic characteristic statistically very relevant in the many different countries studied, which are not limited to the use FASB accounting norms, or the English speaking world, or Europe and North America, or a dominant Christian/Catholic cultural background, or countries that are part of the G20 group of most industrialized countries.

Chapter 10 discusses the relation between findings and the separability assumption commonly assumed in neoclassical economics, and the final chapter concludes this thesis, after several claims from neoclassical economics have been studied. In those claims are included claims such as organizations should be considered homogeneous black boxes; human beings are like assets or capital; operating decisions are independent from investing and financing decisions; firms registered with the same industry code are homogenous and/or sell homogenous products; and a simple comparison between market and book values is merely explained by growth prospects and intangible assets.

The current thesis contributes to exhibit the little we know about the intangibility of economic phenomena, and to praise scientific curiosity that can help us advance human knowledge. Intangible flow theory can help us in this purpose. Its major role is not to offer definitive answers, but to offer a framework that could assists us in formulating new questions

2- Intangible, Flow and Intangible Flow: an Intangible Flow Theory[1]

2.1 Introduction

When one observes a highly trained economist having a conversation with a fellow human being, he might be tempted to ask the economist whether that dialogue is occurring between two human assets or capitals. The question would not be out of place, as these classifications are used to refer to people in prestigious publications (e.g.: Becker, 1962; Ditman et al, 1973; Barro, 2001; World Bank, 2003; Commission of the European Communities – Enterprise Directorate General, 2003; Glaeser et al, 2004;Ciccone and Peri, 2006; Argyres, 2011). The embeddedness critique has been put to neoclassical economists because, although they tend to ignore or undermine the importance of the social relations, economic action is embedded in structures of social relations, and therefore, social relations are necessary to understand the economic action (Granovetter, 1985; Callon, 1998). The intangible flow theory develops the embeddedness critique by addressing the dynamics of social relations in economy and society.

Let us first define intangible; flow; and intangible flow. The word intangible means not tangible. According to Merriam-Webster's dictionary, the term tangible can defined as '*capable of being perceived especially by the sense of touch*', '*capable of being precisely identified or realized by the mind*' and '*capable of being appraised at an actual or approximate value*'. Because it is one of the characteristics that distinguish goods from services, intangibility has been often

[1] Part of this chapter is integrated in Cardao-Pito (2011a) and Cardao-Pito 2004.

studied in organizational studies. Rathmel (1966) and Shostack (1977) noted that there are very few products which are pure physical goods or pure services. Most products have tangible and intangible components. However, the degree of product intangibility could be classified according to a continuum. Similarly to Merriam-Webster, Bateson (1979) makes a distinction between approaches to intangibility, identifying two types. i) Physical intangibility: a product is intangible if it is not palpable or cannot be touched. It is roughly the first definition on Merriam-Webster that comes from the Latin origin of the word. Nonetheless, Flipo (1988, p. 287) makes us note that '*immateriality must not be confused with imperceptibility*'. Even if the element has no material body, it is possibly perceptible by one of the four other human senses. ii) Mental intangibility, where the product cannot be grasped mentally (roughly a synthesis of the second and third definitions of Merriam-Webster). Later, Bielen and Sempels (2003) offered support for the dual description in Bateson. We will use the concept of intangibility without necessarily relating it to the sense of touch, but to the faculty of being identified with precision, that is, capable of being precisely identified or realized by the mind and capable of being appraised at an actual or approximate value.

Intangibility is not an exclusive characteristic of services. It can be used to describe other important economic elements as information. Mathematicians and statisticians are aware that information is intangible and try to devise quantitative methods to study it (e.g.; Soofi, 1994; Cover and Thomas, 2005). Soofi (1994, p. 1243) clearly states: '*the notions of information consist of a spectrum ranging from semantic to technical. In the semantic context, the term information is used in an intuitive sense. It does not refer to a well-defined numerical quantity that can be* *used for measuring the extent of uncertainty differentials due to changes in the states of nature. In the technical sense, information is referred to as a well-defined function that quantifies the extent of uncertainty differentials*'.

Yet, here we attain the *paradox of quantifying intangibility* which applies to information. The elements of previous intangibility for which scientists can find quantitative methods to attribute well defined quantities, and therefore, can be precisely appraised at an actual or approximated value have properties of tangibility, whereas the other dimensions remain intangible. Moreover, the use of quantitative methods is not a sufficient condition to achieve tangibility, as those methods can be used to produce pure metaphysical speculation and imaginary projections of future scenarios that could not be reached with precision. Furthermore, scientists support their work on concepts that are themselves highly intangible. As noted by Hayek (1967) in his theory of complex phenomena, there is a distinction between pattern recognition and pattern prediction, and for scientists to recognize complex patterns they must make (intangible) conceptual predictions of those patterns.[2] As described by Soofi (1994), semantics would be a macro set where the dimensions of information that cannot be described through a well defined mathematical function would be put. Hence, for the purpose of scientific knowledge, the use of mathematical analysis can only capture certain dimensions of information.

A simple distinction between data, information, and knowledge might already bring many difficulties (e.g.: Davenport and Prusack, 1998; Boisot and Canals, 2004). The conceptual formulation that there is a symbolic interaction

[2]As in Popper (1959; 2008), and in this thesis, Hayek defends a fact based scientific work, where scientific predictions must be formulated with the possibility of refutation/falsifiability.

between members of society mediated by symbols and significations, where the meanings attributed evolve with processes of stimulus and response (Blumer, 1962, 1969; Perinbanayagam, 1985) would not be reachable merely through mathematical reasoning. Nevertheless, the failure of mathematical reasoning to capture them would not imply the non existence of symbols, meanings and significations. In an apparently simple nearby communication between two human beings, not only are semantic words and language exchanged but a full range of highly heterogeneous transactions such as body movements and gestures (e.g.: Montepare et al, 1999; Kendon, 1984), facial expressions (e.g.: Ekman and Friesen, 1975), postures (e.g.: Heller, 1997), eye gaze (e.g.: Knapp and Hall, 1997; Richmond and McCroskey, 2000) or paralinguistic sound of the voice (e.g.; Scherer, 1979; Wigboldus et al, 1999) are communicated even without the need for words.

By flow we understand the movement of an element deriving from a source, which implies that an element which is not flowing should be considered as static. A human related intangible flow is therefore the movement of an element, deriving from a person or group of persons that cannot be precisely identified or realized by the mind; and cannot be appraised at an actual or approximate value. This paper focuses on intangible flows that are also human related, thus of direct interest to the social sciences (e.g.: work flows, service flows, communication flows, information flows, etc). Yet, the intangible flow concept could be embraced by the natural sciences because not all intangible flows are human related. For instance, flows of atoms could not be precisely perceived by the human senses, but scientists have figured out ways of studying them. As occurs with the human related intangible flows, the non human related intangible flows can be integrated in dynamic sets comprising both tangible and intangible flows.[3] Most importantly, the intangible flows referred to in this theory have an instrumental property that makes them come from the field of science: they can be verified, even if through an imprecise description. Intangible flows that cannot be demonstrated are from the domain of metaphysics, and thus not a subject of discussion in this theory. Two examples of intangible flows that can be demonstrated are service flows and information flows. As explained in more detail later, products (outputs) such as services have properties that distinguish them from tangible physical goods, such as the already referred to intangibility, and heterogeneity, perishability, and inseparability between consumption and production (Zeithaml et al, 1985; McColl-Kennedy, 2003; Zeithaml et al, 2006; Hoffman and Bateson, 2006; Wilson et al, 2008). Information also has characteristics that distinguish it from material elements because several of its dimensions cannot be precisely appraised at an actual or approximate value. Therefore, intangible flows such as flows of services, information, and other intangible elements cannot be considered equivalent to flows of economic material elements as physical good or cash because those are flows that can be identified with precision. In this thesis flows of material elements refer to the flows of elements that can be identified with precision, and thus as a synonymous to flows of tangible elements. The intangible flow theory will further advance our comprehension of economic material flows by identifying that human related intangible flows are necessary for the consummation of economic material flows.

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[3] As in the example of Heraclitus's river passing by into which one can step only once, the flow of that river may contain both tangible and intangible components.

This chapter is organized as follows: the next section introduces an initial case study where it is possible to observe how human related intangible flows can be associated with specific material flows; the subsequent section explains why neoclassical economics that rejects non mathematical/quantitative scientific approaches could not be technologically prepared to reach and observe intangible flow dynamics by itself; the fourth section formalizes the intangible flow theory; the fifth section discusses the challenge of testing the theory in the real world; and the last section concludes the chapter

2.2- Initial case example

The intangible flow theory can be considered a grounded theory, developed through a collection of facts and formalized for subsequent testability of its predictions, an ultimate goal of the grounded theory method (see for instance Martin and Turner, 1986; or Charmaz, 2006). Let us observe a case study where the facts could be gathered: a conversation between two human beings (A and B) that would be associated with an apparently simple economic activity, namely, the selling of a restaurant's lunch for two. A dynamic interaction between intangible and tangible flows can be identified, which in the theory is called intangible flow dynamics.

- 1) The choice of the restaurant: imagine that A becomes interested about the place after reading a positive review in his regional newspaper. Here an intangible element, moves from the newspaper to A’s cognition, leading him to have an action that he would not have otherwise.

- 2) B will be convinced by A to attend that restaurant through an intangible telephonic conversation, otherwise she would not be aware of that restaurant's existence.

- 3) They arrive in the restaurant, and in comes another human being, C, the maid, smiling and delivering an intangible service; she will soon indicate the table and bring the menu.

- 4) When A and B study the menu, the intangible information moves from the menu to their cognition. The choice will be discussed and communicated to C.

- 5) The tangible food and drinks arrive through the intangible service of C and required also the intangible work produced by staff in the kitchen, those who produced and sold the items, the manager of the restaurant, etc.

- 6) The communication between A and B does not involve only semantic words and language, but also body movements and gestures, facial expressions, postures, eye gaze or paralinguistic sound of the voice. Communicators are, at one and the same time, senders and receivers of messages (Hargie and Dickson, 2004 p.14). After the desert and coffee, it is time to ask C for the bill.

- 7) The intangible information regarding the bill to pay is printed on a tangible piece of paper.

- 8) A is always forgetting his wallet at home. B pays the bill with her bank card. The cash flow will be reported in both bank accounts.

One can observe two aspects in the case above. First, although the transaction was implemented through a bank card in 8), thus containing intangible elements, the respective cash flow has tangible characteristics, as B, the restaurant and the banks can precisely quantify the cash flow. Therefore, the cash flow can be considered a material flow. Second, the occurrence of the material cash flow in 8) was consummated due to the occurrence of the intangible flows described in 1-7. The non occurrence of some intangible flows would necessarily result in the non occurrence of the material cash flow in 8) (e.g.: (1) the newspaper had not published the restaurant's reference; (2) B had not answered her phone; (3) the restaurant was closed).[4]

[4] A similar reasoning is applicable to the occurrence of the material flow of food and drinks in 5).

2.3- Human related intangible flows can demonstrate serious limitations of neoclassical economics

A development towards exclusively legitimizing the reasoning obtained through mathematical/quantitative deduction in highly-ranked economic journals and departments has been noted (e.g.: Leontieff, 1982; Beed and Kane, 1991; Lawson, 2006; Hopwood, 2008; Sutter, 2009). Addressing the predominance of economic reasoning in the disciplines of finance and accounting, which could be enriched by other types/forms of knowledge, Hopwood (2008) complained that unfortunately, we live in an era where curiosity is not enough reason to research. This represents the prevalence of what Caliskan and Callon (2009) call the neoclassical (formalist) economists in their report about the 'economization process.' This group of researchers defines economy by its object: the study of utility maximization under conditions of scarcity. A single concept of instrumental rationality is used to explain the behaviour of persons and organizations in every context. The utility and constraint functions are described mathematically, thus quantitatively, which leads to the idea of the homo economicus decision maker (see for instance Thaler, 2000), an ultra-rational being, whose behaviour would be described perfectly by a mathematical utility function capable of quantifying rational expectations about the (unknown) future without any form of bias.

Caliskan and Callon (2009, 2010) argue for the existence of an 'economization' process in which the attribute (adjective) economics is the result of the 'assembly and qualification of actions, devices and analytical/practical descriptions as 'economic' by social scientists and market actors.' In such a context, neoclassical economics, substantive economics, and economic sociology and anthropology would have distinct 'processes of economization.'[5] Although certainly proposed with the best intentions, the parallel validation of different approaches to explain the economy could lead to quite a problematic interpretation, as it might obstruct the advancement of our knowledge of concrete empirical phenomena, and thus be supportive of the current status quo.

Contrary to Kuhn (1996), who would see distinct research paradigms competing for the dominant status, such as researchers in sociology, anthropology or marketing providing more robust explanations to economic questions than neoclassical economic researchers, Caliskan and Callon (2009, 2010) would see political spheres in which hypotheses are equivalently valid as long as they are portrayed in the adequate research venue. In this relative sense, the 'economization' concept could be compared with that of 'hypothesization' to explain empirical phenomena; that is, hypotheses are valid according to the research environment in which they are depicted, not their actual verification. Let us observe an example of three specific hypotheses precious to the natural sciences: a) the Earth is flat and rests on top of a cube, b) the Earth has a spherical shape, and c) the Earth has the form of a turtle. Depending upon the 'geographization ' process accepted by the peers of the research sub-field, all three hypotheses would be valid. Still, an empirical investigation could eliminate two of the above hypotheses. Similarly, to understand the economy, there are clearly specified empirical questions that can be addressed with testable/refutable

[5] When mentioning substantive economics Caliskan and Callon (2009, 2010) refer to the substantivist position proposed by Karl Polanyi in *The Great Transformation* (1944) and its associations with anthropology and political economy. Nonetheless, the reasoning in Caliskan and Callon would be applicable to other heterodox economic frameworks that do not completely accept the neoclassical propositions such as Post-Keynesianism, Feminist Economics, Evolutionary Economics, Marxist Economics, Institutional Economics, Post Autist Economics and others (see Lee, 2009 or Lawson, 2006).

hypotheses by scientists outside the realm of neoclassical economics, such as the causes for growth, inflation, profits, financial decisions, economic crises, interest rates, etc. This is of great relevance because as Keynes (1936, p. 383) put it, '*the ideas of economists and political philosophers, both when they are right and they are wrong, are more powerful than is commonly understood. Indeed the world is ruled by little else'*.[6]

The questions should not be confused with the answers. The 'economization processes' in Caliskan and Callon (2009, 2010) are related to the answers, whilst the same specific research questions can be studied by distinct groups of researchers. To move in the direction of simply validating different 'economization processes' that provide contradictory hypotheses, as long as they are launched in the proper peer ('economization scene') group regardless of the verification of the hypotheses, would avoid the difficult but necessary challenge of identifying which approach could better explain the empirical phenomena that we observe in society. The allegation of '*economization*' could lead scientists in the direction of an '*economy of thought'* instead of a development of the economic thought. It was certainly not the purpose of Caliskan and Callon (2009, 2010) to keep the neoclassical economists in a 'league of their own' in which their answers could not be directly evaluated by knowledge produced in other scientific areas such as heterodox economics, sociology, anthropology, marketing, strategy, accounting, history, etc.

A second point related to the research methods available in each discipline to explain the same empirical phenomena. As seen before, neoclassical economics

[6] '*Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist*' (Keynes, 1936, p. 383).

advocates a framework where the generality of economic phenomena are explained by maximizing the utility function of agents and organizations in conditions of scarcity. Mathematical/quantitative methods are too precious to fall in a monopoly from neoclassical economics. The use of mathematical/quantitative methods in social sciences must not be confused with neoclassical economics. However, if neoclassical economics can only use mathematical/quantitative tools of reasoning (e.g.: Leontieff, 1982; Beed and Kane, 1991; Lawson, 2006; Hopwood, 2008; Sutter, 2009) to posit its hypotheses, then it cannot be technologically prepared to reach intangible elements that cannot be precisely identified or realized by the mind; and cannot be appraised at an actual or approximate value. This severe limitation of neoclassical economics is not necessarily a form of 'economization,' but a deficiency of the research methods accepted in its research paradigm.

Furthermore, flows of tangible (material) elements such as physical goods or money, can be precisely quantified and thus observed by the research tools of neoclassical economics. However, as suggested by the intangible flow theory, the dynamics of the tangible elements require several human related flows that do not share the same properties of the easily quantifiable material elements that they are moving in economic action. Hence, social science disciplines such as heterodox economics, sociology and anthropology, but also marketing, strategy, accounting, or history have an advantage in explaining concrete economic phenomena over neoclassical economics, because besides accepting advanced statistical and econometric methods of inquiry, they are open to other forms of reasoning to reach testable hypotheses that could capture the intangible flow dynamics in society.

Natural sciences can also be of great help in contributing with methodologies to enhance the study of intangible flow dynamics, but cannot be considered the exclusive source of scientific methodologies. Otherwise, neoclassical economics does not accept hypotheses that are not founded on concrete mathematical reasoning, and as Leontief (1982, pp.104-107) noted, it can avoid the '*outset to the harsh discipline of systematic fact finding*' that is common in other scientific fields. Furthermore, Hopwood (2008) identifies worrying signs of the intolerance of neoclassical economists toward other forms of knowledge not developed under mathematical/quantitative reasoning. In Hopwood's words:

' *While (neo-classic) economics as a subject has tended to invest heavily in the intellectual policing of its own boundaries, over the years ridding itself of its institutional, historical, political economy and other variants, this need not necessarily imply an intolerance of completely different disciplines. But that has often been the case and is increasingly so in a European as well as a US setting both at the disciplinary level and within an individual institution. The latter is often seen as the prevailing situation in the USA where economic and finance-oriented researchers in accounting have seemingly become ever less tolerant of other disciplinary emphases in both hiring and firing decisions. By now there are numerous instances of this at work. Often stemming from a form of raw prejudice that would be completely unacceptable in other settings, there are indeed signs that such behaviour is starting to be deemed acceptable in some European settings, as the recent acrimonious divorce of a formerly united group in* *accounting and finance at one prominent British institution illustrates. To the extent that this is getting to be a more widespread phenomenon, this should be a matter of real concern. Certainly any manifestation of it should be greeted by an explicit denunciation of what it really is – crude intellectual prejudice – and institutional separation where this is possible'* (Hopwood, 2008 p. 91).

Besides its serious discrimination of scientific approaches and scientists outside the realm of neoclassical economics, the prejudice described by Hopwood has further implications. It makes neoclassical economics technologically unprepared to reach and observe human related intangible flow dynamics, and therefore not properly equipped to study economy and society. The major problem is not the mathematical/quantitative methods, as those are relevant instruments at the disposal of scientists. It is an idealization of these methods leading to a belief that the mathematical/quantitative tools should primarily eliminate any other form of scientific inquiry. The instance of calling human beings assets or capitals is one of its consequences of such belief. It becomes acceptable to consider human beings as mere parameters of equations, and to consider that a simple mathematical 'utility' function and its two derivatives could describe the decision process of the entire mankind. However, mathematical/quantitative deduction, as it requires quantification, could not be technologically prepared to observe that the flow of many elements that cannot be quantified with precision (e.g.: (1)-(7) in the case study above), and have properties precluding being considered either assets or capitals, are necessary for the occurrence of the material flows (e.g.: (5) and (8) in the case study above). That is, neoclassical economics does not possess the research tools necessary to understand concepts formulated without mathematical/quantitative reasoning or even to understand the pernicious concepts it is obtaining with its theological belief. Hence, the intangible flow theory, formalized in the next section, can be employed as a response to the metaphysics of mathematics in social sciences (and possibly the natural sciences).

2.4- Intangible Flow Theory

The initial formulation of the intangible flow theory is developed in this section. The first step to reach the intangible flow conceptual framework is through the tangibility of concrete material elements. Physical goods, such as cars, clothes, or washing machines are tangible elements and clearly quantifiable with precision. The same applies to long-term fixed investments such as property, equipment, and plant. However, what about money, which can take several forms, such as notes and coins, cheques, credit cards, or online accounts? The intangible flow theory defines cash flows, i.e., flows of money and its equivalents (Merriam Webster) as tangible because they can be precisely quantified at an exact-value. The material practice of money is one of its defining properties, even if related to distinct symbolic referents and social systems (Gilbert, 2005). That is, although money can have several social roles and meanings, under discussion by social scientists, it also has a pragmatic nature in modalities of exchange and circulation (Maurer, 2006). As put by Maurer (2006, p.30): '*representational flaw does not mean representational failure, either for money or for anthropological (and other* *social science) accounts of it*' or, as put by Callon and Muniesa (2005, p. 1245): '*Economic calculation is not an anthropological fiction, precisely because it is not a purely human mechanical and mental competence; it is distributed among human actors and material devices*.' Whichever form a cash flow may assume, human beings are able to know the exact amount of money that has been moved. In the same manner, through the cash flow statement, a corporation presents a precise report of its complete cash movements during each fiscal period.

Therefore, through their research tools that require mathematical/quantitative modelling, the neoclassical economists can observe the cash flows, and they can also quantify several empirical variables that are materialized in monetary values, such as inflation, profits, growth, capital structures, interest rates, financial deficits, etc. When neoclassic economists call people and their contributions human capital or human assets (e.g.: Becker, 1962; Ditman et al, 1973; Barro, 2001; World Bank, 2003; Commission of the European Communities – Enterprise Directorate General, 2003; Glaeser et al, 2004;Ciccone and Peri, 2006; Argyres, 2011) they do so without any previous explanation or demonstration of why should be people be considered assets or capital. The denomination of humans as assets or capital could be compared with a performative function, described in Mackenzie (2007) or Mackenzie and Millo (2003), as instead of representing an external reality, such comparison directly intervenes in the reality it claims to represent. People would be assets or capital because neoclassical economists call them this, not because there is any empirical evidence that we behave like property, equipment, plant, merchandizing, bank loans or stock market shares in economy and society. Besides the serious ethical issues in placing people at the same level as material things, the neoclassical economic framework is profoundly flawed, as it fails to understand the complexity of people and their intangible activities in the economy and society. Let us further study two types of intangible elements that have different properties to tangible (material) elements, namely, services and information.

Organizational literature revealed that products can be classified according to their level of intangibility. The scale suggested by Schostack (1977) ranges from most tangible (such as clothes and furniture) to most intangible (pure services such as consulting or teaching). In the middle of the scale are the products combining tangible and intangible components. For example, meals in restaurant chains mix tangible food and drinks with intangible services and marketing. Several academic textbooks on the marketing of services (e.g.: McColl-Kennedy, 2003; Hoffman and Bateson, 2006; Zeithaml et al, 2006; Wilson et al, 2008) adapt a definition of services that could be traced back to Rathmel (1966, p. 33), who defined services as ‘acts, deeds, performances, or efforts,’ and physical goods as ‘articles, devices, materials, objects, or things.’ As noted also by Rathmel (1966), there are very few products that are purely services or purely physical goods. The most tangible of goods requires services to be sold/delivered to customers, and the most intangible of services are generally associated with elements of tangibility (e.g.: receipt).

In their literature survey, Zeithaml et al (1985) identified four important characteristics that distinguish services from physical goods: intangibility, heterogeneity, inseparability of production and consumption, and perishability. The property of perishability suggests that services cannot be saved, stored, resold, or returned as physical goods. Zeithaml et al identified these four properties through the survey of a significant number of research papers in organization studies. Lovelock and Gummeson (2004), who tried to substitute the framework in Zeithmal et al (1985), recognize that the system of Zeithaml et al is the most widely acknowledged and amply taught in academic textbooks. Lovelock and Gummeson argued that the critical characteristic that would distinguish services from the physical goods would be the non-ownership of the services. By non-ownership, they mean that although the customer has the right to consume the service through a rental or access fee, he cannot own the service as he would be able to own a physical good (e.g.: a car or sports equipment). Nonetheless, the non-ownership of services seems to derive from the same properties identified by Zeithaml et al (1985), and, particularly, the key goods-services distinction from which the other differences emerge may be the intangibility of services (Bateson, 1979; Zeithaml et al, 1985). Intangible, heterogeneous, and perishable products such as services, normally consumed when produced, are not reported on the balance sheet as assets (or capital), unlike physical goods or other assets (or capital) such as cash.

Stiglitz (2000) claims that neoclassical economic studies about information have made a rupture with the past. He is also an author on the theme. Currently, we might readily accept that information is imperfect, that there are costs in obtaining information, that there exist important asymmetries of information, and that those asymmetries are affected by individuals and by organizational actions. According to Stiglitz, the traditional knowledge from the neoclassical characterization of the market economy would be deeply affected by such findings. Following a neoclassical framework, some studies have been proposing a framework where information or knowledge would be *public goods* (e.g.: Romer, 1998; World Bank, 2003; Guellec e Ralle, 2001; Stiglitz, 1999, 2007), comprising two main distinctive properties (Stiglitz, 1999 p. 309, or 2007): i) Nonrivalrousness: that there is zero marginal cost from an additional individual enjoying the benefits of the knowledge (or information) and ii) and non-excludability, which implies that no one can be excluded from the respective use that is, if information and knowledge are not defended with copyright, licenses, or confidentiality, then they cannot be easily protected, unlike, for example, a machine that was bought and registered in the name of a corporation.

Still, the neoclassical understanding about the economic properties of information might yet be very poor. Because it ignores the intangibility of information, neoclassical economics could not notice that intangibility distinguishes information from physical goods. Furthermore, information may not verify the same conditions of scarcity observed in other resources. The oil or gold reserves of our planet are limited, whereas a good idea can be downloaded on the internet as many times as possible. In order to apply its pareto optimality via utility functions, neoclassical economics needs to assume that scarcity is the natural condition of any resource. Thus, it misses the sociocultural element of the analysis because scarcity could be inherent to the human use of that resource (Daoud, 2010). Moreover, resources do not always need to be scarce. They can also be sufficient or abundant, as occurs with information, and poses series difficulties to the neoclassical analytical framework based on assuming the scarcity of all resources (see Lee and Keen, 2004 or Daoud, 2010).

Furthermore, as described by Voler et al (2009) neoclassical economics sees information as signals, which separates information from cognition and makes a distinction between meaningful signals and noise, with the latter being understood as a lack of determined patterns. The movement of information would be similar to that of signals circulating on a circuit board. Yet, the logic of neoclassical economics, that information, knowledge, and relations would be assets implies that those so-called assets are inside the brains of human beings. Hence, the human use of information and knowledge can not be separated from the respective human cognition and affectivity. What is worse, for millennia in philosophy, an unsolved debate of what is in fact knowledge (and information) has subsisted. There are many definitions of knowledge (and information). However, taking a shortcut, neoclassical economics already makes monetary valuations of knowledge and information without knowing what they are and where they are. One could suggest that first it would be necessary to understand it. The work with knowledge and information is not static. It is dynamic, as it is the work with relationships and of what are called social assets. A relationship must be dynamized to exist.

The utility functions can be used to solve problems where resources are really scarce and precisely quantifiable. For instance, a firm can use utility function to decide which proportion of physical goods x and y should buy given its limited budget. However, as described by a neo-Schumpeterian theory of the firm (e.g.: Nelson and Winter, 1982; Winter, 2006; Levintahl, 2006), just as the fragmentation of knowledge in the firm makes innovation difficult and the consequences of attempted innovation unpredictable, it tends to frustrate the economist who wants to predict the lines that knowledge innovation will take. Innovation management researchers recognize that the uncertainty with regard to the value-creating potential of product innovations increases with their technological novelty, and have argued that the usefulness and value of novel products are socially constructed (Rindova and Petkova, 2007). Innovation is both a process and an outcome (Crossan and Apaydin, 2010). As noted by Winter (2006, p. 138) General Motors has a certain knowledge about producing automobiles that may or may not be applicable to the problem of producing corn flakes.

Nevertheless, neoclassical economics acts as if it could quantify every dimension of information and knowledge, in order to develop its mathematical reasoning. As shown before, mathematicians and statisticians know that their work cannot reach the semantic dimensions of information (e.g.: Soofi, 1994; Cover and Thomas, 2006), and to recognize complex patterns is necessary to make conceptual predictions (Hayek, 1967). The conceptual background of science is itself highly intangible. Through utility functions, neoclassical economics previously assumes homogenization of human reactions and decisions related with information. Hence, it fails to address a simple aspect as two persons can differently interpret the exact same information. The neoclassical practice of treating information as mere parameters in the utility functions is in direct contradiction with the facts that: i) mathematical/quantitative reasoning is not technologically able to reach the semantic dimensions of information; and ii) human use of information and knowledge is not separable from the respective human cognition and affectivity.

The mathematical homogenization of human cognition and affectivity professed by neoclassical economics is an unscientific belief that can be refuted through cognitive distortions of human perception that influence human beings rather heterogeneously, and can vary even with the same person, according to the information received or communicated. In those distortions, one could include the halo effect that refers to drawing a general impression about an individual on the basis of a single characteristic, as the appearance or status (e.g.: Murphy and Anhalt, 1992; Naquin and Tynan, 2003); the contrast effect, where the appraisal of information would be considered differently if not compared to other information (e.g.: Plous, 1993); the Freudian projection effect, which refers to attributing characteristics or emotions of the self to other people or information (e.g.: Wade, 2000) or the stereotyping effect (e.g.: Judd and Park; 1993; Hilton and Hippel, 1996). It is not a matter of finding psychological or sociological based parameters to include in the computation of utility functions and Pareto equilibriums, as done in what is often called behavioural economics, and represents a mere development of the neoclassical framework, as clearly stated in the literature reviews of Camerer and Loewenstein (2004) or Rabin (1998). Such an approach would fail to capture basic intangible instances of human cognition, social relations, symbols, meanings and significations. To advance our scientific knowledge of economy and society we must break free from the metaphysics of mathematics that neoclassical economics would want to impose upon social sciences.

Accordingly, the Intangible Flow Theory will proceed as follows: First, one defines cash flows as tangible flows because they represent concrete monetary transactions that are clearly identifiable and quantifiable. Second, one posits that the information (and knowledge), physical goods, and capital should be considered static in the generation of cash flows if they are not dynamized by intangible flows that are mainly human-related and cannot be precisely appraised at an actual or approximate value. Although human beings are not intangible, some of their contributions can be intangible (e.g.: work flows, service flows, information flows, knowledge flows, communicational flows, etc.).

Hence, we can now reach the fundamental proposition: *In Society, the occurrence of economic material flows, as the flows of physical goods or cash, is associated with intangible flows inherent to human actions that are necessary to the prosecution of those material flows. Cash flows cannot be considered intangible flows because even when they have an intangible form, they have properties of tangibility, as they are precisely quantifiable at an actual or approximate value. Thus, the analyses and decisions related to economic material flows must consider the more relevant intangible flows that are necessary for the material flow consummation.*

According to the theory, the intangible flows with effects on the cash flows can be of various types, such as service flows, relationship flows, communication flows, information flows, knowledge flows, data flows, etc. Although they could not be precisely quantified, they are necessary for the occurrence of economic material cash flows. The intangible flows require an abstract formulation precisely because of their inherent intangibility.. Therefore, an abstraction is a necessary description for their study and understanding. Nevertheless, this theoretical formulation can be corroborated by empirical tests that prove the association of intangible flows with concrete cash flows.

In the development of and with reference to this theory, these subsequent corollaries should be considered: *First corollary: associated with the occurrence* *of the economic material flows, there can be a vast and complex conjunct of intangible flows, in which inclusively, some of those intangible flows can be very difficult to identify.* This first development appears to explain that this is not a motive for the concept of intangible flows not to be recognized or scientifically systematized, nor is it a motive for the concept of intangible flows not to be considered. What is complex and what is simple depends on our knowledge and understanding, and changes over time. Scientists may devise precise methods to capture currently intangible dimensions. However, the existing dimensions that scientists are not capable of precisely identifying realizing or appraising at an actual or approximate value will remain intangible.

Second corollary: It is not necessary for a temporal coincidence to exist between intangible flows and economic material flows for intangible flows to impact upon material flows (e.g.: the training of the personnel may take some time to have effects on the productivity of the organization, or the marketing campaigns might take some time to have intangible consequences that will be reflected in the organization's money in-flows). Inclusive cash flows, as they are part of a dynamic process, might have effects on intangible flows and the latter again will have influence on other cash flows of the organization (e.g.: the expenses with publicity or branded merchandizing collocated near the potential clients, etc.).

Third corollary: The non-occurrence of economic material flows can also be a consequence of intangible flows that have a negative effect on their consummation (e.g.: advertising campaign from a competitor, poor quality services, cost reduction policy, etc.). Similarly, intangible flows exist that might worsen the cash flows of an interested person or group (e.g.: staff absenteeism, political effects, etc.).

Fourth corollary: the tangibility of cash flows refers to cash flows that occur within a precise interval of time. Not yet verified cash flows cannot be considered already materialized. This corollary establishes a difference between those cash flows that can be precisely quantified, for they have factually taken place, from those that despite an appearance of measurability might not be precisely quantifiable because their occurrence is uncertain. For instance, when neoclassical economics requires projections of future cash flows to operate their concepts of 'discounted future cash flows value' or 'utility maximization under pareto optimality', the non verified cash flows cannot be considered already materialized and thus their quantification might be the object of speculation and/or imagination. For instance, neoclassical economists claim to have done a mathematical synthesis of Keynes's thinking, but Keynes himself (1936, p 149) was aware that our knowledge of factors that will govern the yield of an investment some years hence is usually very slight and often negligible.[7] The neoclassical futurology can bring much harm to society and social science because it may offer a false appearance of certainty to rather unknown economic outcomes.

Fifth corollary: Although mathematical/quantitative research tools can be used to precisely measure economic material flows, they are insufficient to research and capture intangible flows and their relationships with the material flows. This corollary explains why: 1) although mathematical/quantitative

[7] As Keynes (1936 p. 149) put it: '*If we speak frankly, we have to admit that our basis of knowledge for estimating the yield ten years hence of a railway, a copper mine, a textile factory, the goodwill of a patented medicine, an Atlantic liner, a building in the City of London amounts to little and sometimes to nothing; or even five years hence. In fact, those who seriously attempt to make any such estimate are often so much in the minority that their behaviour does not govern the market*'

methods are highly relevant for science, they are insufficient for studying and understanding the intangible flow dynamics of concrete empirical phenomena observed in economy and society; 2) because it professes a metaphysics of mathematics that refuses to accept non mathematical/quantitative forms of scientific inquiry, neoclassical economists simply cannot reach complex human-related intangible flows that are necessary for the consummation of precisely quantifiable economic material flows.

2.5- The challenge of testing the theory

As currently formalized, the grounded intangible flow theory is stated for subsequent testability of its predictions. Therefore, the challenge is to identify intangible flows and establish concrete associations with economic material flows, as done on the case study above. Figure 1.1 exemplifies the complexity of several intangible flows with influence in the cash flows of an organization. It represents a simplified visual model with a dynamic network of intangible flows that could be used later for testing the intangible flow effects on a organization's cash flows, aiming at the corroboration of the theoretical formulation. The figure's purpose is to express evidence of the intangible flows and their complex effects on the flows of economic material elements, not to represent the complete set of relevant intangible flows.

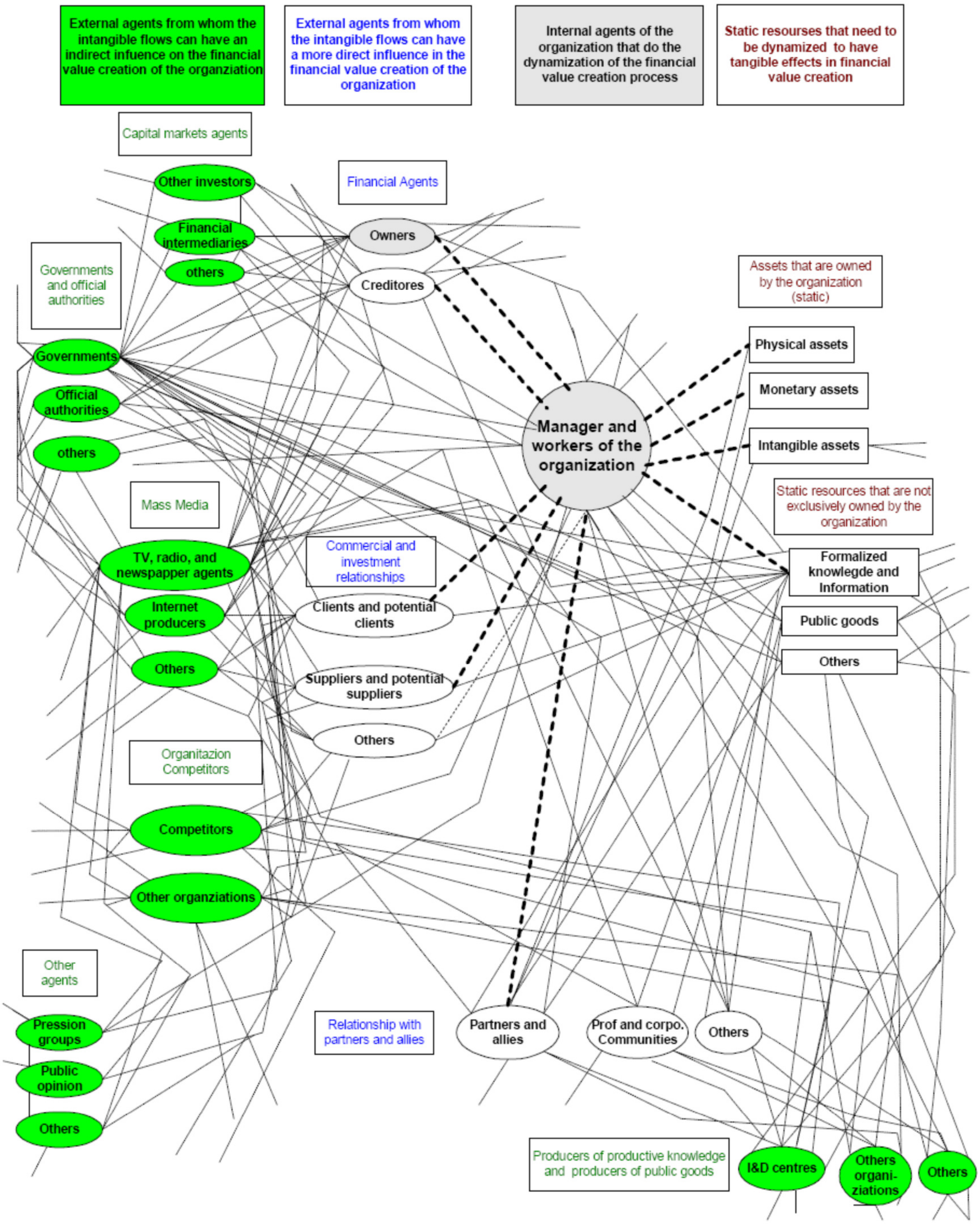
A first component of the model include the manager and the workers of an organization, those persons that with their intangible flows of work, services, communication, information, knowledge or others, contribute to the active consummation of the organization cash flows.

The model includes also resources considering that they need to be dinamized to have material effects in the organization's cash flows. Without the dynamic effect of the human related intangible flows, the resources would be static, with no material effects in generating cash flows. Two types of resources are distinguished, first, assets that are exclusively owned by the organization such as physical assets, monetary assets or intangible assets. Second, static resources that are not exclusively owned by the corporation, such as formalized knowledge and information or public goods.

External agents from whom the intangible flows can have a more direct influence in the cash flow include commercial and investment relationships such as with clients, and suppliers; relationships with partners and allies, and relationships with financiers of the firm, which include owners and debt holders.

Nonetheless, one must not forget external agents from whom intangible flows can have an indirect influence in the cash flow generation of the organization, such as governments and official authorities, capital markets agents, mass media, competitors or other agents.

Figure 1.1– Exemplification of the intangible flow complexity associated with the material cash flows of a corporation



Note: The figure's purpose is to express evidence of the intangible flows associated with the material cash flows of a corporation, not to represent the complete set of relevant intangible flows.

2.6- Conclusion of the chapter

Using an example from the natural sciences, the idea that the Earth has spherical shape is not compatible with the idea that the Earth is flat and rests on top of a cube, regardless of what Caliskan and Callon (2009) call actions, devices, and analytical/practical descriptions that could be used to argue any of those possibilities. Several concrete empirical phenomena of society, traditionally studied by neoclassical economists, can be addressed by alternative explanations, such as the causes for growth, profits, inflation, financial decisions, financial crisis, etc. Scientists outside the realm of neoclassical economics should accept the challenge of attempting what Kuhn (1996) defines as paradigm changes in explaining those phenomena, even if this means entering into direct confrontation with the neoclassical explanations derived from its metaphysics of mathematics. As in Socrates's ancient lesson, the obstacle is not an ignorance aware of its fragility, but the self sufficiency of an apparent knowledge.

Developing the embeddedness critique (Granovetter, 1985; Callon, 1998) the intangible flow theory, and particularly its fifth corollary, demonstrates that, currently, neoclassical economics is not properly equipped to provide explanations for empirical phenomena observed in economy and society. Because neoclassical economics only accepts mathematical/quantitative forms of reasoning to explain human and social activities, it simply does not have the necessary research instruments to cope with society's complex intangible human flows that cannot be precisely identified or realized by the mind; and cannot be appraised at an actual or approximate value.

Therefore, besides acting in the manner that Hopwood (2008) classified as a form of prejudice against other social sciences, neoclassical economics is not technologically prepared to understand the empirical phenomena with intangible flow dynamics. It has further consequences for the exclusive acceptance of mathematical/quantitative tools as method of inquiry, not least an obsession for measurability. As explained by the fourth corollary, often neoclassical economics confuses occurred cash flows that can be precisely quantifiable with predictions of future cash flows that only apparently can be precisely measured. For instance, projected, speculative or imaginary cash flows are necessary to compute utility functions to calculate pareto optimality and discounted future cash flow models. As explained by the first, second and third corollaries, the economic material flows are consummated or annulled by intangible flows that can be highly complex and temporally non coincident with the putative economic material flows. Similarly, to restrict human beings to assets or capitals would fit the need for quantification through mathematical models. People would become computational parameters. No need for other forms of scientific inquiry would be felt. However, such a performative logic must be exposed. Serious ethical issues exist in calling people assets or capital, as this would redirect us to odd discussions about ownership over human beings and the monetary value of a person. Furthermore, these flawed comparisons profoundly sabotage the understanding of intangible flow dynamics in society. People would be assets or capitals not because of any scientific evidence of the statement, but because neoclassical economists previously defined us as such. As explained by the intangible flow theory, complex human related intangible flows, which have properties excluding their being considered assets or capitals, are necessary to consummate material flows.

The explanations of empirical phenomena might benefit from knowledge obtained from quite distinct fields such as heterodox economics, economic sociology, anthropology, organization studies, accounting, history, or philosophy, or interdisciplinary studies among them. Although mathematical / quantitative tools are insufficient to describe and understand intangible flows, they are quite relevant for empirical analysis of hypotheses and samples, and the natural sciences can give very precious help in providing methods for quantifying several dimensions of current intangibility. Scientific work bases itself on highly intangible concepts, and the concept of natural intangible flow may also be of use for the natural sciences.

3- The intangibility of an organization's products (outputs)[8]

3.1- Introduction

As observed in the last chapter, there are two major conceptions of tangibility. One is related to the sense of touch, having developed from the Latin origin of the word (*tangere*). The other conception of tangibility is related to the faculty of being identified with precision; that is, the capability of being identified or realized precisely in one's mind and of being appraised at an actual or approximate value (Bateson 1979; Flipo 1988; Bienlens and Sempels 2003; Merriam Webster's Dictionary). The precision conception implies that cash flows are tangible, just as the flows of physical goods are tangible, because even when cash flows are associated with intangible processes, the precise values of such cash flows are quantifiable. For example, when people go to a restaurant and pay electronically with a bank card, or when a company makes online financial transactions, the cash flows effectuated are precisely identifiable and quantifiable. Even when related to distinct symbolic referents and social systems, the material practice of money is one of its defining properties, as money has a pragmatic nature in the modalities of exchange and circulation (Gilbert, 2005; Maurer, 2006).[9]

Economic material elements, such as cash or physical goods, flow in economies and societies, and these flows are reflected in a variety of economic phenomena, such as growth, profits, investment, inflation, interest rates, debt,

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8 Part of this chapter is integrated in Cardao-Pito (2010a) and Cardao-Pito (2010b).

9 Nevertheless, note that as pointed out in the forth corollary of the intangible flow theory :'the tangibility of cash flows refers to cash flows that occur within a precise interval of time. Not yet verified cash flows cannot be considered already materialized'.

market valuation, crisis, etc. The need to advance our knowledge of the dynamics of economic material flows can be related to a criticism of neoclassical economics: embeddedness. Granovetter (1985) and Callon (1998) defend the notion that economic action is embedded in structures of social relations, and therefore argue that social relations must be considered in order to understand economic actions. On the other hand, neoclassical economic tends to undermine the importance of social relations and their structures. Yet, the dynamics of social relations can be quite relevant to our understanding of economies and societies. As explained by intangible flow theory (last chapter; Cardao-Pito, 2004, 2010), flows of economic material elements are consummated by human-related intangible flows (such as work flows, service flows, information flows, communicational flows) that cannot be appraised precisely at an actual or approximate value and have properties that preclude them from being classified as assets or capital. In intangible flow theory, the term intangible (i.e. not tangible) is defined through the precision approach, and the term flow is defined as the movement of an element deriving from a source. Therefore, an element that is not flowing should be considered static. Note that although this formulation could describe natural intangible flows, intangible flow theory focuses on human-related intangible flows deriving from a person or group of persons.

If there is, in fact, such a thing as a human-related intangible flow and if that flow is necessary to consummate the flows of economic material elements, its existence could have great implications for our understanding of economy and society. Modern explanations of economic phenomena have been dominated by the gestalt of neoclassic economics wherein only mathematical/quantitative methods of reasoning are accepted (Sutter, 2009; Hopwood, 2008; Lawson, 2006; Beed and Kane, 1991; Leontieff, 1982). Therefore, as explained in the 5th corollary of intangible flow theory (see chapter 2, section 2.4), the intangible flow dynamics of economic phenomena are methodologically beyond the technology employed by neoclassic economics. It should be noted that the mathematical/quantitative research methods themselves are not problematic; indeed such methods are highly relevant scientific instruments. On the contrary, it is the belief that these methods should eliminate all other forms of scientific inquiry that is problematic. Demonstration of the existence of intangible flow dynamics could cause severe problems for the way of doing and explaining things in neoclassic economics, and eventually may reveal its technological obsolescence. This is quite relevant for organization sciences because, as noted by Goshal (2005), bad theoretical conceptions of the organization can destroy good management practices.

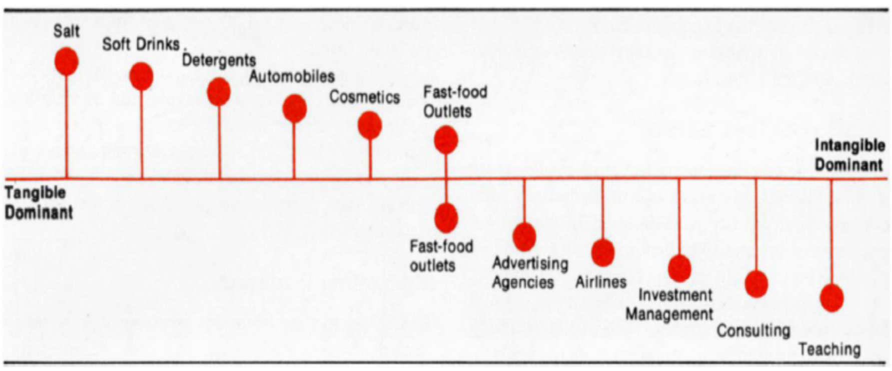
There is a challenge in designing a means by which to empirically demonstrate the intangible flow dynamics of economic phenomena. This challenge may be overcome by employing organizational phenomena that comprise both economic and social processes. Consider the principal mechanism through which organizations must generate material cash in-flows: product sales with customers. In developing the intangible flow theory, one could reach the theoretical prediction that *corporations partially organize themselves according to the operating needs associated with the tangibility of the flows of products used to generate material cash flows through sales to customers.* If this association between operating needs and economic characteristics occurs, it could no longer be ignored that the characteristics of firms cannot be dissociated from the organization they describe, as is often done by neoclassic economists. Nevertheless, to study the theoretical prediction, it is necessary to solve the problem of identifying product (output) at tangibility the firm level. Therefore, to address this problem, the current thesis will further develop the intangible flow theory in the following chapters by introducing the concept of operating intangibility, devising a method with which to measure the level of operating intangibility, and testing its empirical associations with other organizational characteristics. Before addressing these issues, the current chapter discusses the problem of identifying the intangibility of products sold by organizations and relates this problem to previous methods used to classify firms according to their intangible intensity in past literature; and the next chapter demonstrates a concrete building block of neoclassical economic literature that ignores the intangible flow dynamics of economic phenomena.

3.2-The intangibility of the products sold by organizations

As explained in the last chapter, previously intangible dimensions can become tangible when researchers find manners by which they can be precisely identified. There is a paradox of quantifying intangible entities. That is, when scientists develop quantitative methods for ascribing actual or approximate values to previously intangible elements, those now quantifiable elements acquire properties of tangibility, while other still non-quantifiable dimensions remain intangible (see last chapter).

Chapter 2 has defined that in this thesis, a product is understood to be an output from an organization. Products may include services, physical goods, and other outputs that are a mixture of services and physical goods, or outputs that are hybrid products themselves. Furthermore, the previous chapter introduced definitions for services and physical goods, noted that products can be classified according to their intangibility (Schostack, 1977), and made an introduction to the differences between physical (tangible) goods and (intangible) services, that it is further developed in the pages of the current chapter. According to Schostack (1977), intangibility can be used to classify products with a system ranging from the "most tangible" (e.g. salt or pencils) to the "most intangible" (e.g. pure services, such as consulting or teaching). Shostack's classification appears in Figure 1. In the middle of the scale are products that are combinations of tangible and intangible components. For example, meals in restaurant chains mix tangible food and drinks with intangible services and marketing. Services, in particular, which are present in every industry, have characteristics that distinguish them from physical goods.

Figure 3.1- Shostack's (1977) system to classify products according to their intangibility.



In their survey of a large number of research papers in the services marketing literature, Zeithaml et al (1985) identified the following four key characteristics that distinguish services from physical goods: intangibility; heterogeneity; inseparability of production and consumption; and perishability (see also Parasuraman et al, 1985, and Wilson et al 2008).

- Intangibility: The two major approaches to study tangibility were presented above, namely, the sense of touch approach and the precision approach. The current thesis is built upon the precision approach.

- Heterogeneity: For the reason that services are generally human performances, hardly two services will be precisely identically, even if produced by the same provider in the same location. The heterogeneity of services also results because no two customers are alike, and customers are also involved in service production.

- Inseparability of production and consumption: while most goods are produced first, and then sold and consumed, most services are produced and consumed simultaneously, and in many cases sold previously. The presence of the customer is required during many service productions, which also enforces this distinction between goods and services.

- The property of perishability suggests that services cannot be saved, stored, resold, or returned as physical goods.

Lovelock and Gummeson (2004) attempted to work on an alternative paradigm to the one formulated by Zeithaml et al (1985), whilst recognizing that Zeithmal et al's review paper is the key reference in the field, and that Zeithmal et al's framework is amply taught in academic textbooks.

Lovelock and Gummeson claimed that although some exceptions to service characteristics could be found (e.g.: services that are not completely intangible, such as car repair, services that involve car parts, or services that are not consumed exactly when produced, such as cleaning services), the services have a critical characteristic that distinguish them from the physical goods: the non-ownership of the services. By non-ownership it is meant that although customers have the right to consume the service through a rental or access fee, they cannot own the service as they would be able to own a physical good (e.g.: a car or sport equipment).

Nonetheless, as proposed, the non-ownership of services seems to derive from the same properties identified by Zeithaml et al (1985). In particular, the key goods-services distinction from which the other differences emerge may be the intangibility of services (Bateson, 1979; Zeithaml et al, 1985). Indeed, Rathmel (1966, p. 33) had noted previously that 'when a good is purchased, the buyer acquires an asset; when a service is purchased, the buyer incurs an expense'. Furthermore, contrarily to the four properties indentified by Zeithaml et al (1985), the non ownership of services would not distinguish services from public goods, such as public parks or rivers. As described on the last chapter, public good have two main distinctive properties (Stiglitz, 1999, p. 309; or 2007): i) nonrivalrousness: that there is zero marginal cost from an additional individual enjoying the its benefits; and ii) and non-excludability, which implies that no one can be excluded from the respective use. Therefore, the non-excludability of a public park or a river may have similarities with the non ownership of the same public park or river by those who use them.

The intrinsic properties of services have implications to several aspects such quality of product perception, organizational requirements or marketing of products (Zeithaml et al, 1985; Parasuraman et al, 1985; Wilson et al, 2008; Lovelock and Gummeson, 2004). Table 3.1 summarizes the major distinctive characteristics between goods and services, and some of their implications.

Table 3.1 Main different between goods and services, and resulting implications

Goods	Services	Resulting implications
Tangible	Intangible	Services cannot be inventoried Services cannot be easily patented Services cannot be readily displayed or comunicated Pricing of services is difficult
Standardized	Heterogeneous	Service delivery and customer satisfaction depend on employee and customer actions Service quality depends on many uncontrolled factors It is difficult to manage the matching of service expectations
Production separate from consumption	Inseparability of consumption and production	Customers participate in and affect the transaction Customers affect each other Employees affect the service outcome Decentralization may be essential
Non perishable	Perishable	Mass production of services is difficult Services cannot be returned or resold
Ownership transferable	Ownership not transferable	Customers may consume but do not own the services

Notes: the contents of this table were adapted from Zeithaml et al (1985), Parasuraman et al (1985), Lovelock and Gummeson (2004), and Wilson et al (2008).

In pure service selling, or when selling goods that are associated with services both the staff and customers have determinant roles to perform. As explained previously, services are both economic and social processes. Evidence seems to show that the training, job satisfaction and well being of service staff is very relevant for the satisfaction of the customers of services (Schneider and Bowen, 1993; Bowen et al, 1999). As noted by Harris and Ogbonna (2002), staff have effective power to sabotage the distribution of services. Unhappy employees can sabotage services openly or covertly, and intermittently or routinely. Thus, various authors stress the importance of hiring, training and retaining talented staff (e.g.: Singh, 2000; Berry and Parasuraman, 1991; O'Reilly and Pfeffer, 2000). One must not forget that a service selling is also an intangible human relationship, through which ties or bonds may maintain the connection between the service provider and consumer. Several ties may be created, such as instrumental ties, affective ties, or moral ties (see Kanter, 1972). Emotional labour, a term introduced by Hochschild (1983), is often used in service literature to refer to the labour that goes beyond the physical or mental skills needed to deliver quality service. Services may be produced for internal consumption by the members of the organization, or for external consumption by customers. As described by Wilson et al (2008), friendliness, courtesy, empathy, and responsiveness directed towards customers all require huge amounts of emotional labor from the front line employees who shoulder this responsibility for the organization. This type of labor requires to be managed with careful strategies. Frontline service providers are often seen as spanning the boundaries of the organization, by linking the inside of the organization with the outside world (Wilson et al, 2008; Lovelock and Wirtz, 2011).

Another factor that might be highly relevant in terms of intangible flow dynamics of economic phenomena is the participation of the customers in the service production process. The customer is not merely a consumer, but in several cases the customers and their intangible flows are fundamental for the existence of the services. As seen above, Lovelock and Gummeson (2004) criticize the idea that there is an inseparability of production and consumption in services, because not all services must be produced at the same time they are consumed.

Hubert (1995) would have solved this debate, with his typology that divides services according to the requirement of consumer presence during service delivery. Hubert’s (1995) typology suggests three levels. A first rank includes services with low consumer presence during delivery, where products are standardized, and the payment may be the only required customer input, for example a fast food restaurant, pest control, machinery maintenance or office cleaning services are classified in this rank. A second rank includes an intermediate set of services, where consumer inputs are required for service creation, customization of standard of service, and are necessary for an adequate outcome, but the service firm provides the service. This group includes services such as haircut, tax advice, full-service restaurant, agency created advertising campaigns or freight transportation. A third rank of services includes the services where customers co-create the service product. In this set, active client participation guides the customized service, and customers’ inputs are mandatory and co-create the outcome. This set includes services such as personal training, doctor’s appointments, management consulting or installation of computer networks. Thus, in the first rank the firm can manage the customer participation to a minimum; whereas the customer service production in rank 2 and 3 is inevitable, and the firm should manage the relationships with customers very carefully (see Wilson et al, 2008; Lovelock and Wirtz, 2011).

Furthermore, the boundaries between customers and providers of service are not immutable. Companies can actively transfer some service work to customers, with implications for their price, cost and quality. Observe two examples. i) low cost air flight companies such as Easyjet or Ryanair depend on customers to perform service roles for themselves, as contrary to other air flight companies, passengers are asked to get their own food and seat themselves on available sits (Wilson et al, 2008; p. 303); ii) traditional gasoline stations had an employer who would refuel the clients' cars and receive the payment at the pump, but service production has been being redesigned at gasoline stations. Nowadays in most cases customers refuel the car themselves and go inside a shop to pay at a cash point, or can even pay at the pump with an electronic card (Meuter and Bitner, 1998; Meutner et al, 2000). Another intangible role of the customer that must be observed is that in some cases, customer can themselves be competitors of the firms that sell services production, because customers can in some cases perform the services entirely or partially by themselves (Lusch et al, 1992). For example, this situation applies to services such as cleaning services, machine repair or facilities management, where potential customers may decide on whether to produce the service themselves or hire someone else, or a company, to perform the services for them.

These possible intangible flow dynamics of service selling might be quite relevant for intangible flow theory because they may allow the demonstration of the consummation of the flows of economic material elements through intangible human related flows, in the sense, that for instance cash or physical goods require an intangible flow dynamic to flow from a customer to a corporation, or vice versa. For instance Vargos and Lusch (2004, 2006) claim that the differences between goods and services are mere myths that are remnants from a goods based manufacturing logic. According to Vargos and Lusch (2004, 2006) goods would be mere distribution mechanisms for service provision. They claim to have introduced a service dominant logic. However, this logic seems radical, as radical seems the perspective in neoclassical economics where there are no differences according to the intangibility of a firm's products. Claiming to be on the other extreme of neoclassical economics, Vargos and Lusch (2004, 2006) actually would anticipate the same results of neoclassical economics, in the sense that Vargos and Lusch (2004, 2006) would not expect major differences between the firms according to the type of products they are selling, because all firms would be service firms, all economies would be service economies, and the differences between services and goods would be non inexistent. However, customers who buy physical goods have concrete needs associated with the tangibility of the goods bought (e.g.: food, clothes, etc.). Likewise, firms may *partially organize themselves according to the operating needs associated with the tangibility of the flows of products used to generate material cash flows through sales to customers.*[10] The demonstration of

[10] "When referring to the tangibility of the flows of products, one could have also used the formula the materiality of the flows of products, in the sense of using the word materiality as a quasi-synonymous to the world tangibility. Nonetheless, as explained by Hong (2003) the words material and materiality carry ambivalent meanings in vernacular English. On the one hand, material is defined as "things that are material," which emphasizes the physical aspect of things; on the other hand, it means "(in various non-physical applications) something which can be

an association between the tangibility of a firm's flow of products and its economic characteristics would demonstrate that intangible differences between the flows of products are not myths, as claimed by Vargos and Lusch (2004, 2006) but concrete phenomena with implications for societies, organizations and customers.

The characteristics of services described above would exclude them from being registerable as assets on balance sheets (Cardao-Pito, 2004, 2010). In addition, several assets that are registered on the balance sheet may not be considered to be operating products. Drawing a parallel, albeit imperfect, between assets and resources, as defined by a resource view of the firm (c.f. Wernerfelt, 1984; Barney, 1991) we note that these dynamic characteristics of services also preclude them from being considered resources. As pointed out by Hoopes et al (2003), resources are just one component of the competitive heterogeneity that describes the broad differences that exist among firms. Kraaijenbrink et al (2010) note that many resource based view researchers might have restricted themselves

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worked up or elaborated, or of which anything is composed." The second definition can be better understood through its relationship to the first definition that, again, can be differentiated into two major meanings: 1) something material is that which "pertains to a matter as opposed to form"; 2) that which "pertains to matter or body; formed or consisting of matter; corporeal." Thus, although material designates physical matter, it also assumes potential from its association with non-physical matter. Furthermore, there is a specific concept of materiality in accounting,

Furthermore, the word materiality has been used in other contexts that would confuse the thesis such as: 1) the historical materialism as in Marx and Hegels who could not benefit from the second half of Twentiest Century and Twenty First Century's management literature to distinguish services from a physical goods, or mixed products, or the discussion of tacit and non-tacit knowledge after Polyain, Gravonotter, Schostack, Rathmel and others. Marx and Hegel used the word materiality associated with relations in production between what they saw as the exploiters and the exploited; and class struggle in the social relations of production. Whether or not tangible, intangible or semi intangible; products for Marx and Hegel fall generally in the category of commodities. Furthermore, contrary to this thesis, Marx and Hegels see money as another commodity and wrote extensively on their concept of commodity fetchism. 2) the materiality of financial statements in accounting, in the case referring to all facts of relevance that must be reported. Therefore, to avoid the possibility of ambiguity in this thesis, the expression tangibility of flows of products is not used interchangeably with the expression materiality of the flows of products. "

to an inappropriately narrow neoclassical economic rationality, thereby diminishing the opportunities for their research to progress.

There are also dimensions of intangibility and heterogeneity that can be incorporated into products which are beyond those that are characteristic of services. As formulated in a neo-Schumpeterian theory of the firm (see Winter, 2006; Levintahl, 2006; Nelson and Winter, 1982), intangible knowledge and capabilities are integral constituents of an organization's production system (e.g.: the knowledge and the capabilities necessary to produce and sell a product). In a classical typology introduced by Polanyi (1962; see also Nonaka and Takeuchi, 1995), knowledge could be distinguished between tacit and codified knowledge. Tacit knowledge defines the knowledge which is difficult to articulate, communicate and transfer. It may be defined by heuristic, subjective and internalized knowledge that needs to be learned by experience and practice. On the other hand, codified knowledge may be transferred using formal and systematic language. The transferences of knowledge, which have an intangible flow nature, can be more or less complex according to the type of knowledge involved.

Nonaka and Takeuchi (1995) also make a distinction between tacit knowledge and explicit knowledge. They propose a model with four types of knowledge conversion in organizations (SECI): i) socialization: the conversion of tacit knowledge into explicit knowledge through the sharing of experiences, and the creation of shared mental models and technical skills; ii) externalization: the creation of explicit knowledge from existing tacit knowledge through dialogue and collective reflection; iii) combination: the exchanging, combining and reconfiguring of existing explicit knowledge through diverse communicational channels; iv) internalization: the internalization of explicit knowledge by individuals.

However, Polanyi (1969) clarified that tacit and codified knowledge are not straightforwardly divided. While tacit knowledge can be possessed by itself, codified knowledge must rely on being tacitly understood and applied. Hence, all knowledge is either tacit or rooted in tacit knowledge. Or to put it another way, it would be erroneous to consider tacit knowledge as knowledge not yet articulated because it would reduce it to the knowledge that could eventually be articulated (Tsoukas, 2003). This redirects us to the description of the last chapter that notes that significant part of the knowledge is inside the head of human beings, but the intangible transference of knowledge should not be confused with the human beings involved. As noted by Blacker (1995) knowledge is multifaceted and complex, being both situated and abstract, implicit and explicit, distributed and individual, physical and mental, developing and static, verbal and encoded. Knowledge may be associated with a complex social process (Mckinlay, 2000).

The intangible knowledge flows are not limited to the workers of the firm. They may involve a complex network involving persons exterior to the organization, a space, a period of time and a set of resources, which may have a lack of natural boundaries that expands far beyond the confines of any organization, community or sector (Mitchell 1969; Barnes 1979; Law and Callon, 1992; Conway and Steward, 2009). As noted above, the boundaries of the organization are far from being clear with regard to the dynamics of intangible flows. Previous literature noted that some individuals may have specific roles of boundary spanners, gate keepers or brokers of the organizational flows of knowledge and innovation (Allen, 1977; Tushman, 1977; Burt, 2005). A diversified network might be essential for capturing varied resources (Bouty, 2000). The productive knowledge may arise from a large variety of sources such as customers, competitors, suppliers, distributors, universities, public agencies, etc.

On the other hand, as described on the third corollary of intangible flow theory (see chapter 2, section 2.4), some intangible flows might have a negative effect on the consummation of a firm's cash in-flows (e.g.: advertising campaign from a competitor, poor quality services, cost reduction policy, etc.). Similarly, intangible flows exist that might worsen the cash flows of an interested person or group (e.g.: staff absenteeism, political effects, etc.). For example, even the question of when should a firm put its products in the market is not completely clear, because it is known that to be the first organization to reach the market with a product is not always the best strategy. Pioneering may be advantageous in some circumstances, but it is not the better strategy for all entrants, because in some cases, innovative late movers can reduce the effectiveness of pioneers' marketing efforts (Lieberman and Montgomery 1988, 1998; Shankar et al 1998).

Min et al (2006) studied 264 new industrial product-markets to compare survival risks in markets that were started with a really new product versus an incremental innovation. When the pioneer starts a new market with a really new product, it can be a major challenge just to survive. In contrast, in markets started by an incremental innovation, market pioneer survival risks are much lower. Interestingly, early followers have the same survival risk across both types of markets. Overall, results of Min et al (2006) indicate that in markets started by a really new product, the first to market is often the first to fail. In contrast, in markets started by an incremental innovation, it appears that first-mover advantages protect the pioneer from outright failure. For example, if Xerox sustained the leadership of its paper copier for several years, and Polaroid its invention of the instant camera, many other product first movers to the market were outpaced by innovative followers. Netscape, that introduced the web browser, was surpassed by the Microsoft Explorer. Diamond multimedia that introduced the MP3 player was later surpassed by Apple, Sony and others. Raytheon that introduced the micro wave oven could not resist the pressure from Samsung. Many other examples could be found (see Grant, 2002, p. 347).

In a literature review, Crossan and Apaydin (2010) identified innovation as both a process and an outcome that determines an organization's leadership, managerial levers, and business processes. Some authors see innovation as a social, political and emotional process (e.g.: Conway and Steward, 2009, p. 339-341). Similar to other organizational processes, innovation is consummated mostly by intangible flows. Innovation with respect to products, or product marketing and promotion, are intangible components of the products for which customers are paying. For instance, when a customer buys a bottle of Pepsi-cola or Coca-cola, he does not only pay for the tangible drink and bottle, but also for the intangible concept, brand, symbols, status, and other elements incorporated into that product.

We may expect that the economic properties of firms focused on selling flows of physical outputs (e.g.: cars or furniture) are distinct from those of firms selling flows of intangible outputs (e.g.: consulting services or software), and that those properties change according to the operating needs associated with the of tangibility flows of products sold. Following a neoclassical economic framework, previous studies have employed what is called the product-market framework in their analyses of the implications of products for the economic characteristics of firms. Nonetheless, researchers implement this framework by assuming that there is product homogeneity within each industry (e.g.: Philips, 1995; Chevalier, 1995; Campelo, 2006, 2003; Chemmanur and Yan, 2009). Take, for example, Chevalier (1995), who obtained product market empirical data from the supermarket industry. However, it is not clear whether it would be more appropriate to say that there is a supermarket product market or that each supermarket chain is itself a market of many products. The implementation of the neoclassical conception of a product market framework tends to ignore empirical studies in the organizational literature that have shown that the most important sources of economic rent are business-specific, with industry membership being a much less important source (Rumelt, 1991; Macgahan and Porter, 1997). Furthermore, industry codes are not a suitable framework for investigating product heterogeneity at a firm level. Industry membership cannot establish how firms should be classified within industries and nor can it enable one to determine whether the products of one industry are more or less intangible than those of another.

3.3 Previous intangible intensity literature and the intangibility of a firm's product flows

Neoclassical economic literature has its section of studies concerned with a firm’s intangible intensity, that in general disregard contributions from other social sciences. Nonetheless, this intangible-intensity is a large umbrella that covers a variety of methods, which, though eventually interrelated, capture distinct aspects of a firm's life. Prior economic literature describes three methods, none of which is based on a firm's products: (a) intangible/tangible asset intensity (e.g.: Claessens and Laeven, 2003; Rajan and Zingales, 1995; Frank and Goyal, 2003; Baker and Wurgler, 2004; Wyatt, 2005;); (b) R&D intensity (e.g.: Lev and Zarowin, 1999; Chambers et al, 2001; Kothari et al, 2002; Frazen et al, 2007; Darrough and Ye, 2007); and (c) industry classification (e.g.: Collins et al 1997; Francis and Schipper 1999; Core et al 2003; Armstrong et al 2007). No unifying concept of intangible intensity has been suggested to link these methods; researchers tend to simply choose the path that best accommodates their needs. To demonstrate the difference between the traditional methods, one could ask which of the following corporations is the most intangibly intensive: a) Firm A that has many intangible assets, no R&D expenditures, and belongs to the agriculture industry; b) Firm B that has no intangible assets, large R&D expenditures, and belongs to the metallurgy industry; or c) Firm C that has no intangible assets, no R&D expenditures, and is registered in the educational services industry. Three different approaches can produce three different answers. This problem would be expected repeat itself again if we added a fourth method based on the products sold by the firms as such a method would be used to study a different dimension than those captured by the methods described above.

3.3.1 Intangible asset intensity and the intangibility of products

Products of a service nature provide a strong motivation for measuring product (output) intangibility at the firm level. Services are sold a by all firms, as even the most tangible physical goods often require sales and delivery services

(Rathmel, 1966; Vargo and Lusch, 2004), and their properties preclude them from being registered as assets on the balance sheet, and, therefore, from being captured by an asset (or resource) approach (see last chapter; Cardao-Pito, 2004, 2010). As a result, the intangible assets method is unable to capture major cash flow sources. This divide explains the need for a new intangibility indicator based on products rather than assets. From an economic perspective, one could interpret payroll and other staff expenses as necessary costs for the production of intangible services, either sold to customers or internally consumed. The intangible asset method also neglects many intangibles-related expenses that are consumed in the short run and not registered on the balance sheet (e.g.: communications, R&D, marketing, royalties, etc.). Only long-term assets are monitored by the intangible asset intensity method. Hence, such an approach lacks power in the analysis of flows of goods and services.

3.3.2 R&D intensity and the intangibility of products

R&D intensity is the most common intangible intensity proxy used in the literature. Indeed, several researchers who use R&D expenses to classify firms have argued that R&D is an unrecognized intangible asset and an investment that should be capitalized on the balance sheet. According to this view, R&D expenses are expected to produce future economic benefits by driving intangible innovation (e.g.: Lev and Zarowin, 1999; Frazen et al, 2007; Darrough and Ye, 2007). On the contrary, others researchers (e.g.: Chambers et al, 2001; Kothari et al, 2002), and many accounting authorities, oppose R&D capitalization, advising accounting prudence in relation to R&D expenses. Placing too strong an emphasis on R&D

has well-known shortcomings. First, variations in scaling can cause researchers to obtain contradictory results from the same data. Unfortunately, there is no authoritative theoretical formulation that can explain how the R&D variable should be scaled. For example, when scaling R&D by the market-value of equity, Shi (2003) found that high R&D intensities corresponded with poorer bond ratings and higher risk premiums. Accordingly, Shi concluded that the net effect of R&D is negative for bond holders. Eberhart et al (2009) found precisely the opposite result when they scaled R&D by sales and total assets, using the same sample. A second problem is that many firms do not report R&D values, presumably due to an absence of relevant activities. When constructing probability distributions in manufacturing industries, Cohen and Klepper (1992) found that the largest concentration of R&D intensity occurred near the zero value. Researchers employing R&D-based measures must decide whether to eliminate such firms from their sample or assume that the missing R&D values are equal to zero. If the goal is to appraise the impact of intangible intensity on other variables, then researchers must either disregard valuable information or risk erroneously classifying many intangible-intensive firms that do not engage in R&D.

The capitalization of R&D expenses also raises conceptual issues. When papers in the neoclassical economic literature discuss R&D, they focus mainly on a numerical (monetary) analysis of the reported R&D values. The resultant number is allegedly related to the level of innovative investment. Yet, Knot and Posen (2009) suggest that, in established industries, the innovative behavior of R&D investment is principally intended to regain an eroded advantage rather than to pursue a new frontier. Innovation management researchers, recognizing that the uncertainty related to the value-creating potential of product innovations correlates positively with the technological novelty of a product, have argued that the usefulness and value of novel products are socially constructed (Rindova and Petkova, 2007), and therefore embedded in intangible flow dynamics.

The organizational literature differentiates between several types of innovation, such as product innovation, work-process innovation, market positioning innovation, and firm paradigm innovation (e.g.: Francis and Bessant, 2005). Contrary to the generalizations made in financial economics, R&D investments are firm specific, which implies that there is heterogeneity in the R&D applications of firms within an industry and that firms have the ability to earn increasing returns on their R&D investments (Helfat, 1994).

We must not forget that R&D efforts are related mainly to the technological innovation in products, whereas investments in other forms of innovation are diluted among operating costs and ultimately transferred to customers. It must not be forgotten the informal organization through which much information and ideas flow, and its important effect on boundary spanning, either with the exterior or the interior of the organization (e.g.: Hamel et al, 1989; Tichy et al, 1979; Kreyner and Schultz, 1993). Hence, as a proxy for innovation expenses, R&D values may be not be an accurate reflection of the overall costs related to innovation. Moreover, since R&D is used mostly to produce new products, it may be preferable to analyze R&D in tandem with product (output) values. Thus, this measure suggests that we could learn by balancing R&D against the other expenses that are necessary for producing and selling products to customers.

3.3.3 Industry classification and the intangibility of products

The industry method cannot be used to accurately compare individual firms because it assumes homogeneous intangibility among all firms within the same industry. Furthermore, the discretionary industry designation of ‘more intangible’ that is used in the neoclassical economic literature is rather subjective and thus can lead to inconsistent findings. Collins et al (1997), for example, found that the financial statements of firms drawn from a small selection of intangible-intensive industries were less informative with respect to stock market returns than those of other firms. Francis and Schipper (1999), on the other hand, found only mixed support for this claim when they analyzed firms from a different group of industries. Core et al (2003) have shown that traditional explanatory variables of firm value, such as earnings, book value of equity, and growth opportunities, are relevant to firms in intangible-intensive industries, though perhaps to a lesser degree than for firms in industries that are not.

Each of the studies mentioned above examined firms from just a few, arguably intangible-intensive, industries. Collins et al (1997: p. 51) recognized in a footnote that their selection process was ‘somewhat ad-hoc.’ They considered firms to be intangible-intensive if their production functions were ‘likely’ to contain large amounts of ‘unrecorded intangibles.’ Evidently, their study cannot measure these amounts. Their analysis was restricted to only six industries. Similarly, Armstrong et al (2007) examined firms from only three industries, and both Francis and Schipper (1999) and Core et al (2003) examined firms from only (the same) 14 industries. The subjectivity problem is especially relevant to researchers that intend to consider larger samples and a wider selection of industries. The American Standard Industrial Classification (SIC) system defines 81 two-digit codes, which are subdivided into 444 four-digit codes. To avoid the unsystematic, subjective, and arduous process of hand-picking industries, it would be useful to establish an objective criterion for determining which industries/firms are most intangible-intensive. The intangibility of the flows of products themselves offers a possible criterion to meet this need.

3.4 Conclusions of the chapter

If indeed such a thing as a human related intangible flow exists, with its innate property of non measurability, it could not be captured by neoclassical economics because, as noted by Sutter (2009); Hopwood (2008); Lawson (2006); Beed and Kane (1991) and Leontieff (1982), neo classic economics only accepts quantitative/mathematical methods of reasoning to formulate its hypothesis. Therefore, an intangible flow would concretely exhibit the technological limitations of the frameworks used by neoclassical economists to explain economies and societies. As emphasized before, mathematical/quantitative research methods themselves are not problematic. These methods are highly relevant scientific instruments. On the contrary, it is the belief that these methods should eliminate all other forms of scientific inquiry that may obscure our understanding of economic phenomena.

Therefore, it is necessary to establish demonstrations of intangible flow dynamics of economic phenomena, that is, that the flows of economic material elements, such as cash or physical goods, are consummated by human related intangible flows, such as flows of services, work, communication, knowledge or information, that cannot be appraised precisely at an actual or approximate value and have properties that preclude them from being classified as assets, resource, or capital. A first display was already exhibited in the initial case example of chapter 2, where an apparently simple economic activity, such as the sale of a restaurant meal for two, would not have been consummated without the occurrence of several human related intangible flows.

This chapter has argued that embedded organizational phenomena that are both economic and social processes may contribute to systematically exhibit the dynamics of intangible human flows in the occurrence of economic material flows. In particular, this chapter focused its attention on the principal mechanisms that corporations have to generate material cash in-flows, namely, the transaction of products with their customers. The cash flows generated through a firm turnover are fundamental for its survival, growth, profitability, self funding or obligations payments. As shown, it is possible that flows of products may be classifiable according to their tangibility, and hence, we can use product flows to exhibit concrete cases of intangible flow dynamics. A decision can hardly be more operating than one involving products. Could we consider the possibility that operating decisions could be reflected in the economic characteristics of firms? Such a possibility is quite relevant, because, as the next chapter will show, large building blocks of neoclassical economic theory are founded on assuming a separation between operating, investing and financing decisions.

As a result of such an inquiry, a development of intangible flow theory may be introduced. One could possibly investigate the theoretical prediction that *corporations partially organize themselves according to the operating needs* *associated with the tangibility of the flows of products used to generate material cash flows through sales to customers.* For instance, firms that produce heavy physical goods, such as cars or planes, may be required to have different economic characteristics to firms that exclusively sell highly intangible products, such as services or software. Nevertheless, to study this theoretical prediction, it is necessary to solve the problem of identifying product (output) tangibility at the firm level. As shown in the current chapter, the methods used in economic literature to capture a firm's intangible intensity, namely intangible asset intensity, R&D intensity and industry classification are not specifically designed to capture the intangibility of a firm's product flows. We will return to the problem of identifying the intangibility of a firm's flows of products (outputs) in subsequent chapters.

However, before addressing the issue of the tangibility of product flows at a firm level, the next chapter exhibits actual situations where neoclassical economics has difficulties in handling the intangible flow dynamics of economic phenomena, which may cause it to invoke assumptions that may in some cases be disconnected from the verity of facts. We describe how several neoclassical financial economics theories treat organizations as black boxes, assuming that operating decisions can be separated from investing and financing decisions.

The verification of the theoretical prediction that corporations partially organize themselves according to the operating needs associated with the tangibility of the flows of products used to generate material cash flows through sales to customers, would not be compatible with the separability assumption on which are grounded many neoclassical financial economic theories. In this ambit, the organization science and sociological literature reviewed in this chapter can give major contributions in helpings us better understanding products. Hardly a decision can be more operating than when related with products. As shown, organization science and sociological literature can help us defining and describing products, providing manners of classifying products, typifying differences among products, inquiring a product's level of intangibility and demonstrate the importance of product studies.

4- The separability assumption in neoclassical financial economics[11]

4.1 Where several neoclassical capital structure theories in financial economics assume a separation between operating and financing (and investing) decisions, and how the intangible flow theory can contribute.

One should not confuse the study of important financial phenomena such as capital structure, dividends, investment assessment, or market functioning with the explanations for the occurrence of such phenomena. Neoclassical economic theory is not the same as finance but offers a set of answers to explain financial questions. This chapter will study one assumption commonly held by neoclassical formulations by demonstrating that in modern financial economics, the dominant explanations of a firm's capital structure assume that financial decisions can be taken as independent of operating and investing decisions. The analysis will be conducted on exhibiting the relevance of such foundation for the major neoclassical formulations. To be precise, such a separability assumption was introduced in Modigliani and Miller (1958), the initial paper in the field, and presumes that financing decisions can be isolated from operating (and investing) decisions. Its origin is not merely a matter of interpretation in the current thesis. It is clearly stated and described by Miller himself in Miller (1988 a, b - see more details in section 4.2). Thus, from the beginning, Modigliani and Miller offered quite a convenient solution for researchers who only accept the use of mathematical/quantitative forms of research. The intangible flow dynamics of economic phenomena was put inside a black box that Modigliani and Miller use to represent the firm, and ignored there. The contents of that black box would be considered irrelevant and/or negligible. Subsequent theoretical developments such

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[11] Part of this chapter is included in Cardao-Pito et al (2011b).

as trade-off theory, pecking order theory or market timing theory were built assuming that financial decisions could be taken regardless of a firm's operational requirements. As explained in the current chapter, such an assumption is also presupposed by a group of financial economics studies referred to as the 'product market literature' that, despite inquiring how the market of a firm's products may impact its capital structure, use a rather limited definition of a product market that mainly consist of the set of firms registered with the same industry code.[12]

In this chapter, it is noted that by assuming a separation between financial and operating (and investing) decisions, the neoclassical theorists of capital structure may enter themselves into a paradoxical framework, since they focus on a firm's underlying net cash flows but decide to neglect the operating activities through which those same cash flows are generated. It is suggested that the verifiability of the separability assumption could be scientifically tested through an economic method capable of describing concrete operating decisions.

The principal mechanisms to generate a firm's operating revenues, thus operating cash in-flows, are product sales to customers. Thus, decisions about these operating products might provide a means of testing the separability assumption. Therefore, we may benefit by developing teamwork between financial economics and those disciplines specialized in studying products, such as marketing or strategic management, but also economic sociology and heterodox economics. Furthermore, it can be quite helpful to learn more about what specific information concerning a firm's products can be provided by accounting information. As the intangible flow theory can be used to describe the tangibility

[12] An integrated description of the main capital structure theories can be found in published papers (e.g.: Myers, 2001; Baker and Wurgler, 2002) or comprehensive academic books (e.g.: Damodaran, 2003; Brealey, Myers and Allen, 2007).

of flows of products sold by firms to customers, and the associations between intangible flows and the flows of economic material elements such as cash and physical goods, the intangible flow theory may provide a theoretical framework to build a method capable of studying product (output) tangibility at the firm level, and hence to test the separability assumption of neoclassical financial economics.

4.1.1 Modigliani, Miller, and Fisher framework and trade-off theory

The work of Modigliani and Miller (1958) is often referred as the starting point for modern capital structure theory (e.g.: Harris and Raviv, 1991; Myers, 2001). It is Miller himself (1988 a, p. 103) who credits his joint work with Modigliani for introducing the current dominant view in finance that uses a metaphor of the 'corporation as a black box' into which are put operating activities.[13] As described by Miller, he and Modigliani opted for 'Irving Fisher's view of the firm- now the standard one in finance, but then just becoming known – [that] impounds the details of technology, production and sales in a black box and focuses on the underlying net cash flow. The firm for Fisher was just an abstract engine transforming current consumable resources, obtained by issuing securities, into future consumable resources payable to the owners of the securities' (idem).

Assuming the black box framework, Modigliani and Miller (1958) advocated that it would be possible to demonstrate the irrelevance of capital structures. On a set of restrictive conditions, it was argued that the capital structure would have no material effect either on the value of the firm or availability of capital. Hence, in the classic balance sheet, the left side would be irrelevant to the right side, and vice

[13] A similar comment is repeated in Miller (1988 b, pp.8-9).

versa. Financing decisions could be isolated from investing or operating decisions (e.g.: the choice of issuing more debt or equity would not be related to a new investment in a product factory/selling facility or the type of products sold by the corporation).

Thus, from the beginning, neoclassical economic theorists have avoided looking into the heterogeneity among the operating characteristics of firms because homogeneity would be a property attributed to corporations. This presupposition leads to at least two further consequences: i) the theoretical framework would implicitly advise the financial decision maker to neglect the operational management of the firm, because, allegedly, financial and operating decisions could be taken separately. Accordingly, it would be possible to make correct financial decisions without considering specific operational needs. In this sense, the operating management would be contemplated deterministically as something that happens inside the black box which describes the firm. Consequently, this also leads to, ii) the neglect of accounting information, in the sense that the reporting of a firm's operating activities would be inconsequential for finance.

The problem is that corporations are not boxes or restricted to a single colour. They are complex systems with many tangible, semi-tangible, and intangible elements. Thus it might be possible to test a logical flaw in Modgiliani, Miller, and Fisher's abstraction of the firm described above. More precisely, the underlying net cash flows on which the capital structure theorists decided to focus are mainly generated by the firms' operating activities that theorists decided to neglect, which might have strong implications for financial economics. It can be the case that the once deserted accounting information might be most valuable to understanding firms and their economic characteristics.

As a consequence of the intangible flow theory, this thesis could not continue by employing an abstraction describing firms as homogeneous boxes. Besides being logically defective, it would be to blindfold ourselves as to the operating factors necessary for a better understanding of a firm's capital structure. To conduct a scientific test one requires an economic indicator describing operating decisions, in order to explore whether or not it is correlated with financing and investing decisions. To obtain this indicator, we might gain by learning from the accounting information that describes a firm's operating activities, that is, the information unheeded by many studies that follow the Modigliani, Miller, and Fisher framework. The next chapter introduces a methodology to produce a testable operating decisions indicator.

Three years after their first paper, Miller and Modigliani (1961) argued that their invariance analysis would also be applicable to the dividend policy. As explained by Miller (1988a,b) the dividend invariance was presented to support the leverage invariance claim. The assumption shown to be crucial to Modigliani and Miller's invariance proposition is that: 'the firm's financial decisions can be taken as independent of its real operating and investment decisions,' (separability assumption) an assumption that he admits never sits well, and 'certainly the notion that heavy debt burden might indeed lead to overcautious business behaviour has long been part of the folk wisdom on the dangers of the debt' Miller says (1988a, p. 114-115).

Myers (2001) acknowledges that Modigliani and Miller's theory is ‘exceptionally difficult to test directly.’ (Myers, 2001, p.86). It would be the job of ‘financial innovation’ to provide ‘convincing circumstantial evidence’ (idem). Amongst other features, in Modigliani and Miller’s world every firm or person would have ‘rational behaviour,’ and there would be ‘perfect capital markets’ (their concrete definitions are stated for instance in Miller and Modigliani, 1961). The words ‘rational’ and ‘perfect’ are not without subjective implications. For instance, the definition of ‘perfect market’ in the Modigliani and Miller world assumes ‘no buyer or seller (or issuer) of securities is large enough for his transactions to have an appreciable impact on the then ruling price. All traders have equal and costless access to information about the ruling price and about all other relevant characteristics of shares. No brokerage fees, transfer taxes, or other transaction costs are incurred when securities are bought, sold, or issued, and there are no tax differentials either between distributed and undistributed profits or between dividends and capital gains’ (Miller and Modigliani, 1961, p.412). This is not observable for testing/refuting in the real world.

Furthermore, as stated by Modigliani and Miller (1961, p.412) ‘rational behaviour’ means that ’investors always prefer more wealth to less and are indifferent as to whether a given increment to their wealth takes the form of cash payments or an increase in the market-value of their holding shares’, that is, independently of how the extra wealth is obtained, and assuming that agents are crystal sure of how their actions will imply more or less wealth. And they can quantify it precisely. Thus, Modigliani and Miller’s framework require what the 4th corollary of the intangible flow theory (cf. chapter 2, section 2.4) classifies as immaterial cash flows, which should not be confused with cash flows that have actually occurred. The non verified cash flows cannot be considered already materialized and thus their quantification might be object of speculation and/or imagination.

Moreover, the existence of a rational 'homo economicus' decision maker is something assumed in Modigliani, Miller, and Fisher framework, not a matter we know for fact (see for instance Thaler, 2000). To test the relationship between operating, financing and investing decisional outcomes, that is, after decisions were taken, we will avoid speculation about whether the deciding agents were rational in their choices, a question not yet solved in the literature and raising a great divide between classical and behavioural economics (a description of this discussion can be found in Ritter, 2003; Schiller, 2003; or Fama and French, 2007).

One should not confuse two different questions. Suppose that a firm decides to build a new factory to produce goods, a concrete investment decision already taken. We might ask if that was a rational decision, but we must not confuse this question with another that would inquire as to how such an investment could be reflected in the capital structure. Likewise, if a firm decides to focus its business model on selling intangible services instead of tangible goods, such as cars or washing machines, one can put two different questions: was that choice of products rational? And, how is the choice of products correlated with the capital structure? This thesis will not address the question of whether choices engaged by agents were rational. If a concrete correlation between different types of decisions might exist, it does not let us conclude that agents were 'homo economicus' decision makers or otherwise. Therefore, this thesis does not need to assume full rationality of agents in the same manner of the dominant financial economics paradigm, as it is restricted to a study of the relationship between different types of decisions after they were taken.

In scientific fields other than financial economics the fact that some stances of the Modigliani and Miller theory are difficult (if not impossible) to test for veracity would be considered a fatal flaw. The argument against considering claims that cannot be tested/refuted as scientifically valid is carefully presented in Popper's (2008) book: 'The logic of scientific discovery'. However, plenty of empirical evidence demonstrates that the capital structure is not statistically irrelevant to other variables. For example, Rajan and Zingales (1995) provide concrete evidence of correlations with size, investments in fixed assets, profitability, and market valuation. Perhaps the dominant theory in finance claims that this is not a problem of the Modigliani, Miller, and Fisher framework, but a problem of the 'market imperfections'. See, for instance, Titman (2002), on the 'perfect market' condition.

In scientific work, when the empirical testing of a theory contradicts the theory, an imperfection in the theory might have been found. If further testing confirms the empirical contradiction, the theory would be considered refuted (see, for instance, the reasoning in Popper 2008, chs. 3-6). However, in financial economics one may conclude that the empirical contradiction of Modigliani, Miller, and Fisher's world arises from imperfections in the real world, not from the theoretical formulation in itself. According to the description of the trade-off theory, which assumes that corporations are 'black boxes' and agents operate in 'perfect markets' and with 'full rationality,' the capital structure would be irrelevant. However, because ‘markets are imperfect,’ there is a trade-off between benefits and costs of debt. So, the black boxes take this trade-off into consideration to reach an optimal capital structure. There are three leading alleged market imperfections: taxes, transaction costs of financial distress, and agency costs.

In 1963, Modigliani and Miller made a correction to their initial framework, relating it to corporate taxes; as corporations could obtain a taxation discount by issuing debt, this should lead to higher debt ratios, especially for firms with higher profitability. Miller (1977) uses a similar reasoning to introduce personal taxes into the debate. Baxter (1967) introduced the costs of financial distress into the trade-off theory. In the presence of financial difficulties, the tax benefits of debt could be eliminated by the extra costs arising from the financial constraints, thus, higher financial distress would imply higher equity (less leverage).

The concept of agency cost arises from a theory itself: the agency theory based on a contractual view of the firm developed by Coase (1937), Jensen and Meckling (1976) and Fama and Jensen (1983 a,b). According to agency theory, the managers represent the interests of the shareholders in the firm, but they might not always act in the best interests of the shareholders. From this eventual misrepresentation arise the agency costs. Jensen and Meckling (1976) also highlight the possibility of agency costs between shareholders and bondholders of the firm over deployment of the firm’s assets. Corporate governance mechanisms should be implemented to minimize agency costs. Agency theory is often integrated inside the trade-off theory (e.g.: Baker and Wurgler, 2002, or Fama and French, 2005) or described as supporting the trade-off theory (e.g.: Myers, 2001).

Agency theory in financial economics also assumes ‘rationality of agents’ and separation between operating and financing decisions. The agency costs are one form of friction against 'market perfection'. Shleifer and Vishny (1997) provide a survey on the theme noticing that 'the essence of the agency problem is the separation of management and finance, or in more standard terminology of ownership and control' (Shleifer and Vishny, 1997, p. 740). Logically, the operational management is incorporated in the management of the firm. As explained by Williamson (2002), apart from some exceptions, the propositions that organization matters and is susceptible to analysis were long greeted by skepticism by economists because it is difficult to show how and why. Therefore, to provide a means for scientifically testing interactions linking operating, financing and investing decisions also enables the testing of a major assumption of agency theory studies. Nonetheless, such testing cannot be used to undermine the importance of relations among shareholders, managers and others stakeholders such as customers, bondholders, suppliers, governments or workers.

Several authors argue that the trade-off theory implies a target-adjustment debt ratio; that is, firms make their financial decisions to reach an optimal debt ratio (cf. Jalilvand and Harris, 1984; Myers, 1984; and Shyam-Sunder and Myers, 1999). According to such reasoning, the trade-off theory would need to be tested against a putative optimal capital structure of firms.

The empirical evidence does not offer strong support for the claim that historical debt ratios will be the principal element in the definition of future leverage (Shyam-Sunder and Myers, 1999). Several researchers argue that the adjustments of the capital structure towards a potential debt target are not verifiable in the short run, but only in the lengthy long run (e.g.: Fama and French, 2002; Kayhan and Titman, 2007). Furthermore, contrary to a central prediction in the trade-off theory, firms with more profits tend to have less debt (e.g.: Rajan and Zingales, 1995; Fama and French, 2002; Titman and Wessels, 1988). Additionally, when asked about their debt targets on a social science type survey, only 10% of financial executives declared having very strict debt ratio targets, whereas 34% had somewhat tight debt ratio targets, 37% had flexible targets, and 19% had no target ratio or range whatsoever (Graham and Harvey, 2001). These results are consistent with the survey of UK practitioners in Beattie et al (2006), where only half of the firms sought to maintain a debt target level.

Still, in the presence of this evidence, some researchers thrive on offering answers that would be aligned with the trade-off theory, for instance taking into consideration dynamics of the market (Setrubulaev, 2008), adverse selection costs and asymmetric information (Byoun, 2008). They attempt to explain why trade off theory should still hold, in spite of the empirical findings. Curiously, according to Graham and Harvey's survey, the financial executives themselves attribute very little relevance to transaction costs or free cash flows when deciding their debt policies.

Nonetheless, the question is even more complex. First, it is rather difficult to identify what a firm's optimal capital structure is, as the target ratio is not observable and researchers need to make assumptions Shyam-Sunder and Myers (1999).[14] However, even if a target ratio could be observable, this would not necessarily mean that it would be exclusively dependent on the factors predicted

[14] Shyam-Sunder and Myers (1999) consider the following for the estimated target ratio: historical mean of the debt ratio for each firm, which can be multiplied by total capital and a rolling target for each firm, using only historical information, and adjustment process with lags of more than one year. Kayhan and Titman,(2007) employ a regression methodology based on historical data to identify the target capital structure.

by trade-off theory. Much less could we can conclude that corporations are black boxes and operating activities are irrelevant for financial economics. As noted by Lemmon et al (2008), an unobserved time-invariant effect, not explained by the dominant capital structure theories, generates surprisingly stable capital structures. It is possible that some operating characteristics of firms, such as the type of products they sell, could have some property of stability which might be related to their capital structures.

4.1.2 Pecking order theory

Despite being often offered in competition with the explanation of trade-off-theory (e.g.: Myers, 2001), pecking order theory is also a development from Modigliani, Miller, and Fisher's theoretical framework assuming that corporations are similar to black boxes full of irrelevant operating activities. Pecking order theory advocates that the black boxes follow the same path of preferences (pecking order) when making financing decisions.

When launching it, Myers (1984) and Myers and Majluf (1984) drew on the concept of information asymmetry, in which financing decisions would provide signals to the market. It was assumed that a firm's managers know more about the value of its assets and projects than outside investors do. As both managers and investors would act rationally, the information allocation would lead to a predetermined path of financing decisions applicable to every firm where operating activities are not considered, given that the separability assumption present.

Pecking order theory defends the argument that issuing debt minimizes the information advantage of the firms' managers. Assuming that managers can rationally identify their 'company's market-value', the optimistic managers, who believe shares are undervalued will issue debt rather than equity. Only pessimistic managers will want to issue equity because they consider shares are traded by a value superior to its worth. But in this last case, investors must be suspicious of managers. If debt is an alternative, then any attempt to sell shares would reveal that those shares are not a good buy, and managers are trying to deceive shareholders. Therefore, according to the pecking order theory, equity issues would not be made if debt is available on fair terms, and in equilibrium only debt will be issued. Equity issues will occur only when debt is costly-for example because the firm is already at a dangerously high debt ratio foreseeing high costs of financial distress. In this case, even optimistic managers may turn to the stock market for financing to avoid the inherent financial difficulty costs.

As summarized by Myers (2001, pages 92-93), the order of preferences predicted by the pecking order theory would be the following:

1) Firms prefer internal to external finance. (Information asymmetries are assumed relevant only for external financing.)

2) Dividends are 'sticky,' so that dividend cuts are not used to finance capital expenditure, and so that changes in cash requirements are not soaked up in short-run dividend changes. In other words, changes in net cash show up as changes in external financing.

3) If external funds are required for capital investment, firms will issue the safest security first, that is, debt before equity. If internally generated cash flow exceeds capital investment, the surplus is used to pay off debt rather than

repurchasing and retiring equity. As the requirement for external financing increases, the firm will work down the pecking order, from safe to riskier debt, perhaps to convertible securities or preferred stock, and finally to equity as a last resort.

4) Each firm's debt ratio therefore reflects its cumulative requirement for external financing.

As one can observe, the framework of pecking order does not distinguish firms according to their operating characteristics or activities. Several studies found rather weak empirical support for the pecking order theory, and some researchers, such as Fama and French, state that ‘the pecking order, as the complete model of capital structure proposed by Myers (1984) and Myers and Majluf (1984), is dead’ (Fama and French, 2005, page 580). Myers assumed the fragility of the supporting evidence for his theory. In Myers (1984), he concedes that the level of borrowing is determined not just by value and risk, but also by the type of assets a firm holds. Later, Myers would provide a rather conclusive statement: ‘like all theories of capital structure it (the pecking order theory) works better in some conditions than the others’ (Myers, 2001, p. 95).

Shyam-Sunder and Myers (1999) claimed empirical support for the pecking order theory. They regressed firms’ financial deficits on to new capital issuances to show that firms would prefer debt to equity in financing deficits. Chirinko and Singha (2000) argued that Shyam-Sunder and Myers’s ‘elegantly simple’ test generates misleading inferences when evaluating plausible patterns of external financing. Furthermore, Frank and Goyal (2003) revised Shyam-Sunder and Myers’s findings by demonstrating that the incorporation of the usual control factors in capital structure studies seriously dilute Shyam-Sunder and Myers's results. The control factors used by Frank and Goyal were the variables mentioned in Rajan and Zingales (1995): size, tangibility of assets, profitability and market to book value. Furthermore, the aforementioned Fama and French (2005) presented a more definitive proof against pecking order's predictions. Instead of studying the financing of deficits, Fama and French demonstrated that firms quite often issue equity without being minimally financially constrained. This is consistent with the findings in Leary and Roberts (2010) where under a strict interpretation of the pecking order theory, 77% of their sample follow the pecking order in choosing between internal and external finance, but only 17% follow the pecking order in choosing between debt and equity.

Bharat et al (2008) provides some evidence that asymmetric information is a factor driving capital structures. However, with this as the case, they cannot sustain it as the only factor driving capital structures. Furthermore, in Graham and Harvey's (2001) and Beattie et al (2006) practitioner' surveys, the executives attribute very low importance to signalling information to investors through capital structure decisions.

Besides the contradictory empirical findings about the pecking order theory described above, it is founded on the majority of Modigliani and Miller's assumptions. One of those is the separability assumption, which enables the pecking order theory to make predictions as if firms were homogeneous boxes. Note also that the internal funding, the main source of a firm's financing is mostly generated by the selling of products to customers. Thus we may gain to learn more about it.

4.1.3 Market timing theory

Market timing theory (Baker and Wurgler, 2002) followed the influential survey from Graham and Harvey (2001) in which two-thirds of chief financial officers agree that the price of the stocks is an important factor in their capital structure decisions. The authors summarize their theory in one sentence: 'Capital structure is the cumulative outcome of attempts to time the equity market' (Baker and Wurgler, 2002, p. 3). Accordingly, the main concern of financial decisions would be to obtain funding by issuing equity when the stock price is high and issuing debt when the stock price is low, regardless of a firm's operating activities.

Baker and Wurgler's empirical tests of the theory use the variable market to book (value of the firm) to measure the market timing, in fact, a variable that has been identified many times before in literature. For instance, it is mentioned in Rajan and Zingales (1995), and used also by Baker and Wurgler as a control variable. Baker and Wurgler roll the market to book variable to more than one time period to conclude that low leveraged firms are those that raised funds when their market valuations were high, as measured by the market to book ratio, whilst high leveraged firms are those that raised funds when market valuation were low.

Subsequent empirical findings seem to constrain the importance attributed to market timing in the initial paper. If, for Baker and Wurgler (2002), it appears to be the dominant factor in capital structures, Alti (2006), Hovakimian (2006), and Kayhan and Titman, (2007) argue that the market timing effect on capital structure occurs merely in the short run and disappears with time. Faulkender and Petersen

(2006) note that a firm's capital sources impact upon its capital structure. This point might be relevantly applied to the market timing theory, recalling the case of private equity firms which have no market to book ratio because they are not listed on a stock exchange. Therefore, although other market values might still impact upon their capital structure, the stock market price for those firms would be inexistent, and thus undefined. Although one factor that can lead private firms to decide to go public is comparing their potential market value with the market value of comparable companies (Pagano et al, 1996), not all companies wish or can go public, and several organizations such as not for profit, or governmental organizations have not the option of being listed in a stock market.

Baker and Wurgler (2002) do not exclude the possibility that their market timing findings could be explained by linking their theory with a dynamic version of the pecking order, or agency models (Myers and Majluf, 1984). However, they allow the possibility of a second explanation involving, 'irrational investors (or managers) and time-varying mispricing (or perceptions of mispricing)' (Baker and Wurgler, 2002, p. 27-28).

Nonetheless, the market timing formulation still assumes the concept of the firm inherited from Modigliani, Miller, and Fisher's framework. Baker and Wurgler are not concerned with the operating characteristics of the firms, and treat them likewise as homogeneous boxes in which capital structure is almost exclusively a game of beating the stock market price. Therefore, market timing theory ignores how the type of products sold by a firm might impact its capital structure and other economic characteristics known to be correlated with the capital structure.

4.1.4 Recent developments involving products: the product market literature and its limitations

In this thesis, the preliminary literature in financial economics that has inquired how the market of a firm's products may impact its capital structure is referred to as 'product market literature', as is common in financial economics. Nonetheless, such literature uses a rather limited definition of a product's market that essentially consists in the set of firms registered with the same industry code (e.g.: Campelo, 2002; Campelo, 2006; Karuna 2007; Banerjee et al, 2008).

The product market literature does not encourage a management perspective or economic sociology perspective that are concerned with the impact that operating activities might have on a firm's economic characteristics. It is very far from suggesting a different paradigm establishing a concrete link between operating and financing decisions. It uses the same framework of Modigliani, Miller, and Fisher, in which 'rational agents' and frictions to the 'market perfection' are implied. The firm concept utilized is still that of a homogeneous box to which an industry membership label is attributed. Correspondingly, an industry group is a set of black boxes allegedly selling substitutable products. In a sense, this brings little innovation, as Modigliani and Miller (1958, p. 266) already refer to 'the familiar concept of the industry in which it is the commodity produced by the firms that is taken as homogeneous'. The concept of industry was considered by Modigliani and Miller (1958) as analogous to their assumption of the risk class of shares. As explained by Ross (1988), since the original analysis, economists could discard the risk class assumption based on arbitrage arguments and no longer need to assume the perfectly correlated companion firm to reach the same predictions as Modigliani and Miller.

Because it assumes intra-industry homogeneity, the product market literature faces a high level of difficulty in addressing firm and product (output) heterogeneity. If an industry code could define a set of homogeneous boxes, two problems would become extremely complicated: the classification of firms within an industry, and the classification of industries themselves. The next chapter returns to these problems. For now, the thesis will discuss some limitations of the product market literature.

Can an industry code really define a market of homogeneous products? For instance, Chevalier, (1995) obtained 'product market' empirical data from the 'supermarket industry'. Can one say that there is a supermarket product market, or that each supermarket chain is instead a market of various products where many different companies channel their products to reach the final consumers? Is not the 'supermarket' expression descriptive itself?

Does not product market literature use a rather subjective process to define a market? The same industry code can accommodate firms with quite distinguishable business models and operational requirements. For example, in the agriculture industry, one firm may produce and sell crops, while the next may distribute advanced technology for genetic modification of crops. Moreover, a firm's industry classification can be ambiguous. For example, NOKIA, founded in 1865, has developed activities in industries as diverse as paper, rubber, cables, plastic production, and communications.[15]

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[15] as described in http://www.nokia.com/about-nokia/company/story-of-nokia.

Concrete empirical evidence also supports the need for developing an economic method to address the heterogeneity at the firm level. Empirical studies in the strategic management literature have shown that the most important sources of economic rent are business-specific. Industry membership is a much less important source (Rumelt, 1991; Macgahan and Porter, 1997). These results are consistent with the findings in Mackay and Philips (2005), that most of the variation in capital structures arises within industries, rather than between industries. The industry fixed effects accounted only for 13% of the variation in capital structures, whereas firm fixed effects explained 54%, and within-firm variations explained the remaining 33%.

Therefore, it should be no surprise that product market literature can sometimes be rather inconclusive, occasionally reaching diametrically opposing conclusions in the same paper. For instance, Campelo (2006, p. 168) concludes the following: 'studies on the interaction between a firm´s financing decisions and its product market performance often conclude that debt taking either hurts or boosts competitive performance. This paper proposes that both types of association are likely to be manifested in the data: debt can hurt *and* boost performance.' Philips (1995) follows only four industries to find that in three of them, the firm's output is negatively associated with the average industry debt ratio.[16] In the other industry, it was found to be precisely the opposite situation.[17] Therefore, researchers should be cautious in exclusively employing the industry code to understand a firm's economic characteristics or product heterogeneity.

Some studies have recently proposed explanations for capital structures that,

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16 the fiberglass insulation, the tractor trailer, and the polyethylene chemical industries.
17 the gypsum industry.

despite being related to the industry membership, are not limited to it. Kale and Shahrur (2007) note that the research and development (R&D) intensity of suppliers and clients, and the joint ventures with them, are negatively associated with a firm's leverage. Banerjee et al (2008) also find that the relationships with customers and suppliers are correlated with a firm's capital structure. One could posit that such associations partially occur due to the operational needs inherent in the type of products carried in the commercial transaction. For instance, it might not be irrelevant that to produce an automobile, a firm needs heavy weight machinery, storage facilities, and quite tangible raw materials besides the work; whereas to produce an intangible service, another firm may need only convenient space and few employees.

However, the operational need reasoning is not the one adopted by Kale and Shahrur (2007) and Banerjee et al (2008), who also do not conceptualize that the products are the principal source of a firm’s income and self financing. Both papers follow the analytical reasoning proposed by Titman (1984) and Maksimovic and Titman (1991).[18]

Having the merit of introducing products, clients, and suppliers into the discussion, Titman (1984) and Maksimovic and Titman (1991) do not identify that operating products could demonstrate an inconsistency in the Modigliani, Miller, and Fisher framework, because of the assumption presupposing a separation between operating and financing decisions. Quite the opposite, Titman (1984) and Maksimovic and Titman (1991) attempted to demonstrate that products can be accommodated within the classic framework which assumes the irrelevance of

[18] Which Harris and Raviv (1991, p. 318) acknowledge as the introductory papers on the theme of how debt might influence the interactions with customers and/or suppliers. Maksimovic and Titman (1991) was a forthcoming paper at that time.

operating decisions. For such a very complicated, if not impossible task, the reasoning invoked by Titman (1984) and Maksimovic and Titman (1991) is not that the type of products sold by a firm may directly effect its capital structure. The importance of products would be indirectly reflected in a firm’s liquidation/bankruptcy costs. As described before, the trade-off theory argues that liquidation/bankruptcy costs are a form of 'market imperfection' that impacts upon capital structures. In this substance, the work of Titman, and Maksimovic and Titman can be considered a development of the trade-off theory.

Clearly stated, the objective of Titman (1984, p. 137), is exploring 'one source of contracting costs which is indirectly related to bankruptcy'. His theoretical reasoning would predict that 'firms (such as computer and automobile companies) which can potentially impose high costs on their customers and business associates in the event that they liquidate choose capital structures with relatively low debt/equity ratios. Conversely firms (such as hotels and retail establishments) which impose relatively low costs on their customers and business associates in the event that they liquidate choose high debt/equity ratios' (Titman, 1984, p. 150). Maksimovic and Titman (1991) expand upon this theme, arguing that the effect of debt financing on a firm's ability to maintain a reputation for product quality is a determinant of its capital structure choice. These papers argue that consumer and supplier decisions are mainly determined by the financial status of the producer/seller.

Both Titman (1984) and Maksimovic and Titman (1991) presented analytical papers without directly testing any empirical evidence/refutation of their claims. Such reasoning offers us peculiar predictions. For instance, 'rational customers' attending a shopping centre would evaluate products according to the liquidation/bankruptcy prospects of the producer/seller, for they have carefully read the last balance sheet, and this would affect the capital structures of the producers/sellers. The same applies to all the rational suppliers who place products mainly according to the liquidation prospects of their clients and ignoring the operational factors. Kale and Shahrur (2007) and Banerjee et. al (2008) would follow precisely the same reasoning to interpret their empirical findings, as a firm's liquidation/bankruptcy would be a recurrent happening, and operating decisions by themselves would be irrelevant for finance to the extent that they would not be related with bankruptcy costs, which would be aligned with the trade off theory.

Thus, the product market literature is missing two great opportunities for learning more about operating products and their implications. The first is to embrace an interdisciplinary conversation with those fields that specialize in studying products, such as marketing or strategic management. One can note that it is not at all common for product market literature to refer to studies from publications outside the realm of financial economics. The second opportunity is to further understand what valuable information about a firm’s products can be obtained from the financial accounts.

As it is implemented, some stances taken on the product market literature might be considered as fragile or incorrect. Titman and Wessels (1988), Kale and Shahrur (2007), and Banerjee et al (2008) claim to identify the uniqueness of a firm’s products with only two variables: R&D expenses divided by sales; and selling expenses divided by sales. First, for a product analysis, it is not clear why sales or even the total assets should be the denominator, because this compares expenses with either revenues or assets, two different classes of accounting rubrics. Second, from an accounting perspective, it is conceptually incorrect to define the used variable that sums up selling, general, and administrative expenses as merely selling expenses; because it incorporates many other general and administrative expenses which are mistreated by those researchers. For example, these researchers disregard that the value of selling, general, and administrative expenses includes the R&D expenses, which are also reported in an additional note to the financial statements. Consequently, the researchers included the same variable R&D expenses twice in their regression models.

Furthermore, to study the predictions of Titman (1984), that firms selling durable goods have less leverage, Titman and Wessels (1988, p. 5) arbitrarily identify the durable good selling firms by ‘a dummy variable equal to one for firm as those with USA’s Standard Industry Code (SIC) codes between 3,400 and 4,000 and zero otherwise’. Allegedly, all firms registered in these industries would produce machines and equipment. There is absolutely no explanation for the choice of these rather specific industry codes. Why not pick any other industry codes? Later Banerjee et al (2008) would take this classification as perfectly given in their dual typology of industries: durable goods and non-durable goods. Banerjee et al simply follow Titman and Wessels (1988), who established the benchmark.

Economic sociology, marketing and management literature provide an alternative means of classifying products: according to their intangibility, ranging from the ‘most tangible’ (such as salt or pencils) to the ‘most intangible’ (e.g.: pure services, such as consulting or teaching). Services, in particular, an important type of product present in every industry, have characteristics which distinguish them from physical goods.

One could posit that inside the same industry firms might have very distinct levels of intangibility in the products they sell. This is a point missed by Titman and Wessels (1988), Kale and Shahrur (2007), and Banerjee et al (2008), who also ignore the substantial heterogeneity among industries. They all follow the prediction of Titman, described above, that firms such as ‘computer and automobile companies’ choose capital structures with relatively low debt/equity ratios, and that conversely, firms such as ‘hotel and retail establishments’ choose high debt/equity ratios.

As suggested before, a dialogue with other scientific disciplines that are concerned with studying products might be quite fruitful. The marketing literature, specialized in studying products, learned with Schostack’s (1977) framework to categorize specific products according to their intangibility. One could propose a framework for classifying specific firms and industries according to the products they sell to customers. Computers and automobile intensive companies, as exemplified by Titman, that sell high-cost tangible products, are classifiable as physical goods-intensive firms, while hotels and retail establishments are classifiable as semi-intangible product-intensive firms, because they offer a mix of services and physical goods to customers. Firms focused on selling services or software would be classifiable as intangible product intensive firms.

Nevertheless, it is quite difficult to understand why, as suggested by Titman (1984), Titman and Wessels (1988), Kale and Shahrur (2007) and Banerjee et al (2008) tangible goods-intensive firms that require heavyweight investments in machinery, plants, equipments and raw materials would have less debt/leverage than semi-intangible and intangible product-intensive firms that by having less tangibility requirements could more easily be financed by self funding, and might have less tangibility to offer as collateral in debt financing.

4.2 Conclusion of the chapter

This chapter exemplified a concrete theoretical block of neoclassical economic theory that ignores the intangible flow dynamics of economic phenomena: the neoclassical theoretical formulations for a firm's capital structure. There seems to be clear signs that this theoretical area is suffering a crisis. The above mentioned survey to Chief Financial Officers of Graham and Harvey (2001) found that although the executives were likely to use the mainline techniques learned in business schools to value projects and estimate the cost of equity (e.g.: NPV and CAPM), they were much less likely to follow the academically prescribed factors and theories when determining capital structure. Similar results were found in other surveys (e.g.: with practitioners of UK in Beattie et al 2006; and of different European countries in Brounen et al, 2004). We are not referring to recent theories that executives have not yet had the time to study, but theoretical frameworks such as Modigliani and Miller (1958) that academics have been advocating for many years.

What is worse, the non-adherence of practitioners is empirically justifiable by studies contradicting major predictions of the dominant capital structure theories. Fama and French (2005) claim that the pecking order theory might be considered 'dead', because firms issue equity without being financial constrained as predicted (Leary and Roberts, 2010, confirm it). However, the leading alternative, the trade-off theory suffers from many problems itself. For instance, firms with higher profitability tend to have less leverage, contrary to the trade-off prediction (e.g.: Rajan and Zingales, 1995; Fama and French, 2002). Rajan and Zingales (1995), Welch (2004) and Lemmon et al (2008) note our little understanding about how corporations decide upon their financing decisions. As explained by Goshal (2005), bad (financial) management theories can indeed destroy good management practices.

As shown before, Modigliani and Miller's (1958) paper is habitually considered the starting point for modern capital structure theory. By adopting the Fisher's homogeneous box firm, Modigliani and Miller set the rule of assuming a separation between operating and financing (and investing) decisions. Subsequent financial economic formulations followed that rule. Still, the abstraction of the firm used might convey a logical flaw: the underlying net cash flows on which the capital structure theories decided to focus are mainly generated by the firms' operating activities that theorists decided to neglect. This would have two important consequences under the classic framework: the exclusion of those operating elements put inside the black box from the concerns of the dominant theories in financial economics and the respective negligence of accounting information reporting operating activities because the reporting of a firm's operating activities would be considered inconsequential for finance under the classic framework.

To scientifically test such a possibility, one requires an economic method providing an indicator describing firm specific operating decisions. Decisions can hardly be more operational than those about products sold to customers. Therefore, the separability assumption might be tested with an indicator describing decisions about products sold to customers, as products sales are the principal mechanisms to generate operating revenues.

The separability assumption prevailed in the subsequent capital structure formulations after Modigliani and Miller. The trade-off-theory would argue that in the 'market perfection' conditions described by Modigliani and Miller, the capital structure would be irrelevant. According to the trade off theory, in the real world the capital structure would be relevant because of the trade-off involving 'market imperfections' such as taxes, costs of financial distress or agency cost. Yet, if operating decisions are relevant for the capital structure, this cannot simply be dismissed as 'imperfections in the real world'. It may demonstrate a concrete fragility in the dominant theoretical framework itself.

The pecking order theory built on the same Modigliani, Miller, and Fisher framework to prescribe that the black boxes have the same order of preferences regarding financing choices. As shown before, concrete empirical evidence showed that firms often do not follow the preferences predicted by the pecking order theory, especially in the choice between debt and equity (Fama and French, 2005; Leary and Roberts, 2010). The pecking order theory does not consider the possibility that a firm's operating activities might have implications for its capital structure and other economic characteristics. Furthermore, despite the importance attributed to self financing, the pecking order theory does not try to understand how cash flows are generated. In fact, product sales are the principal sources of a firm's self financing.

The market timing theory describes the financing choices as a game played according to the stock market prices. Empirical evidence shows that the significance of the stock market price is reflected mainly in the short run, and tends to disappear in the long run (Alti, 2006; Hovakimian, 2006; Kayhan and Titman, 2007). Market timing theory cannot explain the financing choices of many private equity corporations or not-for-profit organizations that are not listed on a stock exchange. Moreover, it has no means of addressing how operating decisions might be reflected in the capital structure, as it restricts the financing decisions to a stock market price game.

Product market literature uses a rather limited definition of a product's market that mainly consists of the set of firms registered with the same industry code. By assuming that firms within an industry sell homogeneous products, it faces high-level of difficulty to measure the heterogeneity of the firms registered with the same industry code and among different industries. Furthermore, it is known that the most important sources of economic rent are not industry specific but business-specific (Rumelt, 1991; Macgahan and Porter, 1997; Mackay and Philips, 2005). Therefore, a firm specific indicator based on operating products could be used to study the heterogeneity among firms and industries.

The product market literature does not present an agenda for introducing a management perspective concerned with the impact that operating activities might have on a firm's economic characteristics. It is far from suggesting a different paradigm in which a concrete link between operating and financing decisions could be established, thus demonstrating the fragility of the separability assumption. Quite the opposite, several papers try to align the importance of operating products with the Modigliani and Miller, and Fisher framework by claiming that products' implications would be mainly reflected in a firm's liquidation/bankruptcy costs (Titman, 1984; Titman and Wessels, 1988; Maksimovic and Titman, 1991; Kale and Shahrur, 2007; Banerjee et al, 2008). Accordingly, such papers can be considered a development of the trade off theory.

Nonetheless, instead of being merely reflected in the liquidation/bankruptcy costs, it is possible that the type of products sold might be a strong factor in determining a firm's capital structure and other important characteristics known to be correlated with leverage given that firms' cash in-flows are mainly generated by product sales. Therefore, it is possible that firms organize themselves according to their operational needs. This being the case, it would demonstrate a logical contradiction in one of the major assumptions of Modigliani, Miller, and Fisher theoretical framework.

As noted earlier, the neoclassical economical theory is missing two great opportunities. The first is for financial economics to embrace an interdisciplinary cooperation with those scientific fields that specialize in studying products, such as marketing or strategic management, but also economic sociology or heterodox economics. The second opportunity is to further understand the usefulness of accounting information for studying a firm's products. The intangible flow theory can possibly offer a theoretical framework to build a method capable of inquiring product (output) tangibility at the firm level, and hence testing the separability assumption of neoclassical financial economics. As explained before, the intangible flow theory can be employed to describe the tangibility of flows of products sold by firms to customers in order to generate material cash in flows, and the associations between intangible flows and the flows of economic material elements such as cash and physical goods. Intangible flow theory explains how intangible motions might be very relevant because human related intangible flows (such as work flows, service flows, knowledge flows, or communicational flows) are necessary to consummate the flows of economic material elements (such as physical goods, or cash). Therefore, it might be employed to suggest that firms partially organize themselves according to the operating needs associated with the tangibility of the flows of products (outputs) sold to customers. For instance, firms that produce heavy physical goods, such as cars or planes, may be required to have different economic characteristics than firms that exclusively sell highly intangible products, such as services or software.

The economic characteristics of firms studied in Rajan and Zingales (1995) are the key reference for control variables in neoclassical financial economics studies involving a firm's capital structure (e.g.: Lemmon et al, 2008; Baker and Wurgler, 2004; Alti, 2006): i) size of the cash flow generated trough sales; ii) capital expenditures on property, equipment, and facilities; iii) profitability; iv) stock market valuation of equity (market-to-book); and v) debt as a proportion of the capital structure. Nevertheless, as a result of its separability assumption, neoclassical economics systematically undermines any possible association between these economic characteristics and the operating activities of the firms to its conceptualization of the firm as a black box full of intangible elements that could not be quantified. One important contribution of intangible flow theory could be the creation of an economic indicator capable of inferring operating decisions about flows of products. Such an economic indicator could allow for the dominant separability assumption of neoclassical economics to be empirically tested. A strong statistical association between operating decisions and economic characteristics of firms studied in Rajan and Zingales would demonstrate the non empirical verification of the separability assumption. Therefore it could be used to question a fundamental foundation of neoclassical economical theory.

Perhaps these are contributions that can later be exported back to other scientific areas, which despite studying products, have little familiarity with financial and accounting concepts. As financial economics, those areas might be interested in learning more about operating management and accounting information. Given that product transactions are eminently social processes, this thesis may provide very a solid argument for using scientific approaches outside the realm of neoclassical economics to investigate economic phenomena. If one is able to demonstrate that operating, investing, and financing decisions are not separate but empirically associated after all, then knowledge about products and operating activities gained from organization sciences, sociology, heterodox economics or accounting can possibly enrich our knowledge about financial phenomena.

5- The Level of Operating Intangibility (LOI): an accounting framework for measuring product (output) intangibility[19]

5.1 Developing a framework to test the separability assumption

As described in the last chapter, the dominant capital structure explanations in financial economics presuppose that financing decisions can be detached from operating (and investing) decisions. Such an assumption would be incompatible with the theoretical prediction that *corporations partially organize themselves according to the operating needs associated with the tangibility of the flows of products used to generate material cash flows through sales to customers*. Therefore, in order to clarify this matter, one needs to identify an economic indicator of concrete operating decisions. The operating decisions indicator can be used to study its statistical relationships with financing (and investing) decisions. The decisions about products (outputs) sold to customers are operating decisions directly reflected in the operating income, and operating cash flow. If the findings permit the identification of associations between operating needs and economic characteristics, we could no longer ignore that the characteristics of firms cannot be dissociated from the organization they describe. This link is often ignored by neoclassical economics, which tries to impose upon the social sciences several propositions that are unproved and ethically very questionable, such as describing organizations as homogeneous black boxes, or referring to human beings as assets or capital (e.g.: Becker, 1962; Ditman et al, 1973; Ciccone and Peri, 2006; Barro, 2001;Argyres, 2011; Ployhart et al, 2011).

Nevertheless, it is necessary to solve the problem of identifying product

[19] Part of this chapter is integrated in Cardao-Pito (2010b)

(output) tangibility at the firm level. To address this problem, the current chapter introduces the concept of operating intangibility, devising a method by which to measure the level of operating intangibility, and testing its empirical associations with other organizational characteristics. The economic method introduced in the current chapter for studying the intangibility of a firm's products (outputs) can be employed to classify both firms and industries.

5.2 Operating Intangibility and its measurement

5.2.1 The Level of Operating Intangibility (LOI)

Following the Modigliani, Miller; and Fisher framework (Modigliani and Miller, 1958), financial economics tends to consider firms as homogenous black boxes (Miller, 1988 a b). A set of more recent studies in product market literature supposes a variation among industries, while assuming intra industry (code) product/firm homogeneity (e.g.: Titman and Wessels, 1988; Campelo, 2002; Campelo, 2006; Karuna, 2007; Banerjee et al, 2008; Chemmanur and Yan, 2009). This thesis suggest that it can be fruitful for financial economics to learn about products (outputs), either theoretically and empirically, from those disciplines which specialize in studying products such as strategic management, and marketing, but also from economic sociology and heterodox economics. Moreover, the current thesis suggests that we can gain from comprehending a little more about which product information can be obtained through accounting. An interdisciplinary approach might increase our financial understanding of firms and their economic characteristics. Furthermore, it may enable the productive creation of new knowledge to be exported back to product specialized disciplines. Hence, an interdisciplinary approach may increase our understanding of the economic characteristics of firms.

Distinctions between products and assets, and between products and resources were defined in chapter 3. Products such as services have properties which preclude them from being captured by an asset, capital or resource approach, and also preclude their being registered on the balance sheet. In addition, several assets registered on the balance sheet may not be considered to be operating products. The current thesis identifies the transaction of operating products (outputs) with customers as the principal mechanism for generating operating revenues and cash in-flows.

The products actually sold to customers by a firm are registered in sales revenues. However, the direct appraisal of sales values is not a good option for measuring product (output) intangibility because the items sold may be an intricate mixture of intangible, semi-intangible, and tangible products, as in the case of a restaurant business mentioned above. To address this issue, product (output) intangibility can be inferred from the operating inputs consumed to generate sales. Operating inputs are more precisely identifiable than operating outputs, and such inputs are incorporated into the products. Although a given product may not be immediately recognizable as intangible, semi-intangible, or tangible, whenever a firm sells a tangible physical good, it registers its cost in its accounting. This is a human practice with many centuries of history. On the other hand, intangible products, such as pure services, are not associated with particular physical good costs. However, even purely intangible products are associated with clearly identifiable accounting expenses, such as salaries, commissions, communications, etc. The same principle applies to semi-intangible products. Hence, it should be possible to infer the proportion of tangible and intangible components that are incorporated into a product's value from accounting data.

In order to develop the intangible flow theory by identifying the tangibility of the flows of products sold by a firm, the thesis introduces the concept of '*operating intangibility*: *the dynamic set of intangible flows integrated into a firm's operating productive system that is necessary to generate material cash flows through sales to customers '*. This theoretical framework measures the 'level of operating intangibility' (LOI) as the proportion of intangible-related expenses among total operating expenses. Therefore, we have a solution for our problem because although the intangible flows cannot be measured with precision due to their inherent properties, the material expenses related to the production and consumption of intangible flows can be quantified. Hence, LOI does not quantify intangible flows, but intangible related expenses, which include: i) the production of services for sale; ii) the production of services for internal consumption (e.g.: accounting, security, etc.); iii) the conception, improvement, and marketing of product (output) features (e.g.: development, marketing); and iv) the consumption of other intangible-related expenses (e.g.: communications, royalties, externally acquired services, etc.). R&D is fully integrated; its cost is assumed to be incorporated into all the products (outputs) sold to customers, but similarly to the other identifiable expenses in LOI, it can be extracted from the total value incurred. A potential advantage of LOI is that it encompasses a great many of the intangible-related costs necessary to obtain the cash inflows from customers, including some that are ignored by the intangible asset intensity method and the

R&D intensity method, and some that could hardly be considered as firm assets or resources. Some such intangible items, which are consumed in the short-term and undoubtedly should be expensed, include personnel-related costs (related to production of internally consumed and/or externally sold services), externally acquired services (e.g.: security or consulting), and communications. The LOI is quantified explicitly as follows:

$$\text{Level of Operating Intangibility} = \text{LOI} = \frac{\text{Total Intangible Related Expenses}}{\text{Total Operating Expenses}} =$$

$$= 1 - \frac{\text{Total Non-Intangible Related Expenses}}{\text{Total Operating Expenses}} =$$

$$= (\text{Expenses with services for sale} + \text{expenses with internally consumed services} + \text{expenses with conception, improvement and marketing of products (outputs)} + \text{other intangible related expenses})/\text{total operating expenses} =$$

$$= 1 - (\text{cost of goods sold} + \text{amortizations and depreciations of tangible long term assets} + \text{other tangible related expenses})/\text{total operating expenses}$$

(Equation 5.1)

Thus, as a proportion of total operating expenses, when one looks at intangible related expenses, he also looks at the proportion of non intangible related expenses, such as cost of physical goods sold or amortizations and depreciations of long term tangible assets, because if the level of intangible related expenses increases in productive system, the level of tangible related expenses necessarily decreases. Hence, the denominator is a relevant theoretical issue. For LOI, the scaling identifies the weight (level) of intangible related expenses among total operating expenses. The quantified indicator describes the degree to which an entire organization is reliant on intangible inputs and outputs (e.g.: the LOI can determine whether the products of Microsoft and Coca-Cola are more intangible-intensive than the products of Ford and Shell). The LOI puts physical good-intensive firms (e.g.: firms producing and selling automobiles) at one end of the scale, and intangible product-intensive firms (e.g.: firms producing software and pure services) at the other end. Firms that supply a mixture of physical goods and intangible products in their core business model, or firms offering products that are themselves mixed, are classified somewhere in the middle.

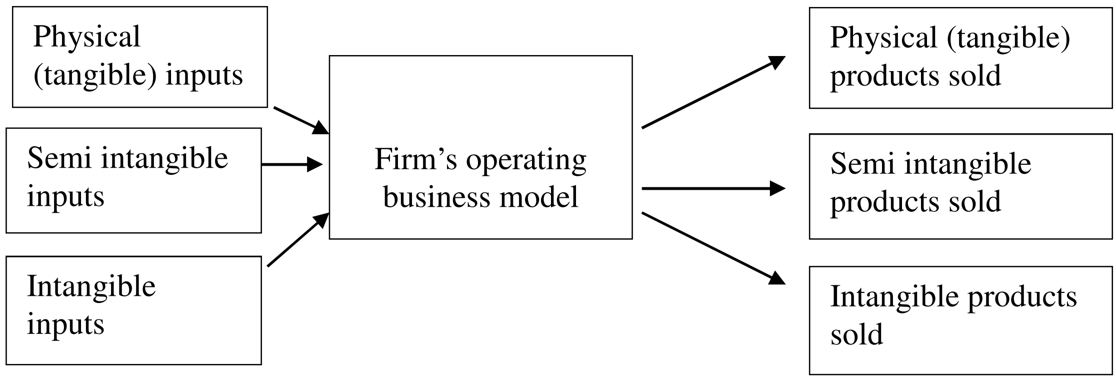
5.2.2 Identifying possible LOI proxies

To compute an LOI value, two inputs are required: the total amount of intangible-related expenses and total operating expenses. The second component is reported in the income statement. However, the first input is generally not directly observable by outsiders. Hence, a proxy must be computed using information that is available from the income and cash flow statements. Figure 5.1 Panel A describes the ideal information with which to compute LOI and Figure 5.1 Panel B describes the information that is generally available and can be used to compute the proxy. Particularly, Figure 5.1 Panel B describes the information obtainable in the primary sample that uses data from the merged CRSP (Center for Research in Security Prices)-Compustat (Computerized Statistics) database.

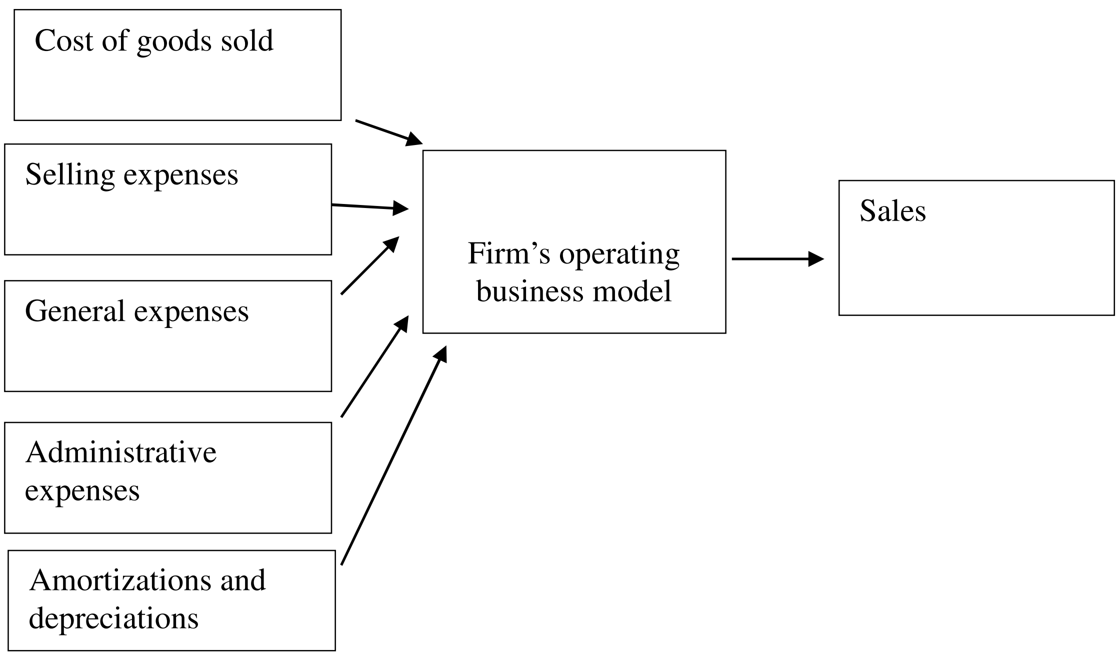
Ideally, one would be able to decompose the products sold by a corporation into tangible, semi-intangible, or intangible sets. But as in the example of products sold by a restaurant, a very complex mixture of products, or products that are hybrid themselves can be included in each sale. Thus, in the information available, we are commonly offered with a rubric of sales that aggregates the different products sold into a single item. Nonetheless, we have also information of the operating inputs incorporated into a firm's productive systems, which can be identified through the cost structure in the income statement. We have also information regarding amortizations and depreciations in the cash flow statement. Thus, we can identify a methodology to infer whether a firm is selling tangible goods, or if it is depreciating large tangible investments. Furthermore, we can infer whether a firm is generating sales through intangible products, such as services or high tech software, if that firm does not register a significant proportions of good sold to customers in its financial statements.

Figure 5.1 – Computation of Level of Operating Intangibility (LOI) of firms

Panel A- Ideal Information to compute the level of operating intangibility



Panel B- Information available on income and cash flow statements (CRSP-Compustat database) to compute the proxy for level of operating intangibility



In the merged CRSP-Compustat database the data available can be identified on the following format:

$$\begin{aligned}\text{Operating Income} &= \text{Sales (Net)} - \text{Cost of Good Sold} \\ &- (\text{Selling Expenses} + \text{General Expenses} + \text{Administrative Expenses}) \\ &- (\text{Depreciations} + \text{Amortizations})\end{aligned} \tag{5.2}$$

Thus, a proxy that could be suggested for LOI would be:

$$\text{Proxy: } LOI = \frac{\text{Selling Expenses} + \text{General Expenses} + \text{Administrative Expenses}}{\text{Total Operating Expenses}} = \\ = 1 - \frac{\text{Cost of Good Solds} + \text{Amortizations} + \text{Depreciations}}{\text{Total Operating Expenses}} \tag{5.3}$$

where:

a) Total Operating Expenses =(-1)×(Operating Income - Net Sales).

b) {Selling Expenses, General Expenses, Adminstrative Expenses} should exclude {Amortizations; Depreciations}. If necessary, the value of Amortizations and Depreciations, should be found in the Cash Flow Statement.

c) In case other operating expenses appear on Income statement not classified either as Cost of Good Sold or Selling, General and Adminstrative Expenses, they should be classified accordingly to such tipology.

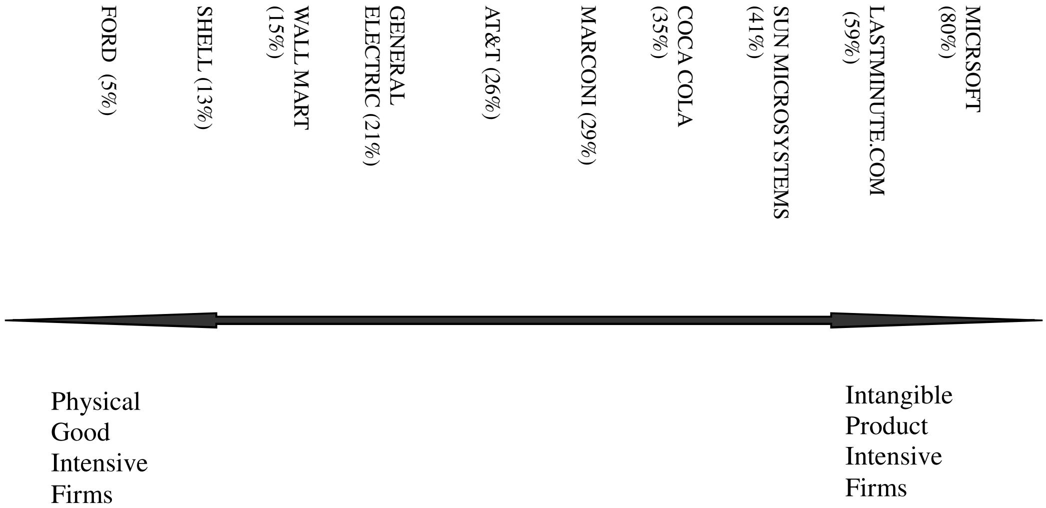
Therefore, the intangibility of product flows sold by a firm to its customers is inferred by the absence of tangible physical goods and amortization and depreciations of long term tangible assets in the operating costs. We reach intangibility of products sold through looking to its opposite: tangibility. Therefore, the intangibility of product flows sold by a firm to its customers is inferred by the absence of tangible physical goods and amortization and depreciations of tangible elements in the operating costs. We reach intangibility of products sold through looking to its opposite: tangibility. The next chapter will also study variations to this proxy by not integrating the amortizations and depreciation expenses in the denominator, and by extracting the R&D expenses from the numerator. [20]

5.2.3 Exemplifying the computation of the level of operating intangibility with well know firms and a few industries

To give the reader an introduction into how the classification system works, Figure 5.2 orders several well-known firms according the tangibility of their flows of products (outputs), as measured by its level of operating intangibility identified through the proxy described in formula 5.3. Each firm's mean LOI value was computed with the available observations in the merged CRSP-Compustat database over a period of 41 years (1966–2006) in a study sample of 10,162 corporations.

[20] The proxy formula in equation 5.3 was created taking into consideration the available information fields in compustat database. If the same information is presented in another format, for example in another database or directly in a firm's financial statements, then adaptations to this formula are necessary to take into account different presentation formats.

Figure 5.2: Example of Corporations Classified by their Mean LOI in the Sample (Years 1966-2006).

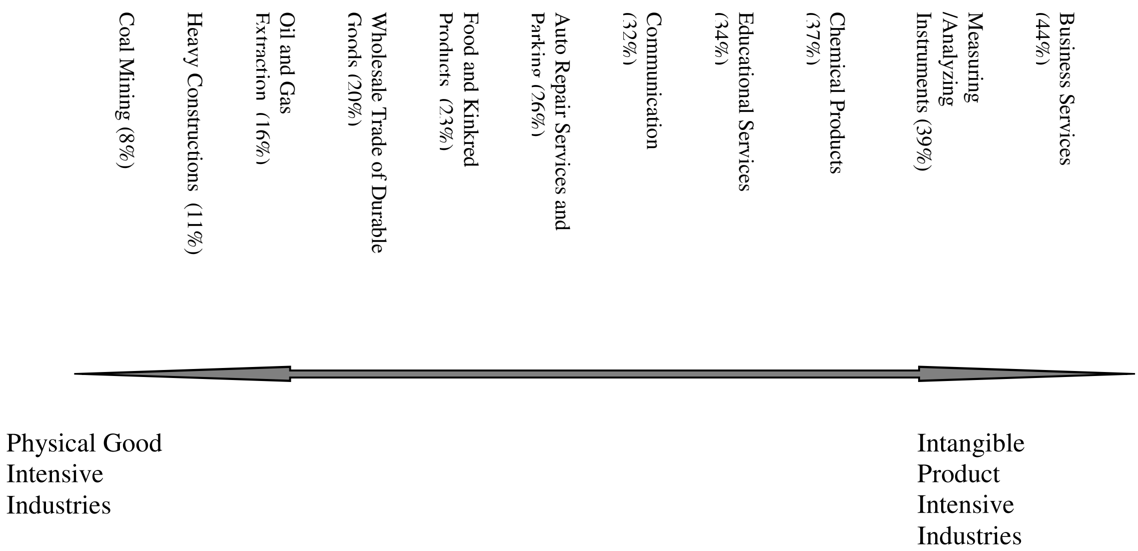


The LOI overcomes the limitations associated with using industry codes as proxies for intangibility. It identifies intangible product-intensive firms registered in industries that are not considered intangible as a whole, as well as physical and semi-intangible product-intensive firms in industries that traditionally been considered to be intangible. Figure 5.3 shows the classification of eleven industries according to their firms´ LOIs.[21] To compute the mean LOI of value of each industry, all available observations of firms registered in the respective industry on the CRSP-Compustat database, over a period of 41 years (1966–2006) in a study

[21] A detailed classification scheme of 72 (out of 81) two-digit industries from the US standard industrial classification (SIC) scheme is presented later.

sample of 10,162 corporations.

Figure 5.3: Example of Industries Classified by the Intangibility of Their Products/Outputs According to the LOI of their Firms (Years 1966-2006).



5.2.4 Exemplifying the computation of the level of operating intangibility with actual financial statements

In databases such as COMPUSTAT and Thomson, the financial statements of companies from many different fields are normalized into the same database format in accordance with the aim of financial reporting comparability. However, databases collect the genuine financial statements of firms, and the LOI proxy could also be quantified directly from the income and cash flow statements provided by each firm. The study's sample comprises 41 years: 1966–2006. For illustration, financial statements of the more recent years of 2008 and 2009 will be used. Observe the case of Wal-Mart. Wal-Mart, which is a discount department store chain company that sells many different products and thus creates a market of many products in each store. Note that the description of revenues in the company's income statement makes a distinction between net sales revenues versus membership and other forms of income. The latter entry could be referring to intangible service sales. However, from net sales, we can obtain only an aggregated value referring to a set that includes physical goods, semi-intangible products, and intangible products. It is not possible to directly decompose this rubric. Furthermore, product sales frequently include tangible goods and intangible components in a single transaction.

The operating income statement enables a useful decomposition for our purposes as it separates the cost of sales, which we can use as a proxy for the cost of tangible goods sold (i.e., $286,350 million for Wal-Mart in 2008; $306,158 million in 2009) from the value allocated to selling, general, and administrative expenses ($70,174 million in 2008; $76,651 million in 2009). The value of amortization and depreciation is identified in the cash flow statement ($6,317 million in 2008; $6,739 million in 2009). To identify the proxy for intangible related expenses, the value of amortization and depreciation is subtracted from the selling, general, and administrative expenses (the values thus obtained are $63,857 million for 2009 and $69,912 million for 2009)[22]. The LOI is a proxy for operating decisions that does not require information regarding non-operating expenses. Applying the formula in (3), Wal-Mart's LOI proxy was 0.179 in 2008 and 0.183 in 2009. An analysis of the primary sample yields a mean LOI of 0.27 for the firms in sample, leading to the conclusion that Wal-Mart should be placed on the physical-goods intensive side of the LOI scale. Therefore, although Wal-Mart could be considered a service retail firm, its material physical goods component is relatively substantial.

22 Note that in the COMPUSTAT database, the selling, general, and administrative expense values are already deducted from the amortization and depreciation value.

Table 5.1- Exemplifying the computation of the LOI Proxy with Wal-Mart's original financial statements from Years 2008 and 2009 (in million dollars)*

	2008	**2009**
Revenues		
Net sales	374,307	401,244
Membership and other income	4,169	4,363
Costs and Expenses		
Cost of sales	286,350	306,158
Selling, general and administrative expenses	70,174	76,651
Operating income	21,952	22,798
Interest		
Debt	1,863	1,896
Capital leases	240	288
interest income	-309	-284
interest, net	1,794	1,900
Income from continuing operations		
before income taxes and minority interest	20,158	20,898
Net income	12,731	13,400
Cash Flow Statement Information		
Depreciation and amortization	6,317	6,739
Proxy Construction		
	2008	**2009**
Product Sales Proxy	378,476	405,607
Cost of Goods Sold Proxy	286,350	306,158
Proxy Intangible Related Expenses	63,857	69,912
Depreciation and Amortization Proxy	6,317	6,739
Operating Income	21,952	22,798
Financial and Other Revenues/Expenses Proxy	-1,794	-1,900
Income before taxation	20,158	20,898
Taxation	6,889	7,145
Income for the period	13,269	13,753
LOI PROXY	0.179	0.183

* Financial statement information obtained from www.walmart.com

The following calculations explain how the LOI proxy can be obtained for Wal-Mart in the years 2008 and 2009. Applying the formula in 5.3:

$$\text{Proxy: } LOI = \frac{\text{Selling Expenses + General Expenses + Administrative Expenses}}{\text{Total Operating Expenses}} =$$

$$= \quad 1- \frac{\text{Cost of Good Solds+ Amortizations + Depreciations}}{\text{Total Operating Expenses}}$$

$$LOI_{Wall-Mart\ 2008} = \frac{70{,}174 - 6{,}317}{70{,}174 + 286{,}350} = 1 - \frac{286{,}350 + 6{,}317}{70{,}174 + 286{,}350} = 0.179$$

$$LOI_{Wall-Mart\ 2009} = \frac{76{,}651 - 6{,}739}{76{,}651 + 306{,}158} = 1 - \frac{306{,}158 + 6{,}739}{76{,}651 + 306{,}158} = 0.183$$

$$fLOI$$

Microsoft Corporation offers another interesting example, in part because it takes greater care than Wal-Mart in detailing its expenses in its income statement (see Table 5.2). Once again, the sales of Microsoft appear aggregated on a single rubric. Thus, such a rubric does not offer substantial information that can be used to classify the firm according to the products it sells. However, because the cost structure is presented in a detailed manner, we can use it to analyze the tangibility of the outputs produced and sold.

Microsoft's income statement conveys the cost of goods sold ($11,598 million in 2008; $12,155 million in 2009) while the value of amortization and depreciation can be found in the cash flow statement ($2,056 million in 2008; $2,562 million in 2009). Again, the value of amortization and depreciation should be subtracted from the general and administrative expenses (a total of $5,127 million in 2008 and $3,700 million in 2009). We integrate the net-value of general and administrative expense in the proxy for intangible related expenses. Microsoft's income statement describes other expenses that we can integrate into a proxy for intangible related expenses: R&D expenses ($8,164 million in 2008; $9,010 million in 2009); sales and marketing expenses ($13,260 million in 2008; $12,879 million in 2009); and employee severance ($330 million in 2009).[23] Table 5.II confirms that the values of operating income and net income are the same after the proxy constructions. Accordingly, Microsoft's LOI proxy values for 2008 and 2009 were 0.642 and 0.613, respectively, which puts this corporation squarely on the intangible product intensive end of the LOI classification system.

[23] In the COMPUSTAT database, these expenses would be incorporated in the Selling, General, and Administrative Expense rubric, which is also subtracted from amortization and depreciation values.

Table 5.2 - Exemplifying the computation of the LOI Proxy with Microsoft's original financial statements from years 2008 and 2009 (in million dollars)*

	2008	2009
Revenue	60,420	58,437
Operating expenses:		
Cost of revenue	11,598	12,155
Research and development	8,164	9,010
Sales and marketing	13,260	12,879
General and administrative	5,127	3,700
Employee severance		330
Total operating expenses	38,149	38,074
Operating income	22,271	20,363
Other income (expense)	1,543	-542
Income before income taxes	23,814	19,821
Provision for income taxes	6,133	5,252
Net income	17,681	14,569
Cash Flow Statement Information		
Depreciation, amortization, and other noncash items	2,056	2,562
Proxy Construction		
	2008	2009
Product Sales Proxy	60,420	58,437
Cost of Goods Sold Proxy	11,598	12,155
Proxy Intangible Related Expenses	24,495	23,357
Depreciation and Amortization Proxy	2,056	2,562
Operating Income	22,271	20,363
Financial and Other Revenues/Expenses Proxy	1,543	-542
Income before taxation	23,814	19,821
Taxation	6,133	5,252
Income for the period	17,681	14,569
LOI PROXY	0.642	0.613

*Financial statement information obtained from www.microsoft.com

Table 5.3 compares Wal-Mart and Microsoft with two other well known companies: Shell and Coca-Cola. Shell, a vendor of petroleum products, is an example of a firm that would be on the physical goods intensive end of the LOI scale system. Its LOI proxy value is indeed quite low (0.079 in 2008; 0.048 in 2009) as would be expected for a company in which physical goods are the dominant component of the operating expenses incurred in its business model. On the other hand, though, one might at first sight think of Coca-Cola as a company that is focused mainly on sales of physical goods, Coca Cola has LOI proxy values (0.464 in 2008; 0.458 in 2009) that are much higher than those of Wal-Mart. These relatively high values fit with a business model that is based not only on the tangibility of the bottles and the liquid drinks sold, which the firm often subcontract to other firms, but also on notable intangible related expenses, such as branding, customer outreach campaigns, and service production.

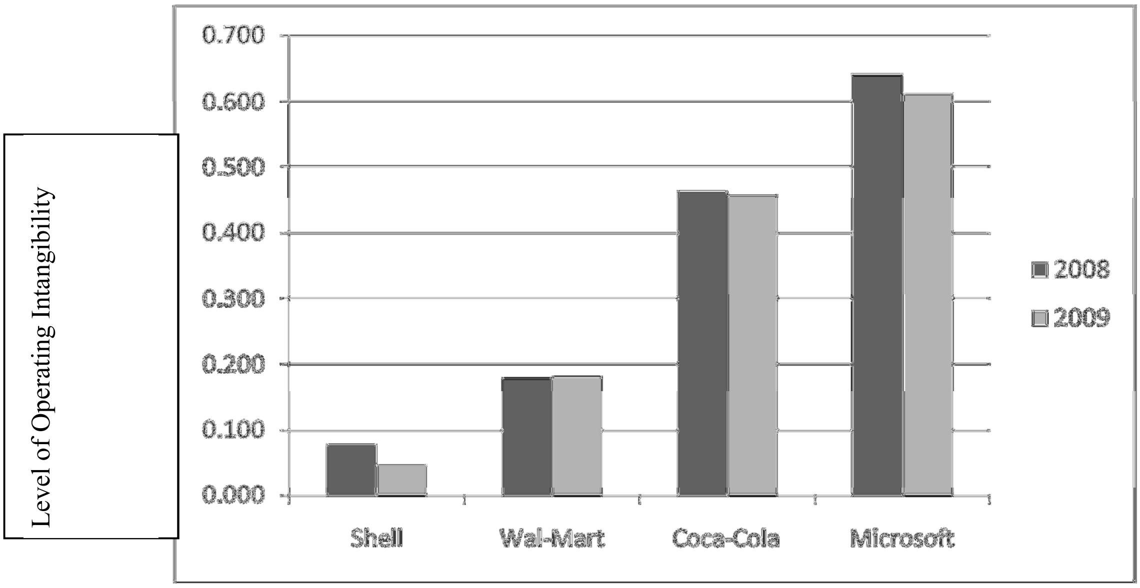
Table 5.3: Comparing the LOI Proxies computed with the original financial statements of well known companies from Years 2008 and 2009 (in million dollars)*

	Shell 2008	Shell 2009	Wal-Mart 2008	Wal-Mart 2009	Coca-Cola 2008	Coca-Cola 2009	Microsoft 2008	Microsoft 2009
Product Sales Proxy	278,188	458,361	378,476	405,607	31,944	30,990	60,420	58,437
Cost of Goods Sold Proxy	228,376	385,152	286,350	306,158	11,374	11,088	11,598	12,155
Proxy Intangible Related Expenses	20,733	20,131	63,857	69,912	10,896	10,435	24,495	23,357
Depreciation and Amortization Proxy	14,458	13,656	6,317	6,739	1,228	1,236	2,056	2,562
Operating Income	14,621	39,422	21,952	22,798	8,446	8,231	22,271	20,363
Financial and Other Revenues/Expenses Proxy	6,399	11,398	-1,794	-1,900	-940	715	1,543	-542
Income before taxation	21,020	50,820	20,158	20,898	7,506	8,946	23,814	19,821
Taxation	8,302	24,344	6,889	7,145	1,632	2,040	6,133	5,252
Income for the period	12,718	26,476	13,269	13,753	5,874	6,906	17,681	14,569
LOI PROXY	0.079	0.048	0.179	0.183	0.464	0.458	0.642	0.613

Financial statement information of Cocal-Cola obtained in www.thecoca-colacompany.com. Financial statement information from SHELL obtained in www.shell.com.

Figure 5.4 illustrates the LOI proxies (for 2008 and 2009) of the four companies exemplified above: Wal-Mart, Microsoft, Shell, and Coca-Cola. Note that the LOI proxies of each firm tend to exhibit low modification; a substantial change in a firm's LOI would only be expected to occur following a substantial change in a firm's business model. This stability characteristic will be later confirmed in larger samples containing many observations of many diverse firms.

Figure 5.4- Exemplifying the calculation of the Level of Operating Intangibility Proxy with the financial statement of well known corporations. *



* The graphic on Figure 5.4 compares the Level of Operating Intangibility proxy of the years 2008 and 2009 that was computed directly with information obtained from the financial statements of four well known firms: SHELL; Wal-Mart; Coca-Cola and Microsoft. The information used is described in table 5.3

5.3 Conclusion of the chapter

The following chapters examine empirically the theoretical prediction that firms partially organize themselves according to the operating needs arising from the flows of products they sell. The research strategy was to create replicable hypotheses that could later be tested by any researcher interested in the topic. The studied hypotheses enhance our link between operating, investing, and financing decisions and further demonstrate the intangible flow dynamics of product production and sales. The hypotheses connect the tangibility of a firm's flows of products (outputs) with the five economic characteristics documented by Rajan and Zingales (1995) as describing or correlating with the capital structure. Concretely, the hypotheses formalized and tested in the next two chapters probe empirically whether higher LOI is associated with five expected characteristics of intangible-product-intensive firms: i) smaller size; ii) lower capital expenditures in property, equipment, and production facilities; iii) lower profitability; iv) higher stock market valuation of equity (market-to-book); and v) less leverage.

6- Methodological strategy with testable hypotheses relating operating intangibility and organizational characteristics[24]

6.1 General approach

This chapter formulates hypothesis to test the theoretical prediction derived from intangible theory that *corporations partially organize themselves according to the operating needs associated with the tangibility of the flows of products used to generate material cash flows through sales to customers.* Intangible flow theory is a grounded theory, developed through a collection of facts and formalized for subsequent testability of its predictions, an ultimate goal of the grounded theory method (see Goulding, 2002; and Charmaz, 2006). It is also a theory that aims to explain the practice observed in organizational phenomena assuming that social life is an ongoing production and thus emerges through people's recurrent actions (as described by Feldman and Orlikowski, 2011). Intangible flow theory can also be classified as a heterodox economic theory, in the sense that attempts to explain economic phenomena, while criticizing neoclassical economics and its methodological framework (see Lawson 2006). Thus, testable hypothesis that can be replicated by any social scientist interested in the topic qualify for the fact gathering, practice oriented and heterodox spirit of intangible flow theory.

Through the quantification of the level of operating intangibility, the last chapter identified a solution for inferring the tangibility of a firm's flow of products. However, it is still necessary to identify economic indicators that could describe how firms are organized. One solution is to use the characteristics studied

[24] Part of this chapter is integrated in Cardao-Pito (2010b)

in Rajan and Zingales (1995): i) size of the cash flow generated through sales; ii) capital expenditures on property, equipment, and facilities; iii) profitability; iv) stock market valuation of equity (market-to-book); and v) leverage, that is debt as proportion of the capital structure. The empirical implementation of these variables is presented further bellow. On one hand Rajan and Zingales (1995) is the key reference for control variables in neoclassical financial economics studies involving a firm's capital structure (e.g.: Baker and Wurgler, 2004; Alti, 2006; Lemmon et al, 2008).

On one hand, neoclassical economics systematically relegates the operating activities of the firms to its conceptualization of the firm as a black box full of intangible elements that could not be quantified. However, one may be able to empirically observe that heavy physical good production (e.g.: cars or washing machines) requires dimensioned factories, and, thus, substantial investments in property, equipment and plant. Therefore, a physical good intensive firm may need sizeable cash flows through sales to keep operating, and considerable external financial sources to proceed with future investments. One the other hand, a firm exclusively selling intangible products such as services (e.g.: consultancy or soliciting services) might have distinct characteristics. It may be able to function with small physical space, and few tangible investments. Furthermore, it may be able to keep working while generating minor cash flows through sales, and few, if any, sources of external financing.

Nevertheless, as prescribed by the Modigliani, Miller, and Fisher framework of the firm (Modigliani and Miller, 1958), the dominant capital structure explanations, such as the trade-off theory, pecking order theory and market timing, assume a separation between operating and financing (and investing) decisions (e.g.: Myers, 2001; Baker and Wurgler, 2002). Such an assumption is a major foundation of those theories through which corporations are considered to be homogeneous black boxes.

Yet, one could posit another possibility: the empirical non verification of the separability assumption. This being as the case, some scholars could have been developing theoretical constructions on non verified fundamental assumption. This could in part explain the divorce between academics and practitioners regarding capital structure explanations, identified in the aforementioned surveys (e.g.: Graham and Harvey, 2001; Beattie et al, 2006). The dominant separability assumption of neoclassical financial economics founds large blocks of the respective theory. Nevertheless, such assumption cannot stand comfortably with the corroboration of any of the five hypotheses formalized in the current chapter. If a separation between operating and investing (and financing) decisions would empirically occur, then it would not be possible for operating decisions to be directly reflected in a firm's capital structure and other economic characteristics known to partially explain a firm’s financial choices.

However, before inquiring into the statistical associations of the level of operating intangibility, one should note that the operating intangibility concept requires the previous concepts of human related intangible flow and intangible flow dynamics, which are components of the intangible flow theory, and were not captured by previous theories. For instance, the mathematical/quantitative research methodologies employed in neoclassical economics could not be prepared to formulate the concept of operating intangibility, and thus predict its statistical associations.

To give another example, despite the merits of its contributions, the resource based view of the organization (as formulated by Wernerfelt, 1984; and Barney, 1991; or implemented by Ployhart et al, 2011) does not make a clear separation between resources (or assets), and intangible products that must be consumed when produced; or a clear distinction between persons, and dynamic human related intangible flows that are quintessential in reaching the operating intangibility concept. Kraaijenbrink et al (2010, p. 349) note that the resource based view research community might have ‘clung to an inappropriately narrow neoclassical economic rationality, thereby diminishing its opportunities for progress.’

On the other hand, what is called by its authors *service dominant logic* (Vargos and Lusch, 2004, 2006) would not be able to predict the statistical associations of LOI because it claims that the differences between goods and services are mere myths that are remnants from a goods based manufacturing logic. Accordingly goods would be mere distribution mechanisms for service provision. Therefore, this logic would not expect major differences between the firms according to the type of products they are selling, because all firms would be service firms, all economies would be service economies, and the differences between services and goods would be nonexistent. However, customers who buy physical goods have concrete needs associated with the tangibility of the goods bought (e.g.: food, clothes, etc.).

Furthermore, intangible flow theory is a concrete alternative to formulations that refer to people as human capital or human assets (e.g.: Becker, 1962; Ditman et al, 1973; Barro, 2001; Subramaniam and Youndt, 2005; Ciccone and Peri, 2006; Argyres, 2011; Ployhart et al, 2011). To call people assets or capital would be very convenient in terms of the mathematical parameterization of human beings, which by this manner could be homogenized through mathematical functions. However, besides serious ethical issues with these metaphors, there is no scientific evidence that people are either assets or capital, and these eventually flawed comparisons may sabotage the understanding of intangible flow dynamics in economy and society. The separation between people and assets, and people and capital is quite important in intangible flow theory. According to intangible flow theory, there is no scientific demonstration that people are assets or capital, but it is fair to say that without the intervention of people the assets and capital would most rarely generate further cash flows only by themselves, as the flows of economic material elements such as the flows of cash and physical goods are consummated by human related intangible flows. Furthermore, a distinction of people and human related intangible flows seems useful to understand why people produce intangible flows such as services or communication flows that are not assets or capital, thus cannot be captured by a balance sheet approach, but generate cash flows and costs than can be captured in the cash flow and income statements.

6.2 Hypotheses

6.2.1 Level of operating intangibility and firm size

The first hypothesis studies whether the inherent constraints of product flow tangibility might be reflected in firms' size of sales values. The variable commonly identified in economics as size, or firm size, describes the magnitude of the monetary turnover generated through the sales of products to customers. The material cash flows generated can be considered tangible flows because they can be precisely quantified to an exact-value (Cardao-Pito, 2004, 2010). Regardless of the form that a cash flow may assume, the exact amount of money that has been moved is knowable. In the same manner, through the cash flow statement, a corporation presents a precise report of its complete cash movements during each fiscal period. Even if linked to distinct symbolic referents and social systems, the material practice of money is one of its defining properties (Gilbert 2005). That is, even though money can have several social roles and meanings, which are debated by social scientists, it also has a pragmatic nature in the modalities of exchange and circulation (Maurer, 2006).

As noted previously, no product sale is completely tangible (Rathmel, 1966). While some firms may trade utterly intangible products (e.g.: pure services), firms dealing in physical goods may trade both tangible and intangible flows of products with their customers (e.g.: selling services, marketing), and thus they may require costly organizational infrastructures to deal with the physical goods. This reasoning is congruent with the enduring economic concept of break-even (e.g.: Dean, 1948; Charnes et al, 1963). As is well known, a firm accomplishes the break-even point when its revenue function equals its cost function. A firm is unable to survive if it remains below the break-even point for many years, due to insolvency. Without loss of generality, one may observe that, in recent years, the sales values of two of the largest intangible product intensive firms (i.e., Microsoft and Oracle) have been rather small compared with those of large physical good intensive firms (i.e., Ford and Shell). Physical good intensive firms may thus require larger economies of scale to function well. Thus, one may expect that

H1: The size of a firm tends to decrease with an increase in its level of operating intangibility.

6.2.2 Level of operating intangibility and firm investment profile

The second hypothesis, which is related to the first, tests whether product intangibility is associated with less capital expenditure for material physical infrastructure being required for producing and/or handling flows of physical goods, such as investments in tangible long-term (fixed) assets. The tangibility of the flows of products may create the need for a firm to invest in material devices necessary for its production and handling such as property, equipment, and facilities. Economic calculation is not an anthropological fiction, precisely because it is not a purely human mechanical and mental competence; it is distributed among human actors and material devices (Callon and Muniesa, 2005). As noted by Volkof et al (2007), when embedded in technology, social aspects, such as routines and roles, acquire a material aspect. Furthermore, the findings of Kerstein and Kim (1995) may lead one to infer that firms of differing sizes have different levels of capital expenditure. Therefore, one may find that

H2: The investments in property, equipment and facilities of a firm tend to decrease with an increase in its level of operating intangibility.

If empirically confirmed, both the first and second hypotheses demonstrate direct relationships between operating and investing decisions.

6.2.3 Level of operating intangibility and firm profitability

Porter (2008, 1979) has suggested that rivalry, threat of substitute products, barriers to entry into the market, or supplier and buyer power could be forces affecting a firm's capacity to generate economic rent if one draws the boundaries of an industry correctly, which can be relatively difficult to do given that industry boundaries can be instable and continuously shifting. For example, firms registered in the agriculture industry that exclusively sell high tech fertilizers compete with firms registered in the chemical and allied products industry that sell high tech fertilizers, not with other agricultural firms that sell and produce corn or beans. The analysis of the flows of products at a firm level can eventually contribute to further research regarding Porter's (2008, 1979) 'five forces'. The incorporation of product-oriented R&D expenses in LOI might be a major driver inducing the correlation with profitability. An association between R&D intensity and negative profitability has been described previously (Darrough and Ye, 2007). Furthermore, R&D intensity and products' technological novelty have been associated with higher uncertainty (Rindova and Petkova, 2007; Kothari et al, 2002; Armstrong et al, 2007). Min et al (2006) studied 264 new industrial product-markets to compare survival risks in markets that were started with a really new product versus an incremental innovation. When the pioneer starts a new market with a really new product, it can be a major challenge just to survive. In contrast, in markets started by an incremental innovation, market pioneer survival risks are much lower. Interestingly, early followers have the same survival risk across both types of markets. Apart from the previously identified R&D factor in the studies referred above, there has not been other empirical evidence reported suggesting that higher intangible product-intensive firms would necessarily be less profitable than lower intangible product-intensive firms. Yet, Evans (1987a and 1987b) indicates that firm growth decreases at a diminishing rate with its size, and former studies have generally ignored the relationship between the size of a firm and the type of products it sells. Thus, the following hypothesis is studied:

H3: The profitability of a firm tends to decrease with an increase in its level of operating intangibility.

6.2.4 Level of operating intangibility and firm market valuation

Since product intangibility is directly perceivable by a firm's investors, analysts, and customers, LOI could be associated with higher market-to-book ratios because it is known that stock market investors attributed higher stock prices to other dimensions of intangibility, such as R&D intensity measures (e.g.: Lev and Sougiannis, 1996; Chan et al, 2001; Chambers et al, 2002) or membership in industries considered to be intangible (e.g Core et al, 2003). Hence, the following hypothesis is tested:

H4: The market-to-book ratio of a firm tends to increase with an increase in its level of operating intangibility.

6.2.5 Level of operating intangibility and firm capital structure

If corroborated, any of the above hypotheses could offer strong evidence to question the empirical validity of the separability assumption. If operating decisions are associated with the economic characteristics that Rajan and Zingales (1995) demonstrated to partially explain capital structures, then, it is necessary to attribute an explanatory role to the operating decisions. Through testing a direct relationship between LOI and leverage, the fifth hypothesis moves further in identifying the operating decisions' importance. The fifth hypothesis suggests a direct association between product flow tangibility and the proportion of debt in a firm's capital structure, which further exhibits the empirical non verification of the separability assumption, which is a fundamental assumption of neoclassical economic studies involving organizations. There are at least two channels through which the tangibility of a firm's flows of products (outputs) might directly affect its capital structure: i) The collateral value associated with physical-good tangibility and related investments offers protection against default to lenders when negotiating debt contracts (see Jimenez et al, 2006). For instance, in the extreme case of default, a creditor may eventually take possession of fixed assets, physical goods, and raw materials. However, as suggested by this thesis, the inherent characteristics of services and other products prevent them from being considered as assets (see also Cardao-Pito, 2004, 2010). Therefore, creditors cannot take possession of services and other products in the same manner in which they would hold material economic elements such as physical goods or cash. ii) The need for external financial sources for highly tangible investments that could be felt less as product-intangibility rises. Self financing is generally considered to be the preferred source of a firm's financing (e.g.: Graham and Harvey, 2001; Fama and French, 2005), and product sales are the principal mechanisms for generating the operating material cash in-flows. If, contrary to the more physical-good-intensive firms, higher intangible-product-intensive firms could more often manage to finance their investments without obtaining external capital (e.g.: debt, equity or hybrid securities), then this ability would have an impact on their capital structures. Thus, the following hypothesis is proposed:

H5: The weight of debt on a firm's capital structure (financial capital) tends to decrease with an increase in its level of operating intangibility.

6.3 Econometric design for inquiring the empirical verification of the hypotheses

To compute the LOI, two inputs are required: the total amount of intangible-related expenses, and total operating expenses. The principal proxy used for computing the LOI is the one described on equation 5.3, and exemplified in the last chapter. Appendix 1 describes the expenses included in the proxy's numerator when using the merged COMPUSTAT/CRESP database. The instrumental *LOI* variable should not be confused with the theoretical definition summarized in equation 5.1. As noted before, this particular solution might be altered in future research.

The proxy is promptly applicable to large samples because it can be computed directly from the financial statements. Two alternative specifications will also be tested: First, a proxy excluding amortizations and depreciations, as those items are mainly part of the investment cycle (empirically denoted as the *LOI_EXC_A&D* variable). Second, to understand how the effects of other kinds of intangible-related expenses might differ from R&D, the LOI proxy is subdivided into an amount excluding R&D and the R&D component of LOI (variables empirically denoted as *LOI_EXC_R&D* and *R&D_IN_LOI,* respectively).

The sample employed comprises a great many firms and years (see following chapters). For robustness over both firm and year effects, we employ Fama and Macbeth's (1973) regressions with standard errors corrected by the Newey-West (1983) approach. As control for serial correlation, Fama and MacBeth's (1973) procedure estimates the main model in the cross-section for each year using ordinary least squares (OLS) and then computes a time-series average and statistical significance (based on the estimated coefficients) using each period as an independent observation. The standard errors are then computed using the time-series variation with a correction for the auto-correlation between the coefficient estimates over time. Besides the serial correlation problem, the yearly regressions computed by the Fama and Macbeth procedure also addresses the economic problem of comparing observations over a period of several decades. Factors such as accounting policies, business environment, political structure, characteristics of markets, type of firms in the sample, etc., may have a different impact in 1966 compared to 2006. For robustness, we compute cross-sectional models controlling for firm and year fixed effects and clustering the standard errors at firm level.

H1-H5 test whether the increase in the *LOI* is associated with: i) smaller size; ii) lower capital expenditure; iii) lower profitability; iv) higher market-to-book ratio, and therefore, v) less leverage. For each hypothesis, the generic hypothesis testing model is adopted:

$$ECONOMIC\_CHARACTERISTIC_{i,t} = \beta_1 + \alpha_1 LOI_{i,t} + \alpha_2 INTANGIBLE\_ASSETS_{i,t} + \sum_{i=1}^{4} \lambda_i CONTROL\_VARIABLE_{i,t} + \varepsilon_{i,t}$$

(Equation 6.1)

Where:

$$ECONOMIC\_CHARACTERISTIC_{i,t} \in \{\ SIZE_{i,t};$$
$$CAPEX\_PPE_{i,t}; PROFITABILITY_{i,t}; LEVERAGE_{i,t};$$
$$MARKET\_TO\_BOOK_{i,t}\}$$

The inferences are made with α_1, taking as a reference point the economic variables in Rajan and Zingales (1995), plus the intangible assets, to control the models. The utilization of these control variables is grounded on the reasoning that a valid indicator of intangible-product-intensity should be able to provide information not directly observable in such characteristics. The economic variables are defined as follows: i) *SIZE* is the logarithm of the sales, after sales values have been deflated by the consumer price index.[25] ii) *CAPEX_PPE* are the capital expenditures in the tangibles property, plant and equipment expressed as a fraction of total assets; although Rajan and Zingales (1995) used initially total property, equipment and plant divided by total assets, their calculation could be affect by different amortizations and depreciation policies of different firms, whereas, the capital expenditures in the same items must be registered in accounting in the moment they occurs for all firms. Moreover, the models already have a variable for intangible assets as a proportion of total assets. Nonetheless, in the robustness procedures, the initial variable computed by Rajan and Zingales (1995) is also tested. iii) *PROFITABILITY* is the net income divided by total assets. In robustness procedures, the ration of operating income to total assets is

[25] The deflation of sale values by the consumer price index is not relevant for the Fama-Macbeth procedure, but is relevant for one of the robustness procedures and the Spearman's correlations.

also tested. iv) *LEVERAGE* is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt sheets. In the robustness procedures the computation of this variable is also made using the market value of equity. v) *MARKET_TO_BOOK* is the market-value divided by the book value of the equity. The *INTANGIBLE_ASSETS* variable is the ratio of intangible assets to total assets. Note that it would be an economic error to put both LOI and R&D in same model, as R&D is already inside the LOI (see definition on section 5.2.2). Thus the R&D impact would affect two coefficients and respective t-values. Nevertheless, a model will be produced that isolates R&D from the other intangible related expenses in LOI, to study both effects.

For robustness, additional econometric specifications will be implemented such as cross-sectional models controlling for firm and year fixed effects, models controlling for random effects through general least squares and maximum likelihood estimators, models computing population averages, and clustering standard errors by firm, models with and without outlier observations, or models with and without missing value observations.

7. Empirical hypothesis testing on the primary sample (Compustat/CRSP database)[26]

7.1 Introduction

For robustness, the empirical tests were conducted on two different samples. The sample called primary sample is a dataset with observations from a large number firms registered in the USA's major stock exchanges, over several decades. It was obtained from CRSP-Compustat database. Later, the empirical tests were repeated and confirmed for other sample with firm/year observations many firms from several other countries' economies. The secondary sample was obtained from the Worldscope/Thomson Datastream Database. This chapter and the following chapter present empirical results obtained from the primary sample. The study of the secondary/international sample will be presented in chapter 9.

7.2 Primary sample

Given the high availability of income and cash flow statements used to compute the LOI proxy, it was possible to analyze an asymptotically large sample of firms described in Table 7.1. The observations for the primary sample were obtained from the merged CRSP-COMPUSTAT database, which contains a total of 251,112 firm-year observations for the years 1950-2006. After eliminating firms not listed in the NYSE, AMEX or NASDAQ exchanges, 177,256 observations remained. Eliminating the period 1950-1960 that had few usable firm/yearly observations, resulted in 167,772 observations. Removing irregular observations and firms following specific accounting systems (without the required data fields)

[26] Part of this chapter is included in Cardao-Pito (2010b) and mentioned in Cardao-Pito (2010a).

yielded 118,356 observations. The observations eliminated were those that have no values for the variables required for this study, or have inscriptions that are not numerical quantifications of the variable, such as '.', or did not comply with the following criteria: total assets >0 ; sales >0; selling, general and administrative expenses >0; operating income before amortizations and depreciations is not missing; operating income is not missing; net income is not missing; stock price at end of fiscal period >0; number of outstanding shares at end of fiscal period >0; shareholders' book value of equity >0; note that this automatically eliminates the firms following specific accounting systems that do not verify the above fields. After eliminating observations where the *LOI* could not be computed or fell outside the interval [0,1], the sample contained 118,135 observations. Finally, there was an elimination of outlier observations with values in the top or bottom 1% of the size, profitability, leverage, and market–to-book distributions, and those in the top 1% of tangible fixed assets and intangible assets. The resulting sample had 107,070 observations, from 10,162 different firms, which enables the implementation of a very robust empirical analysis.

Table 7.1
Primary sample selection

Sample Selection	Firm/Year Observations
Initial CRSP-COMPUSTAT Sample (years 1950-2006)	251,112
After eliminating firms not listed on NYSE, AMEX or NASDAQ	177,256
After eliminating observations for the years 1950-1965	167,772
After setting criteria for the data necessary to the study, which eliminates irregular observations and the firms following specific accounting systems	118,356
After eliminating observations where the LOI could not be computed, or was outside the interval [0,1]	118,135
Final sample after eliminating outliers on the variables Size, Capital Expenditures in Property, Plant and Equipment, Profitability, Leverage, Intangible Assets and Market to Book	107,070
	=======
Number of Firms in the Final Sample	10,162
	=======

*Note: The sample for this study was obtained from CRSP and COMPUSTAT databases. The Table presents the stages in sample selection.

Table 7.2 describes the number of observations used by each fiscal year. One can observe that the number of usable observations in the database is larger in the most recent decades. For each year, Table 7.2 also reports the number of firms that were in the previous year sample, the number of firms that were not on previous year sample, and the number of firms that are not in the next year sample.

Table 7.2 – Observations/ Firms used by Year

Year	Observations/Firms used for this year	Firms that were in previous year sample	Firms that were not in previous year sample	Firms that are not in next year sample
1966	821			9
1967	974	812	162	24
1968	1088	950	138	43
1969	1223	1,045	178	20
1970	1345	1,203	142	24
1971	1454	1,321	133	41
1972	1881	1,413	468	79
1973	2042	1,802	240	267
1974	1882	1,973	107	64
1975	2064	1,974	246	97
1976	2114	1,975	147	131
1977	2076	1,976	93	123
1978	2101	1,977	148	144
1979	2085	1,978	128	138
1980	2073	1,979	126	140
1981	2108	1,980	175	126
1982	2156	1,981	174	121
1983	2331	1,982	296	186
1984	2376	1,983	231	208
1985	2376	1,984	208	258
1986	2420	1,985	302	252
1987	2487	1,986	319	283
1988	2460	1,987	256	289
1989	2404	1,988	233	215
1990	2418	1,989	229	188
1991	2531	1,990	301	163
1992	2764	1,991	396	195
1993	3519	1,992	950	301
1994	3803	1,993	585	409
1995	3942	1,994	548	441
1996	4114	1,995	613	545
1997	4061	1,996	492	603
1998	3910	1,997	452	624
1999	3783	1,998	497	618
2000	3752	1,999	587	505
2001	3675	2,000	428	370

2002	3728	2,001	423	316
2003	3810	2,002	398	382
2004	3829	2,003	401	395
2005	3832	2,004	398	891
2006	3258	2,005	317	

*Note: the table describes the number of firms/observations used each year, and for each year reports firms that were and were not in previous year sample and firms that are not in next year sample.

7.3 Univariate analysis

Table 7.3 presents descriptive statistics of the variables studied. Over the entire sample, the *LOI* has mean of 27% and standard deviation of 17%. Excluding amortizations and depreciations in *LOI_EXC_A&D* only slightly increases those values (29%; 18%). The decomposition of *LOI* into *R&D_IN_LOI* and *R&D_EXC_LOI* shows that R&D contributes only 3 percentage points to the mean *LOI* (27%); that is, around 11% of the average firm's intangible-related expenses, which provides support for the claim that we can gain from integrating the study of R&D expenses with other intangible related expenses necessary to produce and sell products to customers.

Both *R&D_TO_TOTAL_ASSETS* and *INTANGIBLE_ASSETS* variables represent very small percentages of total assets (3% and 6% respectively, averaged over the complete sample). Recall that as described before, because there are products such as services, which are intangible, heterogeneous, perishable and generally must be consumed when produced (Zeithaml et al ,1985; Zeithaml et al, 2006; Hoffman and Bateson, 2006; McColl-Kennedy, 2003; Wilson et al, 2008), their properties preclude their being registered as assets in the balance sheet. Therefore, they could not be captured by an asset method approach.

Moreover, an empirical problem related to using intangible asset or R&D variables as measures of intangible intensity is also described in Table 7.2. One can observe that many observations have zero or missing values. For the variables *R&D_TO_SALES, R&D_TO_TOTAL_ASSETS* and *INTANGIBLE_ASSETS* the mean for the 25th percentile is zero. Furthermore, the median is zero for all prior quantitative measures.

These results are consistent with Cohen and Klepper (1992) who, by constructing probability distributions of R&D intensity in several manufacturing industries, found that the largest concentration occurred near the zero value. This probably indicates that many firms are not engaged in relevant R&D activities and some firms do not report R&D values in an extra note to their income statement. Therefore, when researchers exclusively use either R&D or intangible assets to categorize firms, they base their analysis on variables having quite a limited range. Researchers have to decide whether they will eliminate the observations with missing values in R&D or intangible assets or consider missing values equal to zero. If the objective is to study the effect of R&D or asset intangible intensity on other variables, the researcher must either throw away valuable information or risk erroneously classifying many intangible-intensive firms that simply do not report or engage in R&D. The same problem does not occur with the LOI proxy, because it is computed with the information available from the mandatory income and cash flow statements. Therefore, the LOI proxy can be computed for nearly every firm, the condition being the existence of the respective financial statements. Thus, with the LOI proxy, the researcher can avoid the subjective decision of either eliminating the observations with missing values or consider them equal to zero.

Table 7.3
Descriptive statistics*

Variable	Mean	Std. Dev.	25 th Pctl.	Median	75th Pctl.
LOI	0.27	0.17	0.15	0.24	0.37
LOI_EXC_A&D	0.29	0.18	0.16	0.25	0.39
LOI_EXC_R&D	0.24	0.14	0.14	0.22	0.33
R&D_IN_LOI	0.03	0.07	0.00	0.00	0.03
RD_TO_SALES	0.03	0.14	0.00	0.00	0.02
RD_TO_TOTALS_ASSETS	0.03	0.05	0.00	0.00	0.03
INTANGIBLE_ASSETS	0.06	0.11	0.00	0.00	0.06
SIZE	5.55	1.79	4.22	5.43	6.75
CAPEX_PPE	0.06	0.06	0.02	0.05	0.09
PROFITABILITY	0.03	0.10	0.01	0.04	0.08
LEVERAGE	0.32	0.24	0.11	0.31	0.49
MARKET_TO_BOOK	2.18	1.85	1.00	1.61	2.66

*Notes:

Table 7.3 reports descriptive statistics of the variables used.

The LOI measures are defined as follows: a) *LOI* is the general proxy for the Level of Operating Intangibility, defined as selling, general and administrative expenses (excluding amortizations and depreciations) divided by total operating expenses; b) *LOI_EXC_A&D* is an alternative proxy where selling, general and administrative expenses (excluding amortizations and depreciations) are divided by total operating expenses excluding amortizations and depreciations; c) *R&D_IN_LOI* is the ratio of R&D expenses to total operating expenses; d) *LOI_EXC_R&D* is equal to *LOI* minus *R&D_IN_LOI*.

The measures of intangible intensity used in prior literature are defined as follows: 1) *RD_TO_SALES* is R&D divided by sales; 2) *R&D_TO_TOTAL_ASSETS* is R&D divided by total assets; 3) *INTANGIBLE_ASSETS* is the ratio of intangible assets to total assets on the balance sheet.

The variables identifying economic characteristics of corporations are defined as follows: 1) *SIZE* is the logarithm of the market-value of equity, 2) *CAPEX_PPE* is the value of the capital expenditures in property, plant and equipment expressed as a fraction of total assets, 3) *PROFITABILITY* is measured as net income divided by total assets, 4) *LEVERAGE* is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt, and 5) *MARKET_TO_BOOK* is the market-value of equity divided by the book value of equity.

Figure 7.1 and Table 7.4 reports the evolution of mean LOI in sample by year. The results allow comparing the full sample, with the top 30% and lower 30% LOI percentile values each year. It is observable that mean LOI in sample has increased at a consistent path from 1966 until 2006. After the 80s of the last century, a faster increase has occurred. From 1966 to 2006, mean LOI increased from 0.16 to 0.31. Such increase seems to have occurred also in the top LOI percentiles where for the 30% observations with higher LOI each year, mean LOI increased from 0.34 to 0.56. From 2004 to 2006 a decrease in mean LOI appears to have occurred on the yearly samples. Nonetheless, for firms with lower mean LOI each year (30% percentile), where are included firms focused on selling tangible physical goods, there was a much smaller increase in its mean LOI from 1966 to 2006, from 0.08 to 0.1, that is still an increase of 20%, but only 2% of total operating costs devoted to intangible related activities.

Figure 7.1 Evolution of mean LOI in sample by year, for full sample, top 30% and lower 30% percentiles.

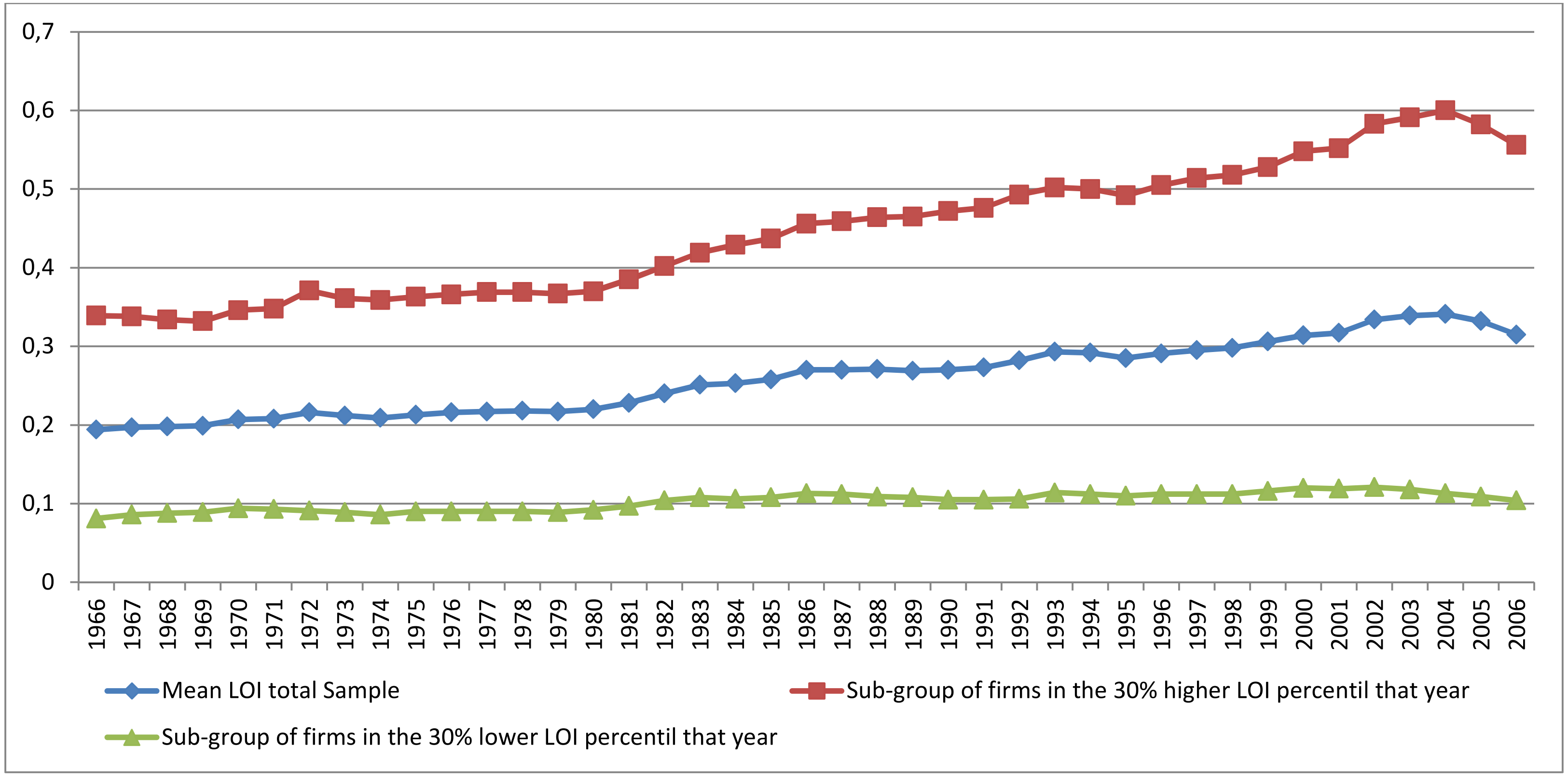


Table 7.4 Evolution of mean LOI in sample by year, for full sample, top 30% and lower 30% percentiles.

Fiscal Year	Mean LOI total Sample	Mean LOI Sub-group of firms in the 30% higher LOI 173percentile that year	Mean LOI Sub-group of firms in the 30% lower LOI 173percentile that year
1966	0.19	0.34	0.08
1967	0.20	0.34	0.09
1968	0.20	0.33	0.09
1969	0.20	0.33	0.09
1970	0.21	0.35	0.09
1971	0.21	0.35	0.09
1972	0.22	0.37	0.09
1973	0.21	0.36	0.09
1974	0.21	0.36	0.09
1975	0.21	0.36	0.09
1976	0.22	0.37	0.09
1977	0.22	0.37	0.09
1978	0.22	0.37	0.09
1979	0.22	0.37	0.09
1980	0.22	0.37	0.09
1981	0.23	0.39	0.10
1982	0.24	0.40	0.10
1983	0.25	0.42	0.11
1984	0.25	0.43	0.11
1985	0.26	0.44	0.11
1986	0.27	0.46	0.11
1987	0.27	0.46	0.11
1988	0.27	0.46	0.11
1989	0.27	0.47	0.11
1990	0.27	0.47	0.11
1991	0.27	0.48	0.11
1992	0.28	0.49	0.11
1993	0.29	0.50	0.11
1994	0.29	0.50	0.11
1995	0.29	0.49	0.11
1996	0.29	0.51	0.11
1997	0.30	0.51	0.11
1998	0.30	0.52	0.11
1999	0.31	0.53	0.12
2000	0.31	0.55	0.12
2001	0.32	0.55	0.12

2002	0.33	0.58	0.12
2003	0.34	0.59	0.12
2004	0.34	0.60	0.11
2005	0.33	0.58	0.11
2006	0.32	0.56	0.10

Note: The table reports the evolution of mean LOI in sample by year for full sample, top 30% and lower 30% LOI percentile values each year.

7.4 Multivariate analysis

7.4.1 Correlation analysis

Table 7.5 reports Spearman's correlation coefficients for the variables studied. The two alternative specifications *LOI* (mean: 0.27) and *LOI_EXC_A&D* (mean 0.29) have coefficients of 99%. Hence, it is fair to conclude that the exclusion of the amortizations and depreciations from the proxy is not an especially relevant matter. The same occurs with the exclusion of R&D expenses from the proxy, as the correlation of *LOI_EXC_R&D* (mean: 0.24) with the initial *LOI* proxy is still 95%. Given these high correlation coefficients, the regression analysis produces similar results when those variables are substituted for one another.

We observe strong empirical associations between *LOI* and the other variables referred to in the hypothesis, which are in the direction of the stated hypotheses. Accordingly, *LOI* has Spearman's correlation coefficient of -0.307 with *SIZE,* -0.249 with *CAPEX_PPE,* -0.095 with *PROFITABILITY,* 0.243 with *MARKET_TO_BOOK,* and -0.212 with *LEVERAGE*. Similar correlation coefficients can be found with the alternative proxies *LOI_EXC_A&D* and *LOI_EXC_R&D*.

Therefore, we observe two features of the Spearman's associations. The first is that the correlation provides initial evidence for the posited hypotheses (1-5). The second is that despite the strong associations between the LOI proxies and those variables, we cannot say that the LOI is the exclusive explanatory factor, as the correlations between LOI proxies and the hypothesis variables are not complete.

We should also observe that the LOI is not a substitute indicator for previous intangible intensity indicators because it offers different information about firms. The correlation between *LOI* and *R&D_TO_TOTAL_ASSETS* or *R&D_TO_SALES* is similarly approximately 0.360. Nonetheless, LOI_EXC_R&D has only a correlation of approximately 0.150 with the same variables. Moreover, clearly, LOI is not an indicator for book intangible assets, as each LOI proxies has only an approximate correlation of 0.06 with *INTANGIBLE_ASSETS*. Hence, LOI offers additional information to the previous intangible intensity indicators, with a new method based on firm specific product information.

Table 7.5 Spearman's correlation coefficients between variables*

	LOI	*LOI_ EXC_ A&D*	*LOI_ EXC_ RD*	*R&D_ IN_ LOI*	*R&D_ TO_ SALES*	*R&D_ TOTAL_ ASSTS*	*INTANGIBLS_ ASSETS*	*SIZE*	*CAPEX_ PPE*	*PROFITABILITY*	*LEVERAG*	*MARKET_ TO_ BOOK*
LOI	**1.000**											
LOI_EXC_A&D	**0.987**	**1.000**										
LOI_EXC_ R&D	**0.952**	**0.938**	**1.000**									
R&D_IN_LOI	**0.368**	**0.359**	**0.158**	**1.000**								
R&D_TO_SALES	**0.368**	**0.359**	**0.158**	**1.000**	**1.000**							
R&D_TO_TOTAL_ASSETS	**0.355**	**0.344**	**0.148**	**0.994**	**0.994**	**1.000**						
INTANGIBLE_ASSETS	**0.061**	**0.054**	**0.060**	**0.058**	**0.058**	**0.047**	**1.000**					
SIZE	**-.307**	**-.315**	**-.293**	**-0.080**	**-0.085**	**-0.081**	**0.172**	**1.000**				
CAPEX_PPE	**-.249**	**-.210**	**-.272**	**0.075**	**0.073**	**0.082**	**-0.065**	**0.150**	**1.000**			
PROFITABILITY	**-.095**	**-.105**	**-.087**	**0.053**	**0.039**	**0.055**	**-0.023**	**0.161**	**0.294**	**1.000**		
LEVERAGE	**-.212**	**-.206**	**-.134**	**-0.325**	**-0.323**	**-0.322**	**0.050**	**0.206**	**-0.103**	**-0.352**	**1.000**	
MARKET_TO_BOOK	**0.243**	**0.251**	**0.189**	**0.202**	**0.197**	**0.192**	**0.116**	**0.029**	**0.124**	**0.303**	**-0.171**	**1.000**

*Notes:
1. Table 7.5 reports the Spearman's correlation coefficients between the variables used in this study.
2. A bold in a correlation coefficient denotes a p-value lower than 0.01%. Therefore, all correlations in the table have very strong p-value that is lower than 0.01%.
3. The LOI measures are defined as follows: a) *LOI* is the general proxy for the Level of Operating Intangibility, defined as selling, general and administrative expenses (excluding amortizations and depreciations) divided by total operating expenses; b) *LOI_EXC_A&D* is an alternative proxy where selling, general and administrative expenses (excluding amortizations and depreciations) are divided by total operating expenses excluding amortizations and depreciations; c) *R&D_IN_LOI* is the ratio of R&D expenses to total operating expenses; d) *LOI_EXC_R&D* is equal to *LOI* minus *R&D_IN_LOI*.
4. The measures of intangible intensity used in prior literature are defined as follows: 1) *RD_TO_SALES* is R&D divided by sales; 2) *R&D_TO_TOTAL_ASSETS* is R&D divided by total assets; 3) *INTANGIBLE_ASSETS* is the ratio of intangible assets to total assets on the balance sheet.
5. The variables identifying economic characteristics of corporations are defined as follows: 1) *SIZE* is the logarithm of the market-value of equity, 2) *CAPEX_PPE* is the value of the capital expenditures in property, plant and equipment expressed as a fraction of total assets, 3) *PROFITABILITY* is measured as net income divided by total assets, 4) *LEVERAGE* is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt, and 5) *MARKET_TO_BOOK* is the market-value of equity divided by the book value of equity.

7.4.2 Regression tests

Tables 7.6 to 7.11 present the results of the empirical analysis of the five hypotheses. The results obtained are robust to the inclusion of the other economic variables in Rajan and Zingales (1995) and the *INTANGIBLE_ASSETS* in the models. As explained before, the Fama-Macbeth procedure, with standard errors corrected by the Newey-West approach, is an econometric specification addressing the problem of serial correlation in the observations.

7.4.2.1 The level of operating intangibility and a firm's size

The results in Table 7.6 support H1: *the size of a firm decreases with an increase in its level of operating intangibility*. The general *LOI* proxy has a coefficient of −2.382 with a *t*-value of −8.87, while the *LOI_EXC_A&D* has a coefficient of −2.387 with a *t*-value of −10.7. Both proxies are significantly associated with size at the 1% level. Separating R&D expenses from all other intangible-related expenses in the *LOI* reveals an interesting relationship: *LOI_EXC_R&D* is negatively associated with size (coefficient of −2.694; *t*-value of −10.13), while *R&D_IN_LOI* is not significantly associated with size (-0.133; -0.12).

Thus, as expected from the tangibility constraints that are inherent in the break-even functions, the physical good-intensive firms tend to generate more cash flow through sales than firms focused on selling intangible products. As noted before, no product sale is completely tangible. However, while intangible product intensive firms may have constraints mainly related to their intangible production system, the physical good intensive firms have substantial constraints arising both from their tangible and intangible components of their production system. Therefore, the decrease in the LOI should be associated with an increase in the size of the sales of the firm. Attributing illustrative examples, firms focused on exclusively selling consulting services to customers tend to be smaller than firms producing highly tangible airplanes or buildings.

Moreover, it seems particularly relevant to observe from the LOI decomposition that the R&D expenses are not statistically associated with smaller firm size, which may denote the incorporation of R&D in the physical goods of several larger tangible products intensive firms. For instance, firms producing high tech cars or sport equipments can be selling highly tangible goods which have been enhanced by a substantial R&D effort.

Table 7.6

The association between *level of operating intangibility* and *size**

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	5.511***	5.520***	5.534***	4.840***	4.843***	4.794***
	(47.74)	(48.16)	(49.07)	(35.76)	(35.69)	(34.73)
LOI	-.382***					
	(-8.87)					
LOI_EXC_A&D		-.387***				
		(-10.7)				
LOI_EXC_R&D			-.694***			
			(-10.13)			
R&D_IN_LOI			0.133			
			(0.12)			
R&D_TO_SALES				-0.269		
				(-0.21)		
R&D_TO_TOTAL_ASSETS					-0.720	
					(-0.71)	
INTANGIBLE_ASSETS	0.891*	0.948*	0.970*	0.549	0.544	0.581
	(1.77)	(1.92)	(1.96)	(0.96)	(0.95)	(1.01)
CAPEX_PPE	0.454	0.793	0.376	1.706***	1.695***	1.760***
	(0.9)	(1.56)	(0.77)	(2.77)	(2.76)	(2.82)
PROFITABILITY	4.271***	4.184***	4.427***	4.651***	4.751***	4.918***
	(11.28)	(11.11)	(11.77)	(13)	(13.44)	(14.98)
LEVERAGE	1.365***	1.362***	1.456***	1.634***	1.635***	1.707***
	(9.19)	(9.34)	(10.07)	(10.04)	(9.73)	(9.73)
MARKET_TO_BOOK	-0.020	-0.017	-0.030	-0.072	-0.073	-0.082*
	(-0.42)	(-0.36)	(-0.6)	(-1.52)	(-1.53)	(-1.78)
R Squared	0.168***	0.172***	0.173***	0.130***	0.129***	0.125***
T-Value R-Squared	(7.28)	(7.72)	(7.41)	(7.47)	(7.45)	(7.03)
Observations	107,070					
Firms	10,162					
Beginning Year	**1966**					
End Year	**2006**					

*Notes:

1. Table 7.6 presents results for estimating equations using the Fama and Macbeth (1973) specification, and correcting the *t*-values by the Newey and West (1987) approach (41-year sub-samples: 1966-2006).

2. The regression model is:

$$\begin{aligned} SIZE_{i,t} &= \beta_1 + \alpha_1 INTANGIBLE\_INTENSITY\_MEASURE_{i,t} \\ &+ \alpha_2 INTANGIBLE\_ASSETS_{i,t} + \lambda_1 CAPEX\_PPE_{i,t} \\ &+ \lambda_2 PROFITABILITY_{i,t} + \lambda_3 LEVERAGE_{i,t} \\ &+ \lambda_4 MARKET\_TO\_BOOK_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{2a}$$

Where,

$$\begin{aligned} &INTANGIBLE\_INTENSITY\_MEASURE_{i,t} \in \{LOI_{i,t}; LOI\_EXCL\_A\&D_{i,t}; \\ &(LOI\_EXCL\_R\&D_{i,t} + R\&D\_IN\_LOI_{i,t}); R\&D\_TO\_SALES_{i,t}; \\ &R\&D\_TO\_TOTAL\_ASSETS_{i,t}; 0\} \end{aligned}$$

(2b)

3. The LOI measures are defined as follows: a) *LOI* is the general proxy for the Level of Operating Intangibility, defined as selling, general and administrative expenses (excluding amortizations and depreciations) divided by total operating expenses; b) *LOI_EXC_A&D* is an alternative proxy where selling, general and administrative expenses (excluding amortizations and depreciations) are divided by total operating expenses excluding amortizations and depreciations; c) *R&D_IN_LOI* is the ratio of R&D expenses to total operating expenses; d) *LOI_EXC_R&D* is equal to *LOI* minus *R&D_IN_LOI*.
4. The measures of intangible intensity used in prior literature are defined as follows: 1) *RD_TO_SALES* is R&D divided by sales; 2) *R&D_TO_TOTAL_ASSETS* is R&D divided by total assets; 3) *INTANGIBLE_ASSETS* is the ratio of intangible assets to total assets on the balance sheet.
5. The variables identifying economic characteristics of corporations are defined as follows: 1) *SIZE* is the logarithm of the market-value of equity, 2) *CAPEX_PPE* is the value of the capital expenditures in property, plant and equipment expressed as a fraction of total assets, 3) *PROFITABILITY* is measured as net income divided by total assets, 4) *LEVERAGE* is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt, and 5) *MARKET_TO_BOOK* is the market-value of equity divided by the book value of equity.
6. The symbols *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively. Coefficient estimates and *t*-statistics are reported in the table.

7.4.2.2 The level of operating intangibility and a firm's investments in property, equipment and plant

Table 7.7 presents results supporting H2: *The investments in property, equipment and facilities of a firm tend to decrease with an increase in its level of operating intangibility.* The *LOI* proxy has a coefficient of −0.084 with a *t*-value of −13.96, while the *LOI_EXC_A&D* has a coefficient of −0.054 with a *t*-value of −9.47. Hence, both proxies are significant at the 1% level. The *R&D_IN_LOI* is not statistically significant, even at the 10% level (−0.012; -0.71). The *LOI_EXC_R&D,* however, is statistically associated with less capital expenditure (coefficient of −0.093; and *t*-value of −16.00).

Hence, a concrete association between the intangibility of the products sold by a firm and its investment profile is documented. As expected, firms more focused on selling tangible products (e.g.: cars, machines) tend to make larger investments in the long term tangible infrastructure. The higher investments in property, plant and equipment are likely to be associated with the needs associated with handling the physical goods. Naturally, physical goods may need tangible factories to be produced, tangible storage facilities to be kept and large trucks to be transported, whilst the production of services may dispense those types of investments.

Furthermore, once again the decomposition of the LOI enables us to observe that the R&D expenses are not statistically associated with a firm's investment profile. This may further denote the incorporation of R&D in several physical good or semi-intangible products.

Table 7.7
The association between *level of operating intangibility* and *investments in property, equipment and plant**

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	0.069***	0.060***	0.070***	0.040***	0.042***	0.039***
	(12.92)	(11.89)	(13.34)	(8.14)	(8.5)	(7.97)
LOI	-.084***					
	(-13.96)					
LOI_EXC_A&D		-.054***				
		(-9.47)				
LOI_EXC_R&D			-.093***			
			(-16.00)			
R&D_IN_LOI			-0.012			
			(-0.71)			
R&D_TO_SALES				-0.017**		
				(-2.15)		
R&D_TO_TOTAL_ASSETS					-.063***	
					(-5.37)	
INTANGIBLE_ASSETS	-0.026**	-.032***	-0.022**	-.042***	-.043***	-.042***
	(-2.65)	(-3.66)	(-2.08)	(-4.87)	(-5.02)	(-4.86)
SIZE	0.000	0.001	0.000	0.002***	0.002***	0.002***
	(0.71)	(1.35)	(0.59)	(2.82)	(2.78)	(2.88)
PROFITABILITY	0.054**	0.058***	0.059***	0.065***	0.062***	0.070***
	(2.54)	(2.74)	(2.78)	(3.03)	(2.84)	(3.4)
LEVERAGE	-0.001	0.002	0.001	0.006	0.004	0.007
	(-0.13)	(0.17)	(0.11)	(0.61)	(0.38)	(0.78)
MARKET_TO_BOOK	0.009***	0.008***	0.009***	0.007***	0.007***	0.007***
	(5.93)	(5.59)	(6.01)	(5)	(5.15)	(4.84)
R Squared	0.101***	0.082***	0.103***	0.065***	0.066***	0.063***
T-Value of R-Squared	(10.41)	(9.5)	(10.67)	(7.88)	(7.98)	(7.5)
Observations	107,070					
Firms	10,162					
Beginning Year	**1966**					
End Year	**2006**					

*Notes:

1. Table 7.7 represents results for estimating equations using the Fama and Macbeth (1973) specification, and correcting the *t*-values by the Newey and West (1987) approach (41-year sub-samples: 1966-2006).
2. The regression model is:

$$CAPEX\_PPE_{i,t} = \beta_1 + \alpha_1 INTANGIBLE\_INTENSITY\_MEASURE_{i,t}$$
$$+\alpha_2 INTANGIBLE\_ASSETS_{i,t} + \lambda_1 SIZE_{i,t}$$
$$+\lambda_2 PROFITABILITY_{i,t} + \lambda_3 LEVERAGE_{i,t}$$
$$+\lambda_4 MARKET\_TO\_BOOK_{i,t} + \varepsilon_{i,t} \tag{2a}$$

Where,

$$INTANGIBLE\_INTENSITY\_MEASURE_{i,t} \in \{LOI_{i,t}; LOI\_EXCL\_A\&D_{i,t};$$
$$(LOI\_EXCL\_R\&D_{i,t} + R\&D\_IN\_LOI_{i,t}); R\&D\_TO\_SALES_{i,t};$$
$$R\&D\_TO\_TOTAL\_ASSETS_{i,t}; 0\}$$

(2b)

3. The LOI measures are defined as follows: a) *LOI* is the general proxy for the Level of Operating Intangibility, defined as selling, general and administrative expenses (excluding amortizations and depreciations) divided by total operating expenses; b) *LOI_EXC_A&D* is an alternative proxy where selling, general and administrative expenses (excluding amortizations and depreciations) are divided by total operating expenses excluding amortizations and depreciations; c) *R&D_IN_LOI* is the ratio of R&D expenses to total operating expenses; d) *LOI_EXC_R&D* is equal to *LOI* minus *R&D_IN_LOI*.
4. The measures of intangible intensity used in prior literature are defined as follows: 1) *RD_TO_SALES* is R&D divided by sales; 2) *R&D_TO_TOTAL_ASSETS* is R&D divided by total assets; 3) *INTANGIBLE_ASSETS* is the ratio of intangible assets to total assets on the balance sheet.
5. The variables identifying economic characteristics of corporations are defined as follows: 1) *SIZE* is the logarithm of the market-value of equity, 2) *CAPEX_PPE* is the value of the capital expenditures in property, plant and equipment expressed as a fraction of total assets, 3) *PROFITABILITY* is measured as net income divided by total assets, 4) *LEVERAGE* is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt, and 5) *MARKET_TO_BOOK* is the market-value of equity divided by the book value of equity.
6. The symbols *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively. Coefficient estimates and *t*-statistics are reported in the table.

7.4.2.3 The level of operating intangibility and a firm's profitability

The results in Table 7.8 offer support to H3: *The profitability of a firm tends to decrease with an increase in its level of operating intangibility.* The *LOI* proxy has a coefficient of –0.055 with a *t*-value of –3.26, while *the LOI_EXC_A&D* has a coefficient of –0.057 with a *t*-value of –3.63. Thus both proxies are significant at the 1% level. Separating *R&D_IN_LOI* from *LOI_EXC_R&D* reveals that the former is less strongly associated with profitability (coefficient −0.01; *t*-value −1.07) than the latter (−0.260; −7.3).

Hence, the profit growth rate of firms with different LOI appears to be distinct. These results are congruent with a further deviation from Gibrat´s rule of proportioned growth stating that the size of a firm and its growth rate are independent (Gibrat, 1931), already shown in Evans (1987a, and 1987b). The homogeneity of growth amongst firms with different sizes is not verified in the sample. What is more, former studies tended to ignore that a firm's size is correlated with the type of products sold to customers.

Nonetheless, the statistical association between LOI and profitability is weaker than with the other economic variables, and is further driven by the R&D in LOI. Further research may explain why firms incorporating high levels of R&D in their products are less profitable than the other firms. One might suggest that a product (output) framework might be quite useful in understanding the R&D impact, as the former analysis in the literature has been done with an asset/investment perspective (e.g.: Darrough and Ye, 2007; Chan et al, 2001; Lev and Sougiannis, 1996; Kothari et al, 2002; Armstrong et al, 2007). Darrough and

Ye (2007) already noted that R&D intensive firms tended to be less profitable. However, the results of the current thesis do not seem excessively supportive of the idea present in Darrough and Ye, Frazen et al (2007) or Lev and Zarowin (1999) that, sooner or later, expending funds on R&D will automatically imply high profits in the future. Indeed, a negative association between R&D and profitability was observed in the sample.

Table 7.8
The association between *level of operating intangibility* and *profitability**

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	0.024**	0.025**	0.018	0.013	0.019	-0.002
	(2.26)	(2.42)	(1.54)	(0.93)	(1.62)	(-0.13)
LOI	-.055***					
	(-3.26)					
LOI_EXC_A&D		-.057***				
		(-3.63)				
LOI_EXC_R&D			-0.010			
			(-1.07)			
R&D_IN_LOI			-.260***			
			(-7.3)			
R&D_TO_SALES				-.232***		
				(-14.86)		
R&D_TO_TOTAL_ASSETS					-.374***	
					(-5.23)	
INTANGIBLE_ASSETS	0.002	0.004	-0.005	-0.005	-0.008	-0.001
	(0.21)	(0.37)	(-0.46)	(-0.48)	(-0.67)	(-0.1)
SIZE	0.009***	0.009***	0.009***	0.009***	0.009***	0.011***
	(6.58)	(6.55)	(6.43)	(6.22)	(6.47)	(5.74)
CAPEX_PPE	0.026	0.034*	0.034*	0.046***	0.037**	0.059***
	(1.33)	(1.96)	(1.88)	(3.26)	(2.39)	(4.64)
LEVERAGE	-.117***	-.117***	-.128***	-.122***	-.132***	-.110***
	(-10.56)	(-10.48)	(-15.75)	(-10.86)	(-18.2)	(-8.04)
MARKET_TO_BOOK	0.010***	0.010***	0.010***	0.010***	0.011***	0.008***
	(10.41)	(10.38)	(12.8)	(9.45)	(12.61)	(6.53)
R Squared	0.248***	0.250***	0.272***	0.286***	0.287***	0.235***
T-Value of R-Squared	(7.69)	(7.82)	(10.07)	(11.35)	(12.19)	(6.56)
Observations	107,070					
Firms	10,162					
Beginning Year	**1966**					
End Year	**2006**					

*Notes:

1. Table 7.8 presents results for estimating equations using the Fama and Macbeth (1973) specification, and correcting the *t*-values by the Newey and West (1987) approach (41-year sub-samples: 1966-2006).
2. The regression model is:

$$PROFITABILITY_{i,t} = \beta_1 + \alpha_1 INTANGIBLE\_INTENSITY\_MEASURE_{i,t}$$
$$+\alpha_2 INTANGIBLE\_ASSETS_{i,t} + \lambda_1 SIZE_{i,t}$$
$$+\lambda_2 CAPEX\_PPE_{i,t} + \lambda_3 LEVERAGE_{i,t}$$
$$+\lambda_4 MARKET\_TO\_BOOK_{i,t} + \varepsilon_{i,t} \tag{2a}$$

Where,

$$INTANGIBLE\_INTENSITY\_MEASURE_{i,t} \in \{LOI_{i,t}; LOI\_EXCL\_A\&D_{i,t};$$
$$(LOI\_EXCL\_R\&D_{i,t} + R\&D\_IN\_LOI_{i,t}); R\&D\_TO\_SALES_{i,t};$$
$$R\&D\_TO\_TOTAL\_ASSETS_{i,t}; 0\}$$

(2b)

3. The LOI measures are defined as follows: a) *LOI* is the general proxy for the Level of Operating Intangibility, defined as selling, general and administrative expenses (excluding amortizations and depreciations) divided by total operating expenses; b) *LOI_EXC_A&D* is an alternative proxy where selling, general and administrative expenses (excluding amortizations and depreciations) are divided by total operating expenses excluding amortizations and depreciations; c) *R&D_IN_LOI* is the ratio of R&D expenses to total operating expenses; d) *LOI_EXC_R&D* is equal to *LOI* minus *R&D_IN_LOI*.
4. The measures of intangible intensity used in prior literature are defined as follows: 1) *RD_TO_SALES* is R&D divided by sales; 2) *R&D_TO_TOTAL_ASSETS* is R&D divided by total assets; 3) *INTANGIBLE_ASSETS* is the ratio of intangible assets to total assets on the balance sheet.
5. The variables identifying economic characteristics of corporations are defined as follows: 1) *SIZE* is the logarithm of the market-value of equity, 2) *CAPEX_PPE* is the value of the capital expenditures in property, plant and equipment expressed as a fraction of total assets, 3) *PROFITABILITY* is measured as net income divided by total assets, 4) *LEVERAGE* is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt, and 5) *MARKET_TO_BOOK* is the market-value of equity divided by the book value of equity.
6. The symbols *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively. Coefficient estimates and *t*-statistics are reported in the table.

7.4.2.4 The level of operating intangibility and a firm's market to book ratio

Table 7.9 provides results supporting H4: *The market-to-book ratio of a firm tends to increase with a decrease in its level of operating intangibility.* The general *LOI* proxy has a coefficient of 3.047 with a *t*-value of 10.87, while the *LOI_EXC_A&D* has a coefficient of 2.796 with a *t*-value of 11.1. Thus, both proxies are significant at the 1% level. Separating *R&D_IN_LOI* from *LOI_EXC_R&D* reveals that the latter variable is more strongly associated in terms of t-value stats with high market valuations (coefficient of 2.238; *t*-value of 8.94) than the R&D in LOI (8.882; 7.9).

These results are aligned with the superior market valuation that previous researchers found to be associated with other indicators of intangible intensity, namely R&D intensity (e.g.: Lev and Sougiannis, 1996; Chan et al, 2001; Chambers et al, 2002) or membership in industries outlined as intangible (Core et al, 2003). The findings document that the intangibility of a firm's products, which is directly perceivable by investors, analysts and customers of the firm, is strongly associated with higher stock market valuation. It is an empirical fact that stock market investors attribute higher market valuation to firms focused on selling intangible intensive products. Investors should understand that the principal mechanism for a firm to generate operating cash flows is to trade products with customers. One can verify that during the time period 1966-2006, stock market investors clearly fastened the velocity of the stock price growth (as a proportion of the equity book price) when the level of product (output) intangibility increased.

Table 7.9
The association between *level of operating intangibility* and m*arket to book***

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	0.569**	0.623***	0.644***	1.568***	1.410***	1.847***
	(2.69)	(3.00)	(3.09)	(8.46)	(8.54)	(9.78)
LOI	3.047***					
	(10.87)					
LOI_EXC_A&D		2.796***				
		(11.1)				
LOI_EXC_R&D			2.238***			
			(8.94)			
R&D_IN_LOI			8.882***			
			(7.9)			
R&D_TO_SALES				7.668***		
				(4.04)		
R&D_TO_TOTAL_ASSETS					10.059***	
					(10.01)	
INTANGIBLE_ASSETS	0.505**	0.499**	0.725***	1.115***	1.193***	1.040***
	(2.14)	(2.1)	(3.16)	(4.71)	(4.96)	(4.24)
SIZE	0.010	0.011	-0.000	-0.037	-0.039	-0.045
	(0.21)	(0.24)	(0)	(-0.94)	(-1.01)	(-1.18)
CAPEX_PPE	4.873***	4.409***	4.605***	3.646***	3.782***	3.663***
	(23.01)	(25.88)	(22.17)	(23.28)	(24.6)	(19.84)
PROFITABILITY	5.244***	5.306***	5.539***	5.744***	5.879***	5.062***
	(4.23)	(4.23)	(4.7)	(4.43)	(4.78)	(3.54)
LEVERAGE	0.171	0.139	0.390**	0.090	0.311*	-0.216
	(0.91)	(0.71)	(2.34)	(0.41)	(1.82)	(-0.88)
R Squared	0.188***	0.186***	0.209***	0.160***	0.175***	0.123***
T-Value of R-Squared	(11.23)	(10.32)	(11.7)	(7.11)	(10.08)	(5.77)
Observations	107,070					
Firms	10,162					
Beginning Year	**1966**					
End Year	**2006**					

*Notes:
1. Table 7.9 presents results for estimating equations using the Fama and Macbeth (1973) specification, and correcting the *t*-values by the Newey and West (1987) approach (41-year sub-samples: 1966-2006).
2. The regression model is:

$$MARKET\_TO\_BOOK_{i,t} = \beta_1 + \alpha_1 INTANGIBLE\_INTENSITY\_MEASURE_{i,t}$$
$$+\alpha_2 INTANGIBLE\_ASSETS_{i,t} + \lambda_1 SIZE_{i,t}$$
$$+\lambda_2 CAPEX\_PPE_{i,t} + \lambda_3 PROFITABILITY_{i,t}$$
$$+\lambda_4 LEVERAGE_{i,t} + \varepsilon_{i,t} \tag{2a}$$

Where,

$$INTANGIBLE\_INTENSITY\_MEASURE_{i,t} \in \{LOI_{i,t}; LOI\_EXCL\_A\&D_{i,t};$$
$$(LOI\_EXCL\_R\&D_{i,t} + R\&D\_IN\_LOI_{i,t}); R\&D\_TO\_SALES_{i,t};$$
$$R\&D\_TO\_TOTAL\_ASSETS_{i,t}; 0\}$$

(2b)

3. The LOI measures are defined as follows: a) *LOI* is the general proxy for the Level of Operating Intangibility, defined as selling, general and administrative expenses (excluding amortizations and depreciations) divided by total operating expenses; b) *LOI_EXC_A&D* is an alternative proxy where selling, general and administrative expenses (excluding amortizations and depreciations) are divided by total operating expenses excluding amortizations and depreciations; c) *R&D_IN_LOI* is the ratio of R&D expenses to total operating expenses; d) *LOI_EXC_R&D* is equal to *LOI* minus *R&D_IN_LOI*.
4. The measures of intangible intensity used in prior literature are defined as follows: 1) *RD_TO_SALES* is R&D divided by sales; 2) *R&D_TO_TOTAL_ASSETS* is R&D divided by total assets; 3) *INTANGIBLE_ASSETS* is the ratio of intangible assets to total assets on the balance sheet.
5. The variables identifying economic characteristics of corporations are defined as follows: 1) *SIZE* is the logarithm of the market-value of equity, 2) *CAPEX_PPE* is the value of the capital expenditures in property, plant and equipment expressed as a fraction of total assets, 3) *PROFITABILITY* is measured as net income divided by total assets, 4) *LEVERAGE* is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt, and 5) *MARKET_TO_BOOK* is the market-value of equity divided by the book value of equity.
6. The symbols *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively. Coefficient estimates and *t*-statistics are reported in the table.

7.4.2.5 The level of operating intangibility and a firm's capital structure

Table 7.10 presents results supporting H5: *The weight of debt on a firm's capital structure tends to decreases with an increase in its level of operating intangibility.* The *LOI* proxy has a coefficient of −0.239 with a *t*-value of −6.18, while the *LOI_EXC_A&D* has a coefficient of −0.207 with a *t*-value of −6.41. Therefore, both proxies are significant at the 1% level. Separating *R&D_IN_LOI* from *LOI_EXC_R&D* shows that while the latter variable is highly significant, it is more weakly associated with lower leverage values (coefficient of −0.09; *t*-value of −3.44) than the *R&D_IN_LOI* (−1.021; −23.69).

Therefore, these results document that the LOI was an omitted correlated variable not only in Rajan and Zingales (1995), but also in all the subsequent capital structure studies that were limited to using the variables in Rajan and Zingales to control their models (e.g.: Frank and Goyal, 2003; Baker and Wurgler, 2002). Both here and in the robustness procedures, the LOI is demonstrated to be statistically associated with less leverage. Unlike what occurs for profitability where the R&D keeps driving the association when eliminating the observations with missing R&D values, the statistical association between the other intangible related expenses and leverage increase, whereas the association between the R&D in LOI and leverage decreases greatly (results tabulated in Table 7.10).

In financial economics, the main theories of a firm's capital structure are strongly supported by the separability assumption that financing decisions can be detached from operating (and investing) decisions. Already mentioned in Modigliani and Miller (1958) on such an assumption is founded the trade off theory, pecking order theory, market timing theory and guides product market literature. Nevertheless, the empirical testing of hypotheses 1 to 4 already provides material evidence of the non empirical verification of the separability assumption. It showed that a firm's level of operating intangibility is significantly statistically associated with economic characteristics known to partially explain the capital structure, namely, size, investment profile, profitability and market valuation. Hence, if decisions about operating products have an influence on these economic properties known to impact a firm's capital structure, it is legitimate to conclude that the operating decisions are reflected in financial decisions.

Yet, hypothesis 5 further advances our factual evidence that the separability assumption is not empirically verified in the sample, because it identifies a direct statistical association between operating and financing decisions. Therefore, one can verify that operating decisions have both indirect and direct consequences on the financial decisions. Naturally, the operating decisions are not the only factors affecting financial decisions, as the correlations between these decisions are not complete. Nevertheless, we demonstrate empirically that the mistake of assuming that financing decisions can be taken in isolation from the operational activities of the firm, as is done by the dominant theories of a firm's capital structure. One can then understand the serious limitations of considering corporations as homogenous black boxes into which are put operating activities. Previous theorists advised us that, if we wanted to understand a firm's capital structure, we must undermine such important activities as the operating management of firms, and important information such as the accounting information regarding operational activities.

However, the current empirical results seem to advise us in the opposite direction to neoclassical economics. Chapter 12 further discusses implications of these findings in terms of the study of financial phenomena.

Table 7.10
The association between *level of operating intangibility* and leverage*

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	0.323***	0.316***	0.294***	0.255***	0.270***	0.234***
	(23.93)	(23.46)	(19.7)	(11.67)	(14.29)	(9.61)
LOI	-.234***					
	(-6.18)					
LOI_EXC_A&D		-.207***				
		(-6.41)				
LOI_EXC_R&D			-.090***			
			(-3.44)			
R&D_IN_LOI			-.021***			
			(-23.69)			
R&D_TO_SALES				-.750***		
				(-6.9)		
R&D_TO_TOTAL_ASSETS					-.272***	
					(-16.03)	
INTANGIBLE_ASSETS	0.163***	0.163***	0.126**	0.119**	0.103*	0.138**
	(2.77)	(2.79)	(2.23)	(2.17)	(1.87)	(2.48)
SIZE	0.021***	0.022***	0.022***	0.025***	0.024***	0.027***
	(8.54)	(8.39)	(8.86)	(7.79)	(8.05)	(7.41)
CAPEX_PPE	-0.139	-0.099	-0.098	-0.046	-0.063	-0.032
	(-1.07)	(-0.82)	(-0.81)	(-0.42)	(-0.56)	(-0.3)
PROFITABILITY	-.147***	-.151***	-.199***	-.212***	-.231***	-.124***
	(-5.54)	(-5.55)	(-6.22)	(-6)	(-6.61)	(-5.12)
MARKET_TO_BOOK	0.002	0.002	0.006***	0.002	0.005**	-0.004
	(0.96)	(0.71)	(2.81)	(0.56)	(2.21)	(-1.07)
R Squared	0.234***	0.231***	0.269***	0.239***	0.270***	0.207***
T-Value of R-Squared	(10.82)	(10.32)	(18.08)	(10.4)	(19.18)	(7.84)
Observations	107,070					
Firms	10,162					
Beginning Year	**1966**					
End Year	**2006**					

*Notes:

1. Table 7.10 presents results for estimating equations (2a) using the Fama and Macbeth (1973) specification, and correcting the *t*-values by the Newey and West (1987) approach (41-year sub-samples: 1966-2006).

2. The regression model is:

$$LEVERAGE_{i,t} = \beta_1 + \alpha_1 INTANGIBLE\_INTENSITY\_MEASURE_{i,t}$$
$$+\alpha_2 INTANGIBLE\_ASSETS_{i,t} + \lambda_1 SIZE_{i,t}$$
$$+\lambda_2 CAPEX\_PPE_{i,t} + \lambda_3 PROFITABILITY_{i,t}$$
$$+\lambda_4 MARKET\_TO\_BOOK_{i,t} + \varepsilon_{i,t} \quad (2a)$$

Where,

$$INTANGIBLE\_INTENSITY\_MEASURE_{i,t} \in \{LOI_{i,t}; LOI\_EXCL\_A\&D_{i,t};$$
$$(LOI\_EXCL\_R\&D_{i,t} + R\&D\_IN\_LOI_{i,t}); R\&D\_TO\_SALES_{i,t};$$
$$R\&D\_TO\_TOTAL\_ASSETS_{i,t}; 0\}$$

(2b)

3. The LOI measures are defined as follows: a) *LOI* is the general proxy for the Level of Operating Intangibility, defined as selling, general and administrative expenses (excluding amortizations and depreciations) divided by total operating expenses; b) *LOI_EXC_A&D* is an alternative proxy where selling, general and administrative expenses (excluding amortizations and depreciations) are divided by total operating expenses excluding amortizations and depreciations; c) *R&D_IN_LOI* is the ratio of R&D expenses to total operating expenses; d) *LOI_EXC_R&D* is equal to *LOI* minus *R&D_IN_LOI*.

4. The measures of intangible intensity used in prior literature are defined as follows: 1) *RD_TO_SALES* is R&D divided by sales; 2) *R&D_TO_TOTAL_ASSETS* is R&D divided by total assets; 3) *INTANGIBLE_ASSETS* is the ratio of intangible assets to total assets on the balance sheet.

5. The variables identifying economic characteristics of corporations are defined as follows: 1) *SIZE* is the logarithm of the market-value of equity, 2) *CAPEX_PPE* is the value of the capital expenditures in property, plant and equipment expressed as a fraction of total assets, 3) *PROFITABILITY* is measured as net income divided by total assets, 4) *LEVERAGE* is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt, and 5) *MARKET_TO_BOOK* is the market-value of equity divided by the book value of equity.

6. The symbols *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively. Coefficient estimates and *t*-statistics are reported in the table.

7.5 Robustness checks

7.5.1 Former indicators of intangible intensity

Following a neoclassical economic doctrine without significant references to literature in organization sciences, sociology or heterodox economics, several papers have addressed the question of classifying firms according to their intangible-intensity. However, this intangible-intensity is a large umbrella that covers a variety of methods, which, though eventually interrelated, capture distinct aspects of a firm's life. Prior economic literature describes three methods, none of which is based on a firm's products: (a) intangible/tangible asset intensity (e.g.: Rajan and Zingales, 1995; Claessens and Laeven, 2003; Baker and Wurgler, 2004; Wyatt 2005); (b) R&D intensity (e.g.: Chambers et al, 2001; Kothari et al, 2002; Frazen et al, 2007; Darrough and Ye, 2007); and (c) industry classification (e.g.: Collins et al, 1997; Francis and Schipper, 1999; Core et al, 2003; Armstrong et al, 2007). No unifying concept of intangible intensity has been suggested for linking these methods; researchers tend to simply choose the path that best accommodates their needs. To demonstrate the difference between the traditional methods, one could ask which of the following corporations is the most intangibly intensive: a) Firm A that has many intangible assets, no R&D expenditures, and belongs to the agriculture industry; b) Firm B that has no intangible assets, large R&D expenditures, and belongs to the metallurgy industry; or c) Firm C that has no intangible assets, no R&D expenditures, and is registered in the educational services industry.

Three different approaches can produce three different answers. This problem would be expected to repeat itself again if we added a fourth method based on the products sold by the firms as such a method would be used to study a different dimension to those captured by the methods described above. However, a risk could exist that the *LOI* variable would be redundant with the former indicators of intangible intensity. Alternative models were computed for comparing LOI to previous intangible intensity measures: R&D to sales, R&D to total assets, and the sum of intangible assets reported on the balance sheet. The results exhibit evidence that the *LOI* has distinct empirical associations with the economic variables size, investments in property, facilities and equipment, profitability, market-to-book, and leverage. Therefore, the level of operating intangibility captures a distinctive economic characteristic of firms, which is the relation between intangible related with tangible related expenses, such as cost of goods sold or amortization and depreciations of long term tangible assets, in the productive operating system. The operational demands of generating cash flow through product sales have strong repercussions on a firm's structure, as product sales are a determining factor in every firm's life. In contrast, reported intangible assets represent a very small fraction of total assets and R&D is only indirectly related to the generation of cash flows. Furthermore, there are many intangible product-intensive firms with zero R&D (e.g.: firms dealing only in services) and several tangible product-intensive firms that invest deeply in R&D (e.g.: automobile manufacturers). Moreover, as explained by intangible flow theory, there are many products such as services and other intangible intensive products that have properties precluding them to be considered assets, capital, or resources, and thus would be invisible to an asset/Balance Sheet approach.

The negative profitability is more correlated with *R&D_TO_SALES* (t-value of -14.86) than any *LOI* indicator. However, at least one of the indicators in the subset {*LOI, LOI_EXCL_A&D,* and *(LOI_EXC_R&D* and *R&D_IN_LOI)}* has stronger statistical associations with the other four economic characteristics than any of the former intangible intensity measures. Moreover the *INTANGIBLE_ASSETS* variable is not statistically associated with *SIZE* (t-value: 1.01) or *PROFITABILITY* (t-value: -0.1), and it is statistically associated with more *LEVERAGE* (t-value: 2.48). On the other hand the problem of the scaling the R&D variable is reflected on the t-values. No R&D measure is statistically associated with smaller *SIZE* (the most significant t-value is merely 1.01). The scaling is indeed confirmed to be an important theoretical problem, as the variables *R&D_TO_TOTAL_ASSETS* and *R&D_TO_SALES* reflect very different magnitudes in their associations with the variables *CAPEX_PPE, PROFITABILITY, LEVERAGE* and *MARKET_TO_BOOK* (one t-value is always at least two times greater than the other).

7.5.2 Alternative econometric specification to control for the serial correlation between the observations

The empirical examination was conducted taking in consideration the possibility of using alternatives to the Fama Macbeth methodology implemented in the previous regression analysis. Accordingly, this section describes the results of a complementary econometric specification for the problem of serial correlation among firm/year observations: panel data analysis where fixed effects are considered. Hence, several cross-sectional models controlling for firm and year fixed effects were computed.

Table 7.11 presents the respective results. In each model a measure of intangible intensity was regressed on the five economic characteristics discussed in the thesis to study the statistical associations. A reading of the table allow us to identify additional support for the inferences previously made for hypotheses 1 to 5, due to the signs and magnitude of the coefficients.

The three LOI proxies, namely, *LOI*, *LOI_EXC_A&D* and *LOI_EXC_R&D* exhibit precisely the same statistical associations expected in the hypothesis and previously found with the Fama Macbeth procedure. The proxies are negatively associated with the variables *SIZE, CAPEX_PPE, PROFITABILITY* and *LEVERAGE* and positively associated with the variable *MARKET_TO_BOOK*. Despite the fact that in this framework the intangible intensity indicators were regressed on the entire set of economic characteristics studied in this thesis, all associations were statistically significant at the 1% level.

The table illustrates the important problem identified before of the need for a theoretical framework explaining the scaling of the variables, because the scaling can indeed lead to different results. In these findings, R&D scaled by sales is negatively associated with *SIZE*, whereas R&D scaled by total assets has a positive association with *SIZE* (contrary to the LOI proxies). As before, and contrary to the

LOI proxies, both R&D variables are positively associated with capital expenditures in property, equipment and plant. However, at two different significance levels, namely, 5% and 1%. The statistical associations with the variables *PROFITABILITY*, *LEVERAGE* and *MARKET_TO_BOOK* is the same as the one found using the Fama Macbeth approach. Yet, the t-values can once again exhibit substantial differences.

Moreover, as before, and similarly to the R&D variables, the *INTANGIBLE_ASSETS* variable exhibits statistical associations with the economic characteristics of firms that diverge from the associations of the LOI proxies, as the *INTANGIBLE_ASSETS* is positively associated with *SIZE* and *LEVERAGE* and negatively associated with *MARKET_TO_BOOK*.

Additionally, the direction and robustness of the coefficients were confirmed using alternative econometric specifications, controlling for random effects through general least squares or maximum likelihood estimators, and models with population averages and clustered standard errors by firm.

Table 7.11 – Operating intangibility, neoclassical measures of intangible intensity, and the economic characteristics of the firms – Alternative econometric specification with firm and year fixed effects.

	LOI	*LOI_EXC_A&D*	*LOI_EXC_R&D*	*R&D_TO_SALES*	*R&D_TO_TOTAL_ASSETS*	*INTANGIBLE_ASSETS*
Intercept	0.341***	0.363***	0.333***	0.074***	0.025***	-0.103***
	(208.63)	(200.02)	(184.37)	(36.28)	(38.22)	(-55.42)
SIZE	-0.011***	-0.012***	-0.013***	-0.005***	0.001***	0.029***
	(-39.09)	(-37.39)	(-41.84)	(-14.19)	(9.67)	(90.42)
CAPEX_PPE	-0.013***	-0.013***	-0.014***	0.014***	0.022***	-0.174***
	(-3.13)	(-2.81)	(-3.02)	(2.63)	(12.72)	(-36.06)
PROFITABILITY	-0.102***	-0.127***	-0.053***	-0.183***	-0.091***	-0.024***
	(-39.71)	(-44.6)	(-18.81)	(-56.74)	(-89.57)	(-8.26)
MARKET_TO_BOOK	0.003***	0.003***	0.002***	0.001***	0.001***	-0.001***
	(21.28)	(18.1)	(11.81)	(5.04)	(23.45)	(-8.76)
LEVERAGE	-0.028***	-0.027***	-0.011***	-0.03***	-0.020***	0.053***
	(-19.5)	(-17.09)	(-6.87)	(-16.99)	(-34.68)	(32.96)
Firms Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	107,070	107,070	107,070	107,070	107,070	107,070
Firms	10,162	10,162	10,162	10,162	10,162	10,162
R-Squared	0.179	0.177	0.109	0.123	0.183	0.019

*Notes:

1. Table 7.11 presents results for estimating equations (2a), controlling for firm and year fixed effects, and clustering the standard errors by firm.
2. The regression model is:

$$INTANGIBLE\_INTENSITY\_MEASURE_{i,t} = \lambda_1 SIZE_{i,t}$$

$$+\lambda_2 CAPEX\_PPE_{i,t}$$

$$+\lambda_3 PROFITABILITY_{i,t} + \lambda_4 LEVERAGE_{i,t}$$

$$+\lambda_5 MARKET\_TO\_BOOK_{i,t} + \sum_{i=1}^{10,281} \varphi_i firm_i + \sum_{j=1}^{41} \delta_i year_j + \varepsilon_{i,t}$$

(2a)

Where,

$$INTANGIBLE\_INTENSITY\_MEASURE_{i,t} \in \{LOI_{i,t}; LOI\_EXCL\_A\&D_{i,t};$$

$$(LOI\_EXCL\_R\&D_{i,t} + R\&D\_IN\_LOI_{i,t}); R\&D\_TO\_SALES_{i,t};$$

$$R\&D\_TO\_TOTAL\_ASSETS_{i,t}; INTANGIBLE\_ASSETS_{i,t}\}$$

(2b)

3. The LOI measures are defined as follows: a) *LOI* is the general proxy for the Level of Operating Intangibility, defined as selling, general and administrative expenses (excluding amortizations and depreciations) divided by total operating expenses; b) *LOI_EXC_A&D* is an alternative proxy where selling, general and administrative expenses (excluding amortizations and depreciations) are divided by total operating expenses excluding amortizations and depreciations; c) *R&D_IN_LOI* is the ratio of R&D expenses to total operating expenses; d) *LOI_EXC_R&D* is equal to *LOI* minus *R&D_IN_LOI*.
4. The measures of intangible intensity used in prior literature are defined as follows: 1) *RD_TO_SALES* is R&D divided by sales; 2) *R&D_TO_TOTAL_ASSETS* is R&D divided by total assets; 3) *INTANGIBLE_ASSETS* is the ratio of intangible assets to total assets on the balance sheet.
5. The variables identifying economic characteristics of corporations are defined as follows: 1) *SIZE* is the logarithm of the market-value of equity, 2) *CAPEX_PPE* is the value of the capital expenditures in property, plant and equipment expressed as a fraction of total assets, 3) *PROFITABILITY* is measured as net income divided by total assets, 4) *LEVERAGE* is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt, and 5) *MARKET_TO_BOOK* is the market-value of equity divided by the book value of equity.
6. The symbols *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively. Coefficient estimates and *t*-statistics are reported in the table.

7.5.3 Elimination of the observations where the values of intangible assets, capital expenditures in fixed assets and intangible assets are missing

One advantage of LOI proxies is that they obtain their inputs directly from the income/cash flow statements, whereas the R&D information is in most case extra information provided by the firm in an additional note to the financial statements, when such information is indeed reported. Missing R&D values can be due both to a presumed absence of relevant R&D activities or absence of reporting by the firm (or the database), whereas the LOI proxies can be computed for nearly every firm without requiring a discretionary decision by the researcher.

The previous analysis relied on considering equal to zero the missing values in the variables identifying capital expenditures, R&D and intangible assets. Eliminating those missing values and decreasing the sample period by 10 years, covering only 1976-2006, does not substantially change the statistical association between LOI and the five economic characteristics, in spite of the reduction in the number of observations from 107,070 to 45,966 (42.9%).

Table 7.12 Panel A demonstrates that the *LOI* proxy keeps statistical associations at a 1% level of significance with the variables *SIZE* (t-value of -11,78), *CAPEX_PPE* (t-value of -8.37), *PROFITABILITY* (t-value of -3.17) , *MARKET_TO_BOOK* (t-value of 7.71) and *LEVERAGE* . (t-value of -15.03). The associations are in precisely the same directions predicted in hypotheses 1 to 5.

Table 7.12 Panel B also exhibits similar association for the decomposed LOI proxy where R&D expenses are excluded. As before, *LOI_EXC_R&D* is strongly associated with variables *SIZE* (t-value of -11,78), *CAPEX_PPE* (t-value of -8.37), *MARKET_TO_BOOK* (t-value of 7.71) and *LEVERAGE* (t-value of -15.03).

Furthermore, the variable *LOI_EXC_R&D* displays a not very strong association with *PROFITABILITY* (t-value of -3.17), which may lead one to conclude that once again the negative association between LOI and profitability is driven by R&D expenses. Moreover, one must note an increase in the association between *LOI_EXC_R&D* and *LEVERAGE* when the missing observations are eliminated (from a t-value of -3.44 with the entire sample to a t-value of -11.38 when the observations with missing values were eliminated).

Table 7.12 Computing models without the missing observations in R&D, Intangible Assets and Capital Expenditures
Panel A – Models with the LOI proxy

	SIZE	CAPEX_PPE	PROFITABILITY	MARKET_TO_BOOK	LEVERAGE
Intercept	5.711***	0.059***	0.027*	1.335***	0.304***
	(47.24)	(16.14)	(1.77)	(5.44)	(8.65)
LOI	-2.999***	-0.040***	-0.070***	2.735***	-0.231***
	(-11.78)	(-8.37)	(-3.17)	(7.71)	(-15.03)
INTANGIBLE_ASSETS	1.433***	-0.080***	-0.001	0.243	0.218***
	(2.97)	(-8.67)	(-0.14)	(0.88)	(8.29)
SIZE		0.002***	0.011***	0.047	0.013***
		(4.19)	(5.1)	(1.07)	(7.54)
CAPEX_PPE	2.327***		0.027*	5.053***	0.030
	(4.14)		(1.76)	(10.05)	(0.73)
PROFITABILITY	4.376***	0.018		2.755***	-0.871***
	(8.65)	(1.42)		(2.72)	(-5.08)
MARKET_TO_BOOK	1.617***	0.008	-0.171***		-0.030***
	(7.94)	(1.29)	(-23.48)		(-6.35)
LEVERAGE	0.009	0.007***	0.004***	-2.930***	
	(0.2)	(4.78)	(7.38)	(-12.25)	
R Squared	0.208***	0.092***	0.274***	0.283***	0.375***
T-Value of R-Squared	(7.33)	(9.44)	(8.07)	(9.21)	(15.38)
Observations	45,966				
Beginning Year	**1976**				
End Year	**2006**				

*Notes:

1- Table 7.12 panel A presents results for estimating equations (2a) using the Fama and Macbeth (1973) specification, and correcting the t-values by the Newey and West (1987) approach (31-year sub-samples: 1976-2006), when there was an elimination of the missing observations in the variables related with R&D, intangible assets and capital expenditures.

2. The LOI measure is defined as follows: LOI is the general proxy for the Level of Operating Intangibility, defined as selling, general and administrative expenses (excluding amortizations and depreciations) divided by total operating expenses;

3. The variables identifying economic characteristics of corporations are defined as follows: 1) SIZE is the logarithm of the market-value of equity, 2) CAPEX_PPE is the value of the capital expenditures in property, plant and equipment expressed as a fraction of total assets, 3) PROFITABILITY is measured as net income divided by total assets, 4) LEVERAGE is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt, and 5) MARKET_TO_BOOK is the market-value of equity divided by the book value of equity.

4. The symbols *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively. Coefficient estimates and t-statistics are reported in the table.

Panel B – Models decomposing the LOI proxy

	SIZE	CAPEX_PPE	PROFITABILITY	MARKET_TO_BOOK	LEVERAGE
Intercept	5.727***	0.059***	0.024	1.270***	0.299***
	(47.51)	(16.55)	(1.48)	(5.17)	(8.36)
LOI_EXC_R&D	-3.091***	-0.040***	-0.010	2.134***	-0.149***
	(-10.5)	(-10.71)	(-0.75)	(6.34)	(-11.38)
R&D_IN_LOI	-3.013***	-0.033	-0.261***	6.453***	-0.593***
	(-7.38)	(-1.5)	(-6.74)	(5.36)	(-11.39)
INTANGIBLE_ASSETS	1.435***	-0.079***	-0.018*	0.633***	0.178***
	(2.76)	(-7.21)	(-1.93)	(2.97)	(7.37)
SIZE		0.002***	0.011***	0.049	0.013***
		(4.26)	(4.99)	(1.12)	(7.35)
CAPEX_PPE	2.334***		0.020	5.044***	0.028
	(4.17)		(1.26)	(9.83)	(0.64)
PROFITABILITY	4.433***	0.018		2.905***	-0.898***
	(8.43)	(1.35)		(3.06)	(-5.28)
MARKET_TO_BOOK	1.623***	0.008	-0.179***		-0.028***
	(7.93)	(1.23)	(-22.12)		(-6.15)
LEVERAGE	0.010	0.007***	0.005***	-2.741***	
	(0.2)	(4.94)	(9.12)	(-12.86)	
R Squared	0.211***	0.096***	0.298***	0.294***	0.387***
T-Value of R-Squared	(7.4)	(9.4)	(9.7)	(8.96)	(16.47)
Observations	45,966				
Beginning Year	**1976**				
End Year	**2006**				

*Notes:

1- Table 7.12 Panel B presents results for estimating equations (2a) using the Fama and Macbeth (1973) specification, and correcting the *t*-values by the Newey and West (1987) approach (31-year sub-samples: 1976-2006), when there was an elimination of the missing observations in the variables related with R&D, intangible assets and capital expenditures.

2- The LOI measure is defined as follows: *R&D_IN_LOI* is the ratio of R&D expenses to total operating expenses, and *LOI_EXC_R&D* is equal to *LOI* minus *R&D_IN_LOI*.

3- The variables identifying economic characteristics of corporations are defined as follows: 1) *SIZE* is the logarithm of the market-value of equity, 2) *CAPEX_PPE* is the value of the capital expenditures in property, plant and equipment expressed as a fraction of total assets, 3) *PROFITABILITY* is measured as net income divided by total assets, 4) *LEVERAGE* is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt, and 5) *MARKET_TO_BOOK* is the market-value of equity divided by the book value of equity.

4- The symbols *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively. Coefficient estimates and *t*-statistics are reported in the table.

7.5.4 Using the primary sample without removing the outlier values.

As explained before, the results in the previous sub-sections were obtained in a sub-sample where the outlier observations were removed. From the initial set containing 118,135 observations, there was an elimination of those observations with values in the top or bottom 1% of the size, profitability, leverage, and market–to-book distributions, and those in the top 1% of tangible fixed assets and intangible assets. The primary sample used had 107,070 observations from 10,162 different firms. The current sub section tests the hypothesis using Fama Macbeth procedures with standard errors corrected by Newey West procedures on the initial sample containing the outliers, and thus 118,325 observations. Table 7.12 display the results. As a reading of the table can confirm, there is not a substantial alteration of the coefficients and magnitudes when the outlier observations are regressed along the other observations. Table 7.13 provides further evidence for the five hypotheses relating the tangibility of a firm's flow of products and its economic characteristics by identifying: 1) a negative association between size and level of operating intangibility; 2) a negative association between investments in equipment, property and facilities, and level of operating intangibility; 3) a negative association between profitability, and level of operating intangibility; 4) a positive association between market valuation, and level of operating intangibility; and 5) a negative association between the proportion of debt in a firm's capital structure, and level of operating intangibility.

Table 7.13: The Association between Operating Intangibility and the economic characteristics of firms (Fama and Macbeth regressions with Newey and West t-values) without removing the outlier values from the sample.

	Panel A: Size			Panel B: Investments in Equipment, Property and plant			Panel C: Profitability		
Intercept	5.878***	5.896***		0.094***	0.079***	0.094***	0.010	0.017	0.001
	(46.2)	(50.46)		(11.3)	(11.31)	(11.53)	(0.68)	(1.24)	(0.07)
LOI	-3.178***			-0.076***			-0.069**		
	(-9.53)			(-13.06)			(-2.64)		
LOI_EXC_A&D		-3.188***			-0.037***			-0.077***	
		(-11.2)			(-5.61)			(-2.74)	
LOI_EXC_R&D			-3.527***			-0.084***			0.024
			(-10.95)			(-13.56)			(1.44)
R&D_IN_LOI			-0.719			-0.001			-0.451***
			(-0.67)			(-0.05)			(-6.55)
INTANGIBLE_ASSETS	0.576	0.686*	0.640	-0.040***	-0.048***	-0.037***	-0.013	-0.008	-0.029
	(1.41)	(1.7)	(1.58)	(-5.4)	(-7.47)	(-4.47)	(-0.68)	(-0.46)	(-1.65)
SIZE				-0.001	-0.001	-0.001*	0.016***	0.015***	0.016***
				(-1.65)	(-0.8)	(-1.78)	(5.72)	(5.8)	(5.55)
CAPEX_PPE	-0.482	-0.044	-0.539				-0.017	-0.008	-0.006
	(-0.99)	(-0.09)	(-1.14)				(-0.38)	(-0.2)	(-0.15)
PROFITABILITY	2.627***	2.552***	2.711***	0.041*	0.042*	0.044*			
	(7.47)	(7.37)	(8.09)	(1.85)	(1.93)	(1.97)			
MARKET_TO_BOOK	-0.024**	-0.021*	-0.025**	0.002**	0.002**	0.002**	0.003***	0.003***	0.003***
	(-2.02)	(-1.88)	(-2.03)	(2.32)	(2.27)	(2.31)	(2.73)	(2.75)	(2.84)
LEVERAGE	1.276***	1.261***	1.362***	0.005	0.009	0.007	-0.144***	-0.146***	-0.164***
	(9.74)	(9.61)	(10.28)	(0.45)	(0.89)	(0.64)	(-11.46)	(-12.41)	(-16.85)
R Squared	0.183***	0.192***	0.188***	0.060***	0.045***	0.062***	0.186***	0.188***	0.215***

T-Value R-Squared	(8.13)	(8.73)	(8.31)	(7)	(5.81)	(7.1)	(7.73)	(7.9)	(10.81)

	Panel D: Market valuation			Panel E: Capital structure		
Intercept	-1.615*	-1.217	-1.450	0.307***	0.300***	0.285***
	(-1.74)	(-1.46)	(-1.61)	(28.88)	(25.82)	(24.05)
LOI	16.104***			-0.246***		
	(3.59)			(-7.54)		
LOI_EXC_A&D		14.569***			-0.220***	
		(3.56)			(-8.06)	
LOI_EXC_R&D			13.868***			-0.111***
			(3.26)			(-4.88)
R&D_IN_LOI			28.724***			-0.967***
			(5.09)			(-17.94)
INTANGIBLE_ASSETS	-0.541	-0.853	0.102	0.204***	0.207***	0.170***
	(-0.68)	(-1.07)	(0.14)	(3.63)	(3.75)	(3)
SIZE	-0.685**	-0.684**	-0.707**	0.019***	0.019***	0.020***
	(-2.59)	(-2.62)	(-2.61)	(8.97)	(8.64)	(8.99)
CAPEX_PPE	8.500***	5.962**	8.082***	-0.030	0.006	-0.008
	(3.18)	(2.63)	(3.03)	(-0.32)	(0.06)	(-0.09)
PROFITABILITY	29.902**	30.067**	30.874**	-0.660***	-0.663***	-0.694***
	(2.12)	(2.12)	(2.15)	(-3.63)	(-3.64)	(-3.93)
MARKET_TO_BOOK				0.003***	0.003***	0.004***
				(2.76)	(2.75)	(3.15)
LEVERAGE	8.048***	7.838***	8.639***			
	(2.95)	(2.95)	(2.99)			

R Squared	0.098***	0.098***	0.110***	0.187***	0.183***	0.216***
T-Value R-Squared	(6)	(5.95)	(5.94)	(9.01)	(8.62)	(12.88)
Observations	118,135					
Beginning Year	**1966**					
End Year	**2006**					

Table 7.13 summarizes the results for estimating equations in tables 7.4 to 7.8 while keeping the outlier values that were removed from the initial sample.

The LOI measures are defined as follows: a) *LOI* is the general proxy for the Level of Operating Intangibility, defined as selling, general and administrative expenses (excluding amortizations and depreciations) divided by total operating expenses; b) *LOI_EXC_A&D* is an alternative proxy where selling, general and administrative expenses (excluding amortizations and depreciations) are divided by total operating expenses excluding amortizations and depreciations; c) *R&D_IN_LOI* is the ratio of R&D expenses to total operating expenses; d) *LOI_EXC_R&D* is equal to *LOI* minus *R&D_IN_LOI*.

The measures of intangible intensity used in prior literature are defined as follows: 1) *RD_TO_SALES* is R&D divided by sales; 2) *R&D_TO_TOTAL_ASSETS* is R&D divided by total assets; 3) *INTANGIBLE_ASSETS* is the ratio of intangible assets to total assets on the balance sheet.

The variables identifying economic characteristics of corporations are defined as follows: 1) *SIZE* is the logarithm of the market-value of equity, 2) *CAPEX_PPE* is the value of the capital expenditures in property, plant and equipment expressed as a fraction of total assets, 3) *PROFITABILITY* is measured as net income divided by total assets, 4) *LEVERAGE* is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt, and 5) *MARKET_TO_BOOK* is the market-value of equity divided by the book value of equity.

The symbols *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively. Coefficient estimates and *t*-statistics are reported in the table.

7.5.5 The effect of R&D in the long run

The negative association between R&D measures and profitability empirically found is opposite to the common expectation expressed by several researchers that R&D expenditures would automatically be associated with better economic performance. For instance, Lev and Zarowin, (1999); Frazen et al (2007); and Darrough and Ye (2007) suppose that R&D expenses are expected to produce future economic benefits by driving intangible innovation. However, the empirical results are very clear. They were obtained from several Panel Data tests using Fama Macbeth or fixed effects specifications, and employing the entire sample or eliminating missing observations in R&D and other variables. In all the econometric tests, R&D intensity was statistically associated with negative profitability.

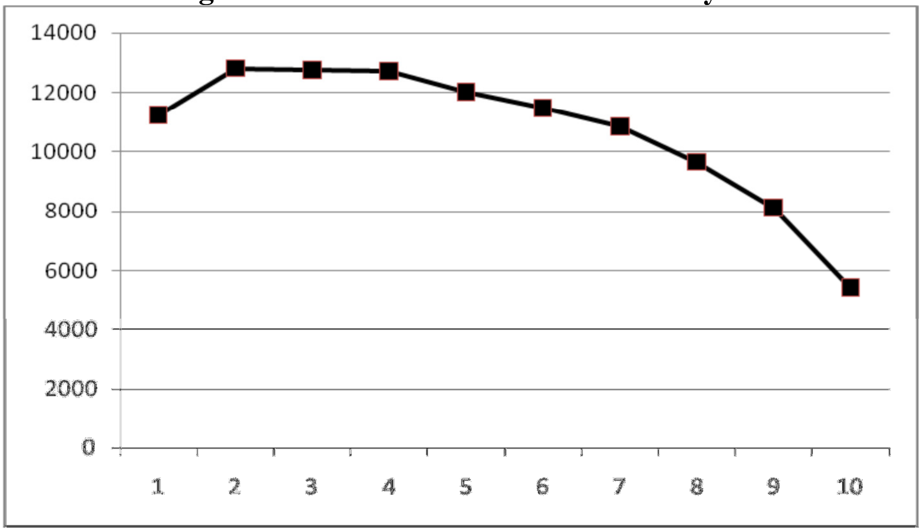
The next chapter will conduct an empirical investigation were firms are classified by deciles according to their mean LOI in the sample. Thus, each decile will have approximately the same number of firms, where a higher decile number describe firms with higher mean LOI. The deciles will reveal themselves very useful in further analyzing and classifying industries. As a advance on the topic, to show the systematic association between R&D intensity and negative profitability, Figure 7.1 clearly portrays that although the number of firms is identical for all deciles, the number of observations decreases with the increase in the LOI decile, and especially so after decile 5. The distribution of the number of observations by decile is consistent with the possibility that worse firm performance leads to shorter expected life of the firm.

Nonetheless, this does not allow one to conclude that innovation is not of major importance for corporations. On the contrary, as noted before, it is possible that the R&D rubric does not capture many forms of corporate innovation, such as, work-process innovation, market positioning innovation, and firm paradigm innovation (described in Francis and Bessant, 2005). One might suggest that R&D captures mainly technological innovation on products, whereas investments in other forms of innovation are diluted among operating costs and ultimately transferred to customers.

However, the R&D intensity associations, which are consistent with the empirical results of Darrough and Ye (2007) seem to demonstrate that it is, at least a little naive to expect that R&D expenses automatically generate economic success, as Darrough and Ye (2007) would insist themselves, despite their own findings. Min et al (2006) used a sample of 264 new industrial product-markets to compare survival risks in markets that were started with an entirely new product versus an incremental innovation. When the pioneer starts a new market with an entirely new product, it can be a major challenge just to survive. In contrast, in markets started by an incremental innovation, market pioneer survival risks are much lower. Interestingly, early followers have the same survival risk across both types of markets. These results are consistent with Knot and Posen (2009) who suggest that in established industries the innovative behavior of R&D investment is principally intended to regain an eroded advantage rather than to pursue a new frontier.

As exhibited empirically, R&D intensity is statistically associated with worse profitability and shorter life expectancy. Perhaps one of the problems in previous studies was to ignore the association between R&D and product creation and or/enhancement. It is possible that R&D might generate and improve very successful products. However, to understand such a link one cannot forget the intimate relationship between R&D and specific products (outputs) or its operating management.

Figure 7.2 – Number of Observations by LOI Decile*



Decile

* Figure 7.2 shows that when firms are classified by deciles, according to their mean LOI in the sample, each decile having a similar number of firms, we observe that firms in higher deciles have a smaller number of observations. The analysis of LOI deciles is further detailed in the next chapter.

Table 7.14 could provide evidence that firms with higher LOI may have less stock market longevity because after the 80s of last century, the mean LOI of firms that will not be in the next year sample is higher than the mean LOI of full sample that year, and firms that remain on the next year sample. Nonetheless, the findings in table 7.14 cannot exclude that firms in higher deciles also have lower observations because they entered later in the sample, given that after the year 1976, the mean LOI of firms entering in the sample tends to be consistently higher than the mean LOI of firms that were in the sample on the previous year. Clearly, for the period of 1966-2006, there was a tendency for a systematic increase in the business models' operating intangibility of the set of all firms listed in NYSE, AMEX and NASDAQ.

Table 7.14- Mean LOI of firms that remain, enter, and exit the sample each year.

Year	Observations/Firms used for this year	Mean LOI	Firms that were in previous year sample	Mean LOI	Firms that were not in previous year sample	Mean LOI	Firms that are not in next year sample	Mean LOI
1966	821	0.19					9	0.22
1967	974	0.20	812	0.2	162	0.20	24	0.16
1968	1,088	0.20	950	0.2	138	0.20	43	0.21
1969	1,223	0.20	1,045	0.2	178	0.20	20	0.18
1970	1,345	0.21	1,203	0.2	142	0.24	24	0.20
1971	1,454	0.21	1,321	0.21	133	0.22	41	0.25
1972	1,881	0.22	1,413	0.21	468	0.25	79	0.20
1973	2,042	0.21	1,802	0.21	240	0.24	267	0.19
1974	1,882	0.21	1,775	0.21	107	0.24	64	0.21
1975	2,064	0.21	1,818	0.22	246	0.19	97	0.20
1976	2,114	0.22	1,967	0.22	147	0.21	131	0.22
1977	2,076	0.22	1,983	0.22	93	0.23	123	0.21
1978	2,101	0.22	1,953	0.22	148	0.25	144	0.22
1979	2,085	0.22	1,957	0.22	128	0.23	138	0.22
1980	2,073	0.22	1,947	0.22	126	0.25	140	0.21
1981	2,108	0.23	1,933	0.22	175	0.29	126	0.22
1982	2,156	0.24	1,982	0.24	174	0.26	121	0.25
1983	2,331	0.25	2,035	0.24	296	0.30	186	0.26
1984	2,376	0.25	2,145	0.25	231	0.30	208	0.25
1985	2,376	0.26	2,168	0.26	208	0.28	258	0.25
1986	2,420	0.27	2,118	0.26	302	0.31	252	0.27
1987	2,487	0.27	2,168	0.27	319	0.28	283	0.27
1988	2,460	0.27	2,204	0.27	256	0.30	289	0.29

1989	2,404	0.27	2,171	0.27	233	0.30	215	0.29
1990	2,418	0.27	2,189	0.27	229	0.28	188	0.33
1991	2,531	0.27	2,230	0.27	301	0.30	163	0.30
1992	2,764	0.28	2,368	0.28	396	0.32	195	0.31
1993	3,519	0.29	2,569	0.28	950	0.33	301	0.34
1994	3,803	0.29	3,218	0.29	585	0.31	409	0.33
1995	3,942	0.29	3,394	0.28	548	0.33	441	0.31
1996	4,114	0.29	3,501	0.28	613	0.35	545	0.31
1997	4,061	0.30	3,569	0.29	492	0.34	603	0.32
1998	3,910	0.30	3,458	0.29	452	0.34	624	0.33
1999	3,783	0.31	3,286	0.29	497	0.39	618	0.35
2000	3,752	0.31	3,165	0.29	587	0.44	505	0.38
2001	3,675	0.32	3,247	0.31	428	0.37	370	0.37
2002	3,728	0.33	3,305	0.33	423	0.38	316	0.41
2003	3,810	0.34	3,412	0.34	398	0.37	382	0.39
2004	3,829	0.34	3,428	0.34	401	0.39	395	0.37
2005	3,832	0.33	3,434	0.33	398	0.37	891	0.36
2006	3,258	0.32	2,941	0.31	317	0.34		

7.6 The issue of imperfection in the LOI proxies used.

Three different proxies were used to compute LOI and similar results are obtainable in the sample. However, one cannot fail to notice that there is a certain sense of imperfection in the proxies employed. That sentiment is both conceptual and empirical. As defined before, intangible flows cannot be measured with precision. Therefore, by definition there cannot be a proxy to measure intangible flows with absolute exactitude because this implies that the measurement would refer to tangible flows.

The solution was to infer the magnitude of intangible flows in the operating productive systems by measuring flows of expenses associated with intangible flows, and flows of expenses related with tangible flows such as flows of goods or amortizations of tangible long term assets as reported expenses can be measured with a certain degree of precision. Yet the proxies used are merely estimates. On the large sample used, the proxies seem to be statistically very significant and congruent with the hypothesis formulated. However, they are approximations not precise measurements over intangible flows that by definition are not measurable with precision.

Furthermore, one must note that as described on Appendix 1, for example an item such as Selling, General and Administrative Expenses (Item 189 according to CRSP/COMPUSTAT Merged Database Guide) incorporate a diverse set of agglomerated expenses. The majority of those seem to be related with intangible flows such as work and services production, marketing, R&D, legal expenses, etc. However, some firms may incorporate in selling, general and administrative expenses some items that are not intangible flow related. On the other hand different accounting policies inter firms and inter years may pose some effects on the results, even though the econometric tests address samples with panel data characteristics.

The fact that a very large sample was used and many econometric tests were implemented may contribute to the robustness of findings. If less observations were used a greater risk would exist that the result had been obtained from the effects of a small sample. Moreover, all proxies used are related with operating expenses and therefore operating decisions, one of the major issues under study in the thesis.

Nonetheless, one must certainly be careful that this is the first time these proxies are being used in the current context of identifying the materiality of a firm's product flows, and therefore, we do not fully understand the behaviour of the proxies used. Furthermore, some issues with the proxy could only be solved by accounting authorities as only accounting norms have the power to mandate companies to discriminate expenses with more detail in the financial statements.

A proxy regarding operating intangibility and computed with available public information must always rely on the sensible balance between inferring immeasurable intangible flows with reasonably quantifiable tangible elements. "

7.7 Conclusion of the chapter

The empirical analysis addressed the heterogeneity of products, firms, and industries with an approach based on testable/refutable hypotheses. As a development of the intangible flow theory, the concept of operating intangibility was introduced and a theoretical prediction was examined: *firms partially organize themselves according to the operating needs associated with the tangibility of the flows of products (outputs) used to generate material cash flows through sales to customers*. The empirical results confirm the theoretical framework, and its relevance for research and organizational practice. It was shown that the intangibility of a firm's flows of products (outputs) is strongly correlated with several important economic characteristics, namely, size, investments in long-term fixed assets, profitability, capital structure, and market-to-book ratio. In addition to capturing a distinctive feature of firms that has not been captured by previous methods, the LOI method overcomes the inherent subjectivity of industry codes, providing a new way of classifying and comparing firms and industries based on publicly available data of registered firms.

Intangible flow theory is a concrete alternative to formulations that refer to people as human capital or human assets (e.g.: Becker, 1962; Ditman et al, 1973; Barro, 2001; Subramaniam and Youndt, 2005; Ciccone and Peri, 2006; Argyres, 2011; Ployhart, 2011). There would be very convenient in terms of mathematical parameterization and homogenization of human beings if one were constrained to using only mathematical/quantitative methods of reasoning, but they have not been previously scientifically demonstrated, and raise serious ethical issues. It was shown that a separation between human beings and human related intangible flows is quite useful for predicting empirical associations between the tangibility of the flows of products sold by a firm and its economic characteristics. Furthermore, despite its merits, the resource based view of the organization (as formulated by Wernerfelt 1984; and Barney 1991, and implemented by Ployhart 2011) does not make a clear separation between resources (or assets), and intangible products that must be consumed when produced; or a clear distinction between persons, and dynamic human related intangible flows that are quintessential for the intangible flow theory to reach the operating intangibility concept. It was also shown that the proposal from Vargos and Lusch (2004, 2006) that the differences between goods and services are mere myths, which are a remnant from a goods based manufacturing logic, was not empirical verified. Firms exhibit concrete empirical differences in their economic characteristics according to the tangibility of the flows of products they sell to customers. Physical goods do not seem to be mere distribution mechanisms for service provision. As noted earlier, customers who buy physical goods have concrete needs associated with the tangibility of the goods bought (e.g.: bread, gasoline, etc.). Moreover, as explained by intangible flow theory, the intangible flows can be very complex and are not restricted to service flows.

The findings support the argument that the intangibility of products (outputs) sold to customers may enhance our understanding of organizations in future research, both theoretical and empirical. The accounting information describing firms' operating activities could become enormously valuable via the LOI approach. Nonetheless, non-financial/qualitative information will remain critical to furthering our understanding of the economic characteristics of organizations, particularly with respect to identifying the importance of products in generating material cash in-flows. Considering the fact that the production and sales of products are themselves concrete social processes, the present empirical findings support the embeddedness critique which purported that neoclassical (orthodox) economics undermines the importance of social relations and their structures, despite economic actions being embedded in social relation structures (Granovetter 1985; and Callon 1998).

As predicted by the intangible flow theory, in concrete intangible flow dynamics, the flows of economic material elements (such as physical goods and/or cash) were found to be associated with the human related intangible flows that are required for their consummation. Hence, we have gained a solid argument in favor of using approaches outside the realm of neoclassical economics to study economic phenomena. Indeed, doing so may be very important to advancing our understanding of economies and societies.

The concept of operating intangibility should not be confused with the proxy used to measure it. The proxy has evident limitations related to the fact it is computed with the information available. Also, it aggregates several intangible related expenses, though, in some cases, it could be useful to dissect out particular types of expenses and study the effects of each in more detail. Nevertheless, the income/cash flow statement approach makes it possible to compute an LOI proxy value for nearly any firm. And perhaps, given the strong statistical significance associated with the LOI proxy, accounting regulators may support academics and practitioners in the future by introducing guidelines to lead firms to provide more detailed data involving the reporting of operating expenses.

8. Investigating industries and refuting the industry homogeneity assumption[27]

8.1- Introduction to the chapter

As described earlier, the assumption that firms registered with the same industry code are either homogeneous or sell homogeneous products is pervasive in neoclassical financial economics. In Modigliani and Miller (1958: 266), widely considered to be the starting point of contemporary corporate financial economic theory, the authors already refer to '*the familiar concept of the industry in which it is the commodity produced by the firms that is taken as homogeneous'*.

Assuming industry homogeneity, some 'intangible intensity' studies hand-picked a few industries that were supposed to be intangible, in order to select their samples of firms (e.g.: Armstrong et al 2007; Core et al 2003; Collins et al 1997; Francis and Schipper 1999). By the same token, the literature in financial economics commonly referred to as 'product market literature' has inquired into how the market of a firm's products may impact upon its capital structure. However, such literature uses a rather limited definition of the market of a product that essentially consists of the set of firms that are registered under the same industry code (e.g.: Campelo 2006; Karuna 2007; Banerjee et al 2008; Chemmanur and Yan 2009; Philips 1995). Because it assumes intra-industry homogeneity, the product market literature faces a high level of difficulty in addressing firm and product (output) heterogeneity. As explained in chapter 3, if an industry code could define a set of homogeneous business models, two problems would become extremely complicated: the classification of organizations within an industry, and the classification of industries themselves. As a result, the selection of industries to

[27] Part of this chapter is included in Cardao-Pito et al (2011a).

study is open to a large degree of subjectivity.

Comparing firms by their industry codes can sometimes be rather inconclusive, and occasionally this literature reaches diametrically opposing conclusions in the same paper. For instance, Campelo (2006: 168) concludes the following: '*studies on the interaction between a firm´s financing decisions and its product market performance often conclude that debt taking either hurts or boosts competitive performance. This paper proposes that both types of association are likely to be manifested in the data: debt can hurt and boost performance*.' Philips (1995) follows only four industries and finds that, in three of them, the firm's output is negatively associated with the average industry debt ratio. In the other industry, he finds precisely the opposite. Thus, researchers should be cautious in exclusively employing the industry code to understand a firm's economic characteristics or product heterogeneity. The theoretical framework developed in chapter five, the Level of Operating Intangibility (LOI), was introduced to study the heterogeneity of product flows of firms and industries. It classifies firms according to the tangibility of the flows of products (outputs) used to generate cash flows through sales to customers. Physical good-intensive (e.g.: Ford; Shell) and intangible product-intensive (e.g.: Microsoft; Lastminute.com) firms appear at both ends of the scaling system. Firms that offer a mix of physical goods and intangible products, or firms offering products that are themselves mixed, lie somewhere in the middle (e.g.: Coca-Cola and Pepsi Cola that sell much intangible marketing and advertising in each bottle of their drinks). This method uses firm specific information to classify both firms and industries. Therefore, it can be used to classify firms within industries. Using the primary sample, involving 107,070 observations of 10,162 US firms over a period of 41 years (1966-2006), the findings reported in the last chapter show that the tangibility of product flows is strongly correlated with several economic characteristics of firms. The results were robust under many alternative econometric tests. Concretely, a higher Level of Operating Intangibility was statistically significantly correlated with five expected properties of intangible-product-intensive firms: i) smaller size of the cash in-flow turnover; ii) lower capital expenditures in property, equipment and plant; iii) lower profitability; iv) higher stock market valuation of equity (market-to-book); and v) less debt in the capital structure (leverage).

This chapter uses the Level of Operating Intangibility framework and the primary sample to show two concrete cases where assuming that firms registered in the same industry are homogeneous or sell homogeneous products may give the wrong impression to researchers. This chapter will exhibit that: i) studies claiming to have selected intangible intensity industries (Core et al 2003; Collins et al 1997; Francis and Schipper 1999) picked quite heterogeneous samples, that included several physical-good-intensive firms along with semi-intangible and intangible–product-intensive firms; and ii) the prediction that firms selling durable goods have less leverage than the others (Titman 1984; Titman and Wessels 1988; Banerjee et al 2008) can be contradicted by inspection of the industries chosen to empirically support the claim, because the physical good intensive firms with those industry codes are far fewer than the intangible product intensive firms.

8.2- Revisiting the related literature

8.2.1 Assuming industry homogeneity in intangible intensity studies

As described in chapter three, several studies compare firms according to the industry codes of industries that were supposed to be intangible-intensive and assume intra industry homogeneity (e.g.: Armstrong et al 2007; Core et al 2003; Collins et al 1997; Francis and Schipper 1999; Collins et al 1997). Armstrong et al (2007) ascertained that earnings forecasts for firms of industrial sectors commonly held to be intangible-intensive are more likely to be biased than those estimated for other firms. However, even this apparently straightforward distinction hides a rather complex choice. Moreover, the literature has shown that relying on industry classifications to identify intangible-intensive firms can lead to contradictory findings. Collins et al (1997), for instance, found that the financial statements of firms drawn from a small selection of intangible-intensive industries were less informative with respect to stock market returns than those of other firms. Francis and Schipper (1999), on the other hand, found only mixed support for this claim when analyzing firms from a different selection of industries. Core et al (2003) have shown that traditional explanatory variables of firm value such as earnings, book value of equity, and growth opportunities are still relevant to firms in intangible-intensive industries, if to a smaller degree. Hence, Core et al (2003) hypothesized that their models were affected by additional unknown factors.

The studies mentioned above draw on just a few industries, arguably intangible-intensive. Collins et al (1997: 51) acknowledge in a footnote that their industry selection is *'somewhat ad-hoc'*. They define firms as intangible-intensive if their production functions are '*likely*' to contain large amounts of *'unrecorded* *intangibles'*. Evidently, they cannot measure these amounts. They restrict their analysis to a very small number of 6 industries registered under the USA's standard industrial classification (SIC) scheme. Collins et al (1997) used both two digit and three digit classifications to select industries. These were: 48 (electronic components and accessories), 73 (business services), and 87 (engineering, accounting, and management related services); 282 (plastics and synthetic materials), 283 (drugs), and 357 (computer and office equipment). All other industries are excluded from consideration.

A similar situation occurs in Armstrong et al (2007 - which follows firms from only 3 industries), Francis and Schipper (1999 – 14 industries) and Core et al (2003 – same industries as Francis and Schipper 1999). Francis and Schipper (1999) and Core et al (2003) used three digit classifications to select industries. For the small number of industries chosen from the wide pool of three digit industries, they adopted a dual subdivision by 'high tech' and 'low tech' industries. However, the selection process was highly subjective, mainly consisting of hand picked industries. Amongst the industries considered as High-Technology were: 283 Drugs; 357 Computer and Office Equipment; 360 Electrical Machinery and Equipment, Excluding Computers 361 Electrical Transmissions and Distribution Equipment; 362 Electrical Industrial Apparatus; 363 Household Appliances; 364 Electrical Lighting and Wiring Equipment; 365 Household Audio, Video Equipment, Audio Receiving; 366 Communication Equipment; 367 Electronic Components, Semiconductors; 368 Computer Hardware (Including Mini, Micro, Mainframes, Terminals, Discs, Tape Drives, Scanners, Graphics Systems, Peripherals, and Equipment); 481 Telephone Communications; 737 Computer

Programming, Software, Data Processing; and 873 Research, Development, Testing Services

The industries considered as Low technology industries were: 020 Agricultural Products-Livestock; 160 Heavy Construction, Excluding Building; 170 Construction-Special Trade; 202 Dairy Products; 220 Textile Mill Products; 240 Lumber and Wood Products, Excluding Furniture; 245 Wood Buildings, Mobile Homes; 260 Paper and Allied Products; 300 Rubber and Miscellaneous Plastics Products; 307 Miscellaneous Plastics Products; 324 Cement Hydraulic; 331 Blast Furnaces and Steel Works; 356 General Industrial Machinery and Equipment; 371 Motor Vehicles and Motor Vehicle Equipment; 399 Miscellaneous Manufacturing Industries; 401 Railroads; 421 Trucking, Courier Services, Excluding Air; 440 Water Transportation; 451 Scheduled Air Transportation, Air Courier; and 541 Grocery Stores.

Nonetheless, such arbitrary method of choosing industries could imply the problem of inherent subjectivity.

8. 2.2 Assuming product-industry homogeneity to predict the capital structure

Some studies in financial economics have recently proposed explanations for capital structures that, despite being related to the industry membership, are not limited to it. Kale and Shahrur (2007) note that the research and development (R&D) intensity of suppliers and clients, and any joint ventures with them, are negatively associated with a firm's leverage. Banerjee et al (2008) also find that the relationships with customers and suppliers are correlated with a firm's capital structure. As suggested in earlier chapters, one could posit that such associations partially occur due to the operational needs inherent in the tangibility of flows of products carried in commercial transactions.

For instance, it might not be irrelevant that to produce an automobile, a firm needs heavyweight machinery, storage facilities, and quite tangible raw materials besides the intangible flows of work; whereas, to produce an intangible service, another firm may need only convenient space and few employees. However, the reasoning concerned with operational need is not that adopted by Kale and Shahrur (2007) and Banerjee et al (2008), who also do not conceptualize that products are the principal source of a firm's income and self financing. Both papers follow the analytical reasoning proposed by Titman (1984) and Maksimovic and Titman (1991), which have the merit of introducing products, clients, and suppliers into the discussion of neoclassical economical literature. However, Titman (1984) and Maksimovic and Titman (1991) tried to demonstrate that products can be accommodated within the neoclassical economic framework, and particularly the trade-off theory that had its origin in Modigliani and Miller's (1958) work, which assumes the irrelevance of operating decisions.

The importance of products would be indirectly reflected in a firm's liquidation/bankruptcy costs. The trade-off theory argues that liquidation/bankruptcy costs are a form of 'market imperfection' that impacts upon capital structures. Nevertheless, trade-off theory has been empirically contradicted. For instance, firms with higher profitability tend to have less debt (e.g.: Rajan and Zingales 1995; Fama and French 2002), contrary to the trade-off prediction, that more profitable firms would borrow more in order to obtain tax benefits. Furthermore, surveys of financial managers show that practitioners do not believe in the current dominant capital structure theories of financial economics (Graham and Harvey 2001; Beattie et al 2006). Clearly stated, the objective of Titman (1984: 137), is to explore *'one source of contracting costs which is indirectly related to bankruptcy*'. His theoretical reasoning would predict that '*firms (such as computer and automobile companies) which can potentially impose high costs on their customers and business associates in the event that they liquidate choose capital structures with relatively low debt/equity ratios. Conversely firms (such as hotels and retail establishments) which impose relatively low costs on their customers and business associates in the event that they liquidate choose high debt/equity ratios*' (Titman 1984: 150). Maksimovic and Titman (1991) expand upon this theme, arguing that the effect of debt financing on a firm's ability to maintain a reputation for product quality is a determinant of its capital structure choice. These papers argue that consumer and supplier decisions are mainly determined by the financial status of the producer/seller.

Both Titman (1984) and Maksimovic and Titman (1991) presented analytical papers without directly testing any empirical evidence/refutation of their claims. Such reasoning offers us peculiar predictions. Kale and Shahrur (2007) and Banerjee et al (2008) would follow precisely the same reasoning to interpret their empirical findings, as a firm's liquidation/bankruptcy would be a recurrent happening. To study the predictions of Titman (1984), that firms selling durable goods have less leverage, Titman and Wessels (1988: 5) arbitrarily identify the durable-good-selling firms by including '*a dummy variable equal to one for firms with SIC codes between 3400 and 4000 (firms producing machines and equipment) and zero otherwise as a separate attribute affecting the debt ratios'*. Allegedly, all firms registered in these industries would produce machines and equipment, and '*firms manufacturing machines and equipment should be financed with relatively less debt*' (Titman and Wessels 1988: 5). There is absolutely no explanation for the choice of these rather specific industry codes. Why not pick any other industry codes? Later Banerjee et al (2008) would take this classification as perfectly given in their dual typology of industries: durable goods and non-durable goods. Banerjee et al simply follow Titman and Wessels (1988), who established the benchmark.

As previously suggested, one could posit that inside the same industry firms might have very distinct levels of heterogeneity in the products they sell (see earlier chapters). This is a point missed by Titman and Wessels (1988), Kale and Shahrur (2007), and Banerjee et al (2008), who also ignore the substantial heterogeneity amongst industries. They all follow the prediction of Titman, described above. A dialogue with other scientific disciplines that are concerned with studying products might be quite fruitful. Under the framework of intangible flow theory, computers and automobile intensive companies, as exemplified by Titman, that sell high-cost tangible products, are classifiable as physical goods-intensive firms, while hotels and retail establishments are classifiable as semi-intangible product-intensive firms, because they offer a mix of services and physical goods to customers. Firms focused on selling services or software would be classifiable as intangible-product-intensive firms.

Nevertheless, it seems quite difficult to understand why physical-good-intensive firms that require heavyweight investments in machinery, plants, equipments and raw materials would have less debt/leverage than semi-intangible and intangible product-intensive firms that, by having fewer tangibility requirements, could more easily be self-financed. With testable/refutable hypotheses, a large sample and many econometric tests, the previous chapter demonstrated that, contrary to the claim of Titman and Wessels (1988), Kale and Shahrur (2007), and Banerjee et al (2008), the proportion of debt in a firm's capital structure tends to increase with the increase in the tangibility of flows of products (outputs) sold by the firm. Thus, this is a matter that requires further investigation.

8.3- Initial empirical analysis

8.3.1 Analysis of LOI deciles

The empirical analysis of this chapter was conducted on the primary sample. A new approach for studying the behaviour of LOI and its relationships with the economic characteristics of firms and industries was implemented. The 10,162 firms were grouped into deciles according to the mean LOI computed using all sample observations. The entire sample was subdivided into ten sets. Thus, firms with analogous mean levels of operating intangibility were grouped together. Each decile has approximately the same number of firms, namely, 1,016 or 1,017 firms. When a firm is classified in one decile, all its observations will be classified in that decile. Thus, the object of analysis are the corporations, which are classified by deciles without assuming any status of homogeneity, but for sharing one similar characteristic, that of having a mean level of operating intangibility under a proximity of values. Table 8.1 describes the allocation of firms, the respective number of observations, mean-LOI, and LOI-variability by decile.

Table 8.1- LOI deciles

Decile	Number of Firms	Observations	Mean	Std. Dev.	25 th Pctl.	Median	75th Pctl.
1	1,016	11,235	0.068	0.034	0.046	0.066	0.085
2	1,016	12,810	0.12	0.037	0.099	0.118	0.139
3	1,016	12,755	0.166	0.043	0.143	0.164	0.186
4	1,016	12,719	0.21	0.048	0.185	0.208	0.231
5	1,016	12,025	0.253	0.054	0.225	0.25	0.277
6	1,017	11,461	0.3	0.062	0.267	0.297	0.327
7	1,016	10,841	0.353	0.073	0.314	0.348	0.388
8	1,016	9,655	0.417	0.077	0.376	0.414	0.455
9	1,016	8,129	0.511	0.084	0.464	0.51	0.558
10	1,017	5,440	0.697	0.113	0.618	0.692	0.78
Total	10,162	107,070					

Note: The 10,162 firms in sample were grouped into deciles according to the mean LOI computed using all sample observations. The entire sample was subdivided into ten sets. Thus, firms with analogous mean levels of operating intangibility were grouped together. Each decile has approximately the same number of firms, namely, 1,016 or 1,017 firms. When a firm is classified into one decile, all its observations will be classified in that decile. *LOI* is the general proxy for the Level of Operating Intangibility that is described in equation (5.3).

The construction of LOI deciles by firm enables us to report two further analyses of the primary sample. First, we can now observe the statistical associations identified in the previous chapter, along the deciles, in order to identify what economic characteristics have changes in mean values from decile 1 to decile 10 that tends to always increase or decrease, and what economic characteristics have a relatively similar mean over a group of deciles, which starts decreasing/increasing after/before one reaches a certain level of operating intangibility. Second, we can now study the product (output) heterogeneity within each industry. As we can classify firms inside each industry according to their LOI decile, such characterization permits us to identify the distribution of firms by industry. Previous researchers in product market literature (e.g.: Titman and Wessels, 1988; Banerjee et al 2008) or intangible intensity literature (e.g.: Core et al, 2003; Collins et al, 1997; Francis and Schipper, 1999; Collins et al 1997) assumed that firms registered with the same industry code were either homogeneous or sold homogeneous products to their customers. We can now use precisely the same industry codes to verify if this is really the case. Could all firms in such industries be distributed amongst few deciles that would be expected from the reasoning of these researchers, or would firms generally be spread amongst several other deciles, which demonstrate their heterogeneity?

Apendix 8.1 displays the descriptive statistics of the economic characteristics of firms by LOI decile. It is possible to observe that the hypotheses tested in the previous chapter seem to be represented in the progression of the mean values from the lower to the higher deciles. Nonetheless, appraisal of gross mean values would not permit a direct comparison of the five hypotheses and its progression along deciles because the economic characteristics are described along different magnitudes of quantification. For instance, the size of sales values cannot be directly compared with the capital structure values, or the profitability values could not be directly compared with the investment profile values. However, correlation coefficients can be directly compared given that they are described in the interval that ranges between -1 and 1.

To identify into what decile a firm was integrated 10 identifier variables were created. The value of one denotes the incorporation into the respective decile, and zero denotes the opposite. The correlation of the decile variables with the economic characteristics of firms is presented in Table 8.2, and exhibited in Figure 8.1. The decile analysis clearly confirms the hypotheses presented in chapter 6, as there is a significant statistical association between the LOI deciles and all the studied economic characteristics. It is however interesting to report that these statistical associations do not follow identical paths. *PROFITIBALITY* is the variable having weaker Spearman's correlations with the LOI decile identifiers. Such correlations are systematically inferior to that of the other variables. Chapter 7 identified that the negative association between LOI and profitability was essentially R&D driven.

Yet, as described by table 8.1, firms allocated to higher LOI deciles have fewer observations, which may convey that intangible product intensive firms have a shorter life and/or are less successful than others. The associations between LOI deciles and the variables *SIZE* and *MARKET_TO_BOOK* could be described as almost monotonic (i.e. always increasing or always decreasing). The Spearman's correlation coefficients between *SIZE* and LOI deciles clearly decrease from decile

1 to decile 10, from positive to negative values, whilst the Spearman's correlation coefficients between *MARKET_TO_BOOK* and LOI deciles increase from decile 1 to decile 10, from negative to positive values. Nonetheless, *MARKET_TO_BOOK*'s correlations tend to increase slowly from decile 1 to decile 5, and quickly after decile 5. On the other hand, the associations between the variables *CAPEX_PPE* and *LEVERAGE* and the LOI deciles verify a certain degree of stability along specific deciles, and suddenly start to decrease/increase fast. *CAPEX_PPE* Spearman's correlations with LOI deciles variables clearly decrease from decile 1 to decile 6, and are relatively stable between deciles 6 and 10. They become negative after decile 4. The Spearman's correlations between *LEVERAGE* and LOI deciles are relatively stable, and positive, between deciles 1 and 6, and clearly decrease from decile 6 to decile 10, becoming negative after decile 7.

Table 8.2- Spearman's correlations between the LOI decile identifiers and the variables employed in this study

	Decile 1	*Decile 2*	*Decile 3*	*Decile 4*	*Decile 5*	*Decile 6*	*Decile 7*	*Decile 8*	*Decile 9*	*Decile 10*
LOI	**-0.51093**	**-0.39808**	**-0.24252**	**-0.08725**	**0.03871**	**0.1633**	**0.25961**	**0.32843**	**0.37874**	**0.33352**
INTANGIBLE_ASSETS	**-0.03114**	**-0.01226**	0.0001	-0.00421	**-0.00861**	0.00653	**0.00842**	-0.00039	**0.02494**	**0.03422**
SIZE	**0.18758**	**0.11769**	**0.08614**	**0.03742**	**-0.02613**	**-0.03024**	**-0.06108**	**-0.12064**	**-0.1507**	**-0.14448**
CAPEX_PPE	**0.12496**	**0.10095**	**0.07931**	**0.02725**	**-0.0162**	**-0.08265**	**-0.09595**	**-0.08011**	**-0.04687**	**-0.06299**
PROFITABILITY	**0.02843**	**0.03459**	**0.03964**	**0.02659**	0.0055	**-0.02262**	**-0.03089**	**-0.03343**	**-0.01336**	**-0.07332**
LEVERAGE	**0.06285**	**0.06145**	**0.05982**	**0.04015**	**0.02697**	**0.0535**	0.00212	**-0.07073**	**-0.1481**	**-0.20423**
MARKET_TO_BOOK	**-0.08336**	**-0.09362**	**-0.08318**	**-0.05877**	**-0.03174**	0.00377	**0.05682**	**0.08867**	**0.13761**	**0.17447**

Notes:

1- A bold correlation coefficient denotes statistical significance at the 1% level.

3- The 10,162 firms in sample were grouped into deciles according to the mean LOI computed using all sample observations. The entire sample was subdivided into ten sets. Thus, firms with analogous mean levels of operating intangibility were grouped together. Each decile has approximately the same number of firms, namely, 1,016 or 1,017 firms. When a firm is classified in one decile, all its observations will be classified in that decile.

2- The variables were defined as follows: *LOI* is the proxy for the level of operating intangibility identifying the proportion of intangible related expenses amongst total operating expenses as defined on equation (5.3); *SIZE* is measured through the logarithm of the firm's sales, after sales values have been deflated by the consumer price index; *CAPEX_PPE* are the capital expenditures in the tangibles property, plant and equipment expressed as a fraction of total assets, PROFITABILITY is the net income divided by total assets; *LEVERAGE* is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt sheets, *MARKET_TO_BOOK* is the market-value divided by the book value of the equity; the *INTANGIBLE_ASSETS* variable is the ratio of intangible assets to total assets; and the variables *Decile* [1-10] are identifier variables that indicate observations from firms classified in the respective LOI decile in the full sample

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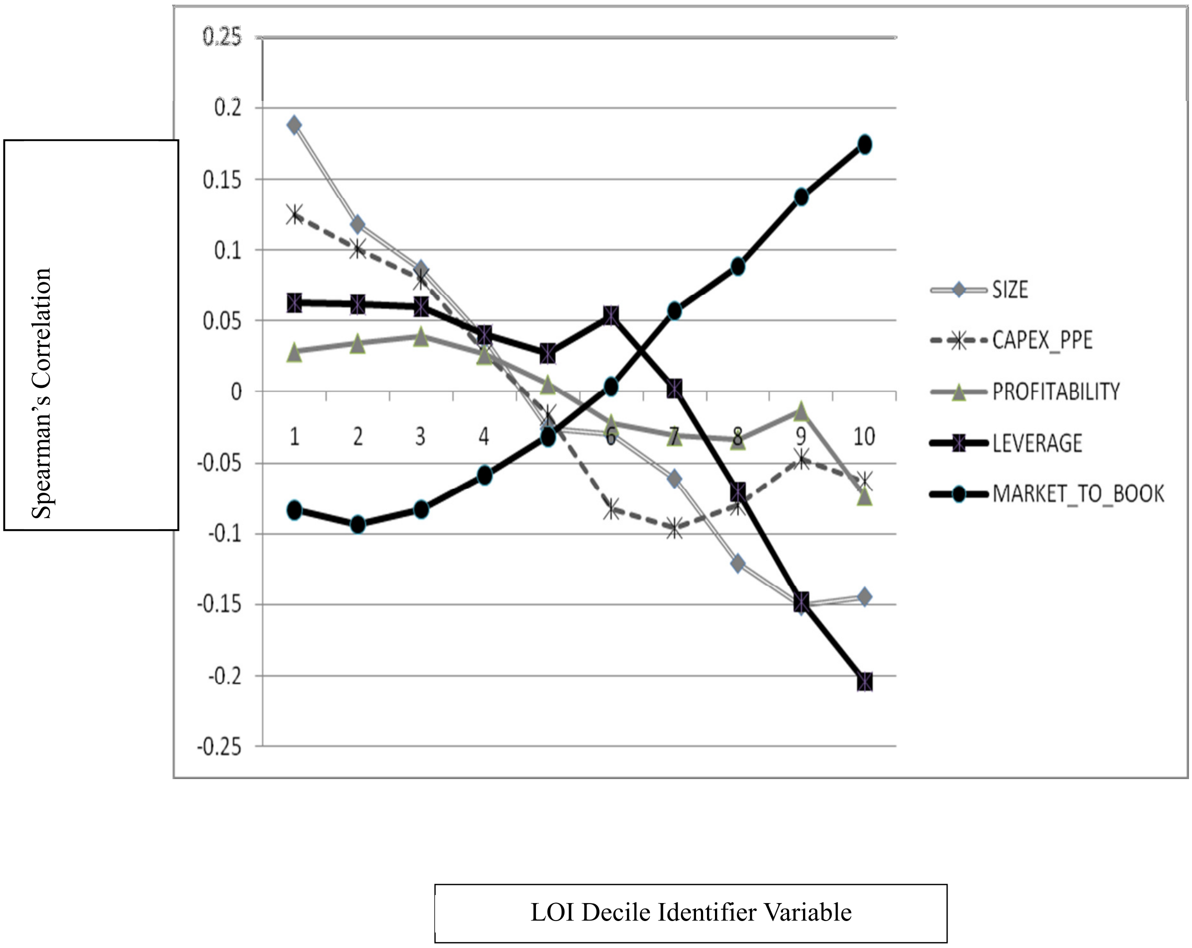
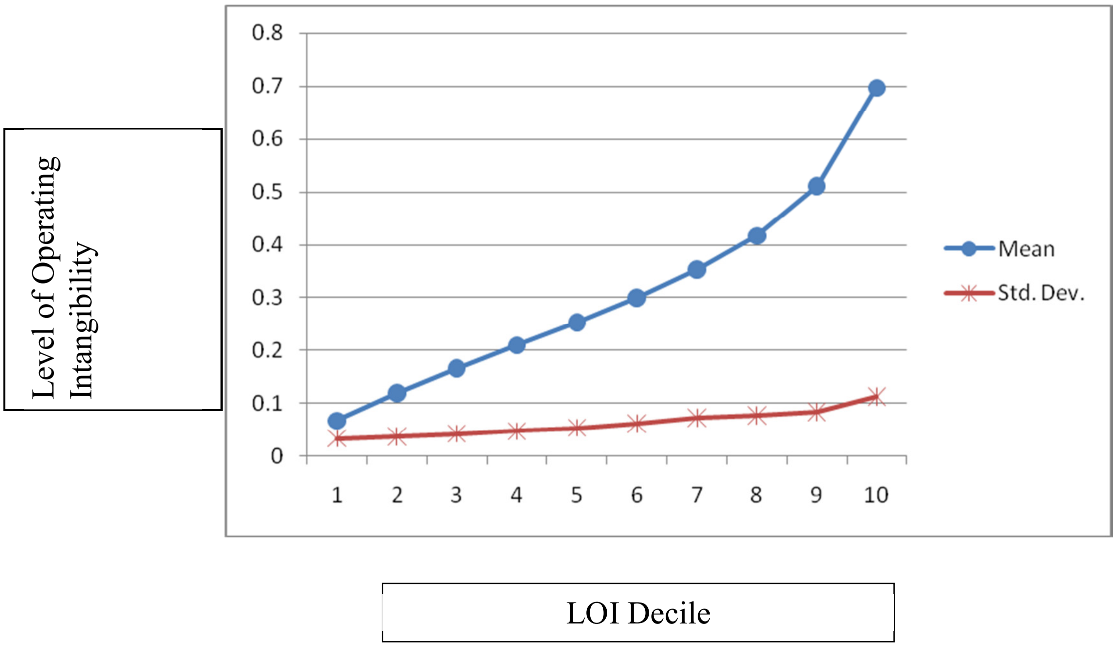
Figure 8.1- Spearman's Correlation between the LOI decile identifiers and the economic characteristics of firms



8.3.2 The stability of LOI by firm versus the heterogeneity of LOI within industries

The previous chapters question whether LOI could be an economic characteristic of firms. Table 8.1 and figure 8.2 seem to provide confirmatory empirical evidence, as the LOI variable is comparatively stable by firm, and thus can be used to describe the respective organization. The standard deviation of LOI inside each decile is relatively low. It is correct that the LOI standard deviation is increasing from decile 1 to decile 10, but this would be expected because the mean of LOI also increases from decile 1 to decile 10, and the standard deviation is in the same unit as the mean LOI. The variable LOI is indeed very stable for firm/year observations because from decile 1 to decile 10 the mean LOI increases 10.25 times (from 0.068 to 0.697), whereas the standard deviation only increases 3.3 times (from 0.034 to 0.113).Naturally, a substantial modification in a firm's LOI would describe a substantial change in its business model.

Figure 8.2 – Evidence of the high stability of the level of operating intangibility by firm and decile



As predicted before, the Level of Operating Intangibility Method can be used to classify and compare both firms and industries based on the public data of registered firms. As described earlier, the industry method has a relevant subjectivity problem. Appendix 2 provides evidence that the *LOI* can be used as an objective criterion for ranking industries with firm financial information. The 72 (out of 81) two-digit SIC codes represented in the primary sample have been ordered in terms of their mean *LOI*.[28] Those with the lowest levels of product

[28] The nine missing industries are not expected to have firms listed on the stock exchanges, as they mainly include governmental organizations, non-profit organizations, and small firms. The SIC codes of industries not included in Table 6 are 43 (united states postal service), 84 (museums, art galleries and gardens), 86 (membership organizations), 91 (executive, legislative and general government), 92 (justice, public order and safety), 93 (public finance & taxation policy), 94 (administration – human resource programs), 95 (administration – environmental quality programs), 96 (administration of economic programs), and 97 (national security and

intangible-intensity are heavily physical good industries such as coal mining, metalworking, heavy construction, and petroleum refining. Those industries with a high mean *LOI* include service industries and high technology industries (e.g.: business services, chemical and allied products, communications, and educational services). In the middle of the scale are those industries where many firms have a mixed business model. For example, transportation firms both produce services and consume expensive physical goods such as fuel. On the other hand, many firms in the food industry concentrate on selling physical goods but also invest massively in intangible inputs such as marketing and advertising.

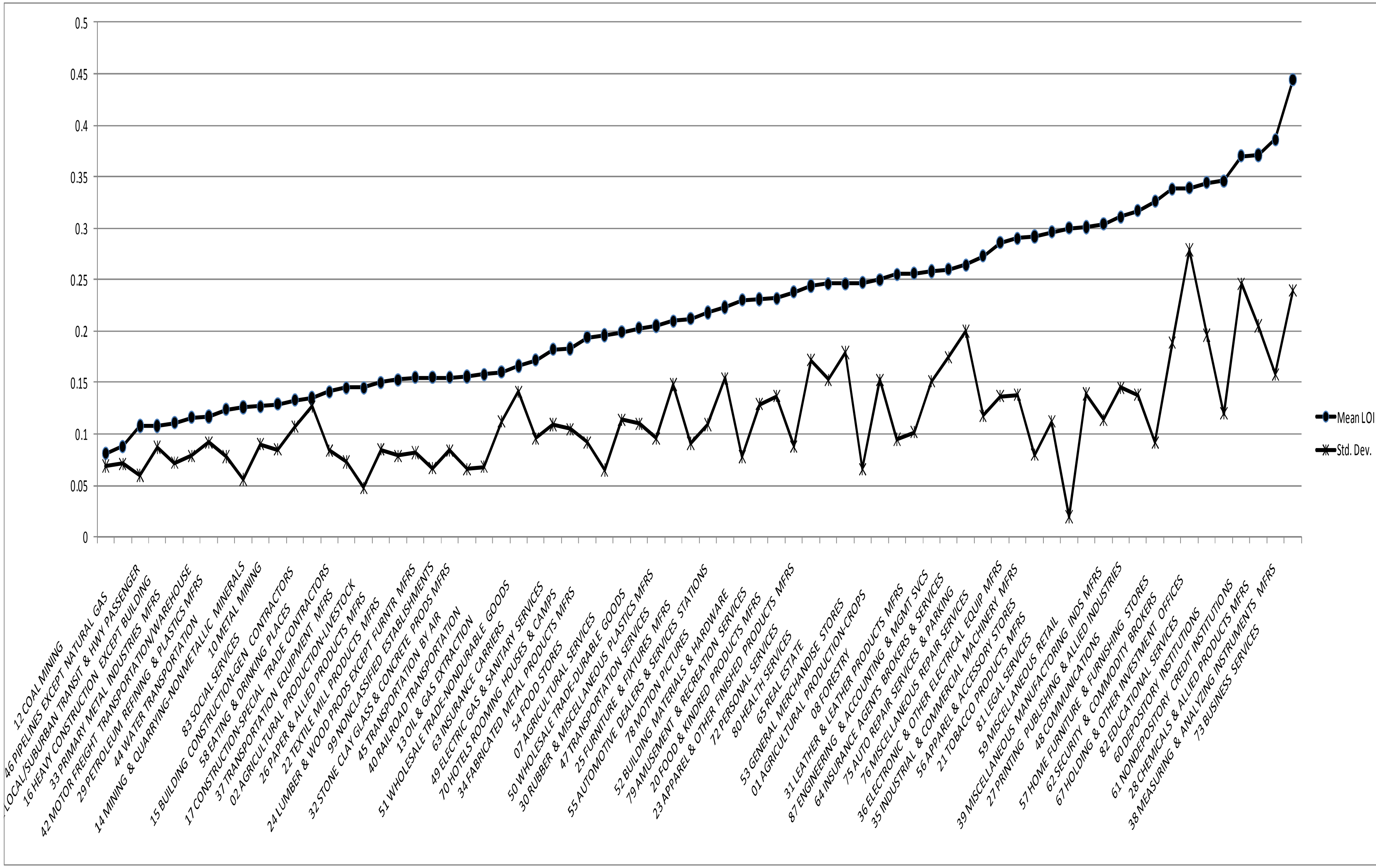
From Appendix 3 we also learn that treating *any* industry as homogeneous in products (outputs) is probably a grave mistake. In most industries the standard deviation of *LOI* is more than half of the mean *LOI*. This is evidence for a high degree of dissimilarity among the products of firms registered under the same industry. Accordingly, Appendix 3 documents that a product homogeneity assumption inside each industry is not empirically verified.

The results of Appendix 3 are visually displayed in Figure 8.3, which describes the classification of 2 digit SIC code industries according to their mean LOI in sample. One can observe how the LOI method puts at one end of the scaling system physical good intensive industries such as coal mining or heavy construction, and at the other end intangible product intensive industries such as business services or the high tech industry: measuring and analyzing instruments. However, one must note another fact: the systematic LOI heterogeneity, described by the high standard deviation of LOI within industries. LOI is an indicator that, as

international affairs).

we learned above, tends to be relatively stable at the firm level. Therefore, this fact gives us another reason to be wary about the industry homogeneity assumption followed in several intangible intensity studies (e.g.: Armstrong et al 2007; Core et al 2003; Collins et al 1997; Francis and Schipper 1999) and product market literature (e.g.: Campelo 2006; Chemmanur and Yan 2009; Karuna 2007; Banerjee et al 2008; Philips 1995).

Figure 8.3 – The heterogeneity of the level of operating intangibility inside industries


0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Mean LOI
Std. Dev.
12 COAL MINING
46 PIPELINES EXCEPT NATURAL GAS
LOCAL/SUBURBAN TRANSIT & HWY PASSENGER
16 HEAVY CONSTRUCTION EXCEPT BUILDING
33 PRIMARY METAL INDUSTRIES MFRS
42 MOTOR FREIGHT TRANSPORTATION/WAREHOUSE
29 PETROLEUM REFINING & PLASTICS MFRS
44 WATER TRANSPORTATION
14 MINING & QUARRYING-NONMETALLIC MINERALS
10 METAL MINING
83 SOCIAL SERVICES
15 BUILDING CONSTRUCTION-GEN CONTRACTORS
58 EATING & DRINKING PLACES
17 CONSTRUCTION-SPECIAL TRADE CONTRACTORS
37 TRANSPORTATION EQUIPMENT MFRS
02 AGRICULTURAL PRODUCTION-LIVESTOCK
26 PAPER & ALLIED PRODUCTS MFRS
22 TEXTILE MILL PRODUCTS MFRS
24 LUMBER & WOOD PRODS EXCEPT FURNTR MFRS
99 NONCLASSIFIED ESTABLISHMENTS
32 STONE CLAY GLASS & CONCRETE PRODS MFRS
45 TRANSPORTATION BY AIR
40 RAILROAD TRANSPORTATION
13 OIL & GAS EXTRACTION
51 WHOLESALE TRADE-NONDURABLE GOODS
63 INSURANCE CARRIERS
49 ELECTRIC GAS & SANITARY SERVICES
70 HOTELS ROOMING HOUSES & CAMPS
34 FABRICATED METAL PRODUCTS MFRS
54 FOOD STORES
07 AGRICULTURAL SERVICES
50 WHOLESALE TRADE-DURABLE GOODS
30 RUBBER & MISCELLANEOUS PLASTICS MFRS
47 TRANSPORTATION SERVICES
25 FURNITURE & FIXTURES MFRS
55 AUTOMOTIVE DEALERS & SERVICES STATIONS
78 MOTION PICTURES
52 BUILDING MATERIALS & HARDWARE
79 AMUSEMENT & RECREATION SERVICES
20 FOOD & KINDRED PRODUCTS MFRS
23 APPAREL & OTHER FINISHED PRODUCTS MFRS
72 PERSONAL SERVICES
80 HEALTH SERVICES
65 REAL ESTATE
53 GENERAL MERCHANDISE STORES
01 AGRICULTURAL PRODUCTION-CROPS
08 FORESTRY
31 LEATHER & LEATHER PRODUCTS MFRS
87 ENGINEERING & ACCOUNTING & MGMT SVCS
64 INSURANCE AGENTS BROKERS & SERVICES
75 AUTO REPAIR SERVICES & PARKING
76 MISCELLANEOUS REPAIR SERVICES
36 ELECTRONIC & OTHER ELECTRICAL EQUIP MFRS
35 INDUSTRIAL & COMMERCIAL MACHINERY MFRS
56 APPAREL & ACCESSORY STORES
21 TOBACCO PRODUCTS MFRS
81 LEGAL SERVICES
59 MISCELLANEOUS RETAIL
39 MISCELLANEOUS MANUFACTORING INDS MFRS
27 PRINTING PUBLISHING & ALLIED INDUSTRIES
48 COMMUNICATIONS
57 HOME FURNITURE & FURNISHING STORES
62 SECURITY & COMMODITY BROKERS
67 HOLDING & OTHER INVESTMENT OFFICES
82 EDUCATIONAL SERVICES
60 DEPOSITORY INSTITUTIONS
61 NONDEPOSITORY CREDIT INSTITUTIONS
28 CHEMICALS & ALLIED PRODUCTS MFRS
38 MEASURING & ANALYZING INSTRUMENTS MFRS
73 BUSINESS SERVICES

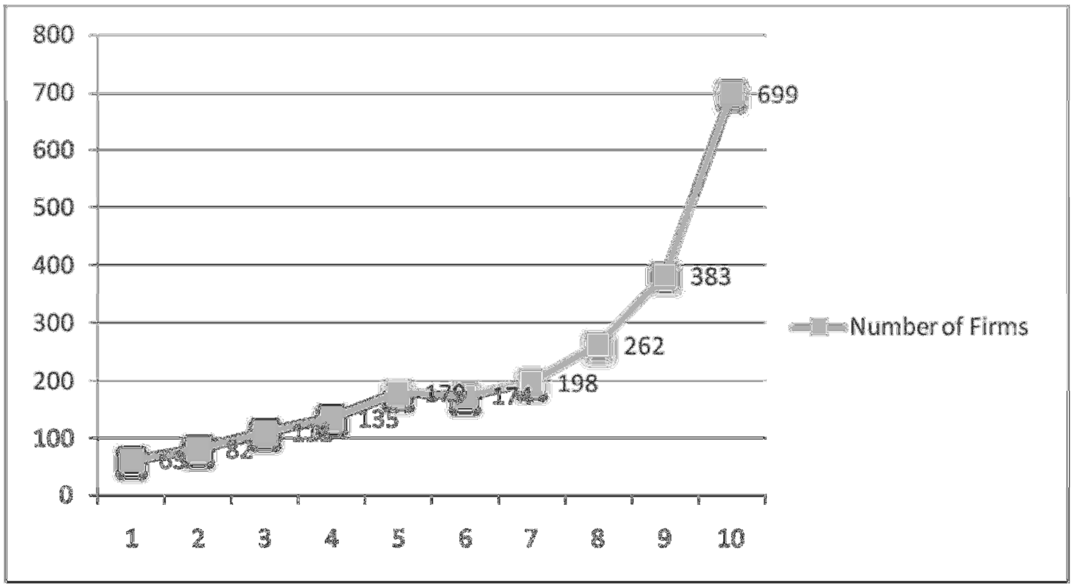
8.4 Further empirically investigating the industry homogeneity assumption

8.4.1 The alleged intangible intensive firms from intangible intensive industries

Figure 8.4 displays the distribution according to the LOI deciles of the firms in the purportedly intangible intensive industries elected by Collins et al (1997), Francis and Schipper (1999), and Core et al (2003). The industries picked by Collins et al (1997) contain in the sample a total of 2,286 firms. Of those, just 699 (31%) firms are classifiable in the top LOI decile, the one containing the most intangible product intensive firms; and only 1,344 (58%) are classifiable in the top 3 LOI deciles. The remainder 7 deciles contain a total of 942 (41%) companies. A similar situation occurs with the firms in the industries selected by Francis and Schipper (1999), and Core et al (2003) for their intangibility of being 'high tech'. They contain a total of 2,383 firms. However, merely 717 (30%) firms would be classifiable in the top LOI decile, and only 1,395 (59%) firms on the top 3 LOI deciles. The other 7 deciles include a total of 988 (41%) firms. Therefore, one can conclude that these intangible intensity studies that claimed to choose supposedly intangible industries picked quite heterogeneous samples that actually included several firms that LOI proxy seem to indicate that they have a large proportion of cost of physical goods in their total operating expenses.

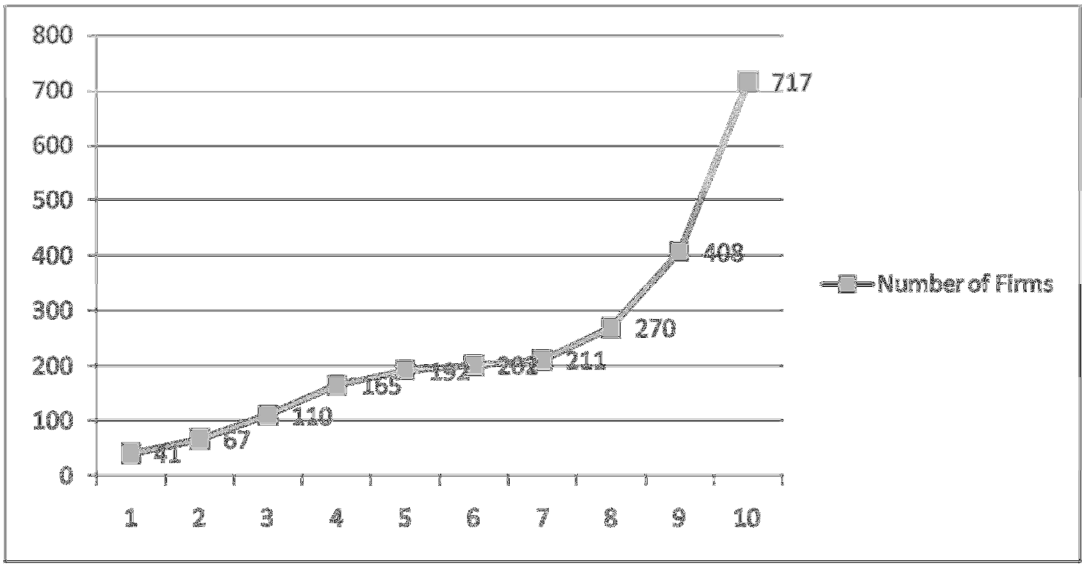
Figure 8.4- Distribution of firms in intangible intensity study industries by LOI deciles

Panel A: Distribution by LOI decile of the firms in the industries chosen by Collins et al 1997



LOI Decile

Panel B: Distribution by LOI decile of the firms in the industries chosen by Francis and Schipper (1999) and Core et al (2003)



LOI Decile

The process of a researcher's hand picking industries can certainly be highly subjective. Table 8.3 provides evidence of such a problem with the 6 industries chosen by Collins et al (1997). Using Fama and MacBeth (1973) regressions with Newey and West (1987) t-values, economic characteristics of firms were regressed on a set of control variables, and identifier variables that are equal to 1 if the respective firm is registered in the identified industry code, and 0 otherwise. As the table shows, the six industries tend to have different economic characteristics in themselves. While plastics and synthetic materials (C282) is strongly associated with larger firm *SIZE;* business services (C73), and accounting, and management related services (C87) are strongly associated with smaller firm *SIZE*. Although electronic components and accessories (C48), and plastics and synthetic materials (C282) are strongly associated with larger capital expenditures in property, equipment and plant; the drugs industry (C283) is strongly negatively associated with such type of investments. Contrary to the other four industries, plastics and synthetic materials (C282) does not exhibit a significant statistical coefficient regarding the market valuation of its firm/year observations described by the variable *MARKET_TO_BOOK*. Business services (C73), accounting, and management related services (C87), drugs (C283), and computer and office equipment (C357) are strongly negatively associated with less debt in their capital structures, whereas the set of firms registered in electronic components and accessories (C48) appears to be strongly associated with higher *LEVERAGE*.

Table 8.3- The Economic Characteristics of the Industries Chosen by Collins et al (1997)

	SIZE	*CAPEX_ PPE*	*PROFITABILITY*	*MARKET_ TO_BOOK*	*LEVERAGE*
Intercept	4.822***	0.040***	0.003	1.616***	0.250***
	(36.89)	(8.08)	(0.22)	(10.02)	(12.25)
C48	0.093	0.023***	-0.021***	0.727***	0.033***
	(1.31)	(5.63)	(-3.07)	(3.77)	(4.91)
C73	-.334***	0.000	-0.022***	0.935***	-0.097***
	(-5.21)	(0)	(-3.26)	(5.94)	(-4.4)
C87	-.518***	-0.004*	-0.018***	0.553***	-0.053***
	(-4.6)	(-1.9)	(-10.27)	(5.85)	(-2.93)
C282	1.101***	0.008***	-0.010**	0.050	-0.014
	(12.65)	(3.16)	(-2.06)	(0.49)	(-1)
C283	0.172	-.018***	-0.021***	1.737***	-0.087***
	(0.98)	(-5.44)	(-2.74)	(12.65)	(-7.46)
C357	0.152*	-0.003	-0.029***	0.957***	-0.109***
	(2.02)	(-0.94)	(-4.24)	(6.15)	(-3.79)
INTANGIBLE_ASSETS	0.626	-.045***	0.007	0.438**	0.149***
	(1.03)	(-5.4)	(0.68)	(2.04)	(3.11)
SIZE		0.002***	0.010***	-0.038	0.025***
		(2.88)	(5.9)	(-0.96)	(8.22)
CAPEX_PPE	1.699***		0.056***	3.647***	-0.057
	(2.83)		(4.5)	(22)	(-0.5)
PROFITABILITY	4.797***	0.069***		5.144***	-1.144***
	(14.96)	(3.34)		(4.02)	(-5.46)
MARKET_TO_BOOK	1.653***	0.005	-0.116***		0.000
	(10.25)	(0.5)	(-10.56)		(0.18)
LEVERAGE	-0.078	0.007***	0.009***	0.035	
	(-1.62)	(4.97)	(8.69)	(0.19)	
R Squared	0.136***	0.073***	0.250***	0.178***	0.239***
T-Value of R-Squared	(7.58)	(8.63)	(7.66)	(9.27)	(12.66)
Observations	107,070				
Firms	10,162				
Beginning Year	**1966**				
End Year	**2006**				

Notes:
1-The variables *C48*; *C73*; *C87*; *C282*; *C283*; and *C357* are identifier variables that indicate observations from firms registered in the industries considered as intangible intensive by Collins et al (1997): 48 (electronic components and accessories), 73 (business services), and 87 (engineering, accounting, and management related services); 282 (plastics and synthetic materials), 283 (drugs), and 357 (computer and office equipment). In these variables, the value 1 implies that the respective firm is registered in the identified industry code, and the value 0 implies the opposite.
2- The other variables were defined as follows: *SIZE* is measured through the logarithm of the firm's sales, after sales values have been deflated by the consumer price index; *CAPEX_PPE* are the capital expenditures in the tangibles property, plant and equipment expressed as a fraction of total assets, PROFITABILITY is the net income divided by total assets; *LEVERAGE* is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt sheets, *MARKET_TO_BOOK* is the market-value divided by the book value of the equity; the *INTANGIBLE_ASSETS* variable is the ratio of intangible assets to total assets; and the variables
3- The econometric models in Table 8.3 were computed using Fama and MacBeth regressions and Newey and West t-values.
4-The symbols *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively. Coefficient estimates and *t*-statistics are reported in the table.

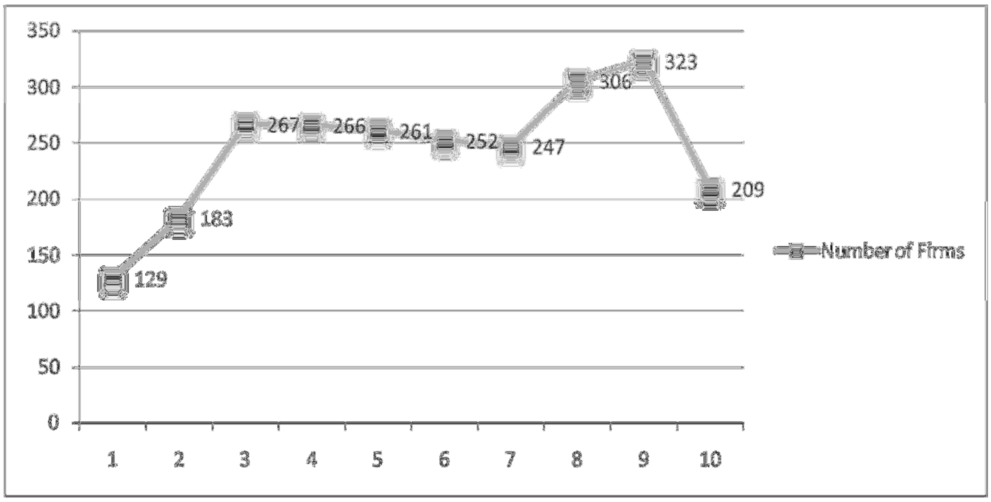
8.4.2 The alleged durable good firms that would have less debt

As described above, several studies (such as Titman and Wessels, 1988; Banerjee et al 2008) used the industry codes (SIC) ranging from 3,400 to 4,000 to pick a sample of firms that were supposed to be selling durable goods; and to demonstrate that firms selling durable goods would have less debt than the others. Our sample contains a total of 2,443 firms registered with these codes. Figure 8.5 Panel A demonstrates that the assumption that such firms were selling homogeneous products is clearly not verified in the sample. In fact, the firms in the lower LOI deciles, which correspond to the most physical goods intensive firms, were in the minority in the sample. Many firms selling semi-intangible and intangible intensive products (outputs) are registered with an industry code (SIC) lying between 3,400 and 4,000. Only 129 (5%) firms would be classified in the most material goods LOI decile, and only 579 (24%) would be classified in deciles 1, 2, or 3. The other 1,864 (76%) firms would be classified in the higher LOI deciles (4-10), which correspond to the semi intangible and intangible product intensive firms.

Furthermore, Figure 8.5 Panel B shows that even the sample of firms with an Industry Code (SIC) between 3,400 and 4,000 give us empirical support for the hypothesis in Cardao-Pito (2010 b) that firms selling flows of material goods to their customers tend to have more debt in their capital structure than other firms, which goes against the prediction of the product market literature. As we can clearly observe, the mean debt leverage of the firms in that sub sample tends to remain relatively stable for the LOI deciles between 1 and 5; and starts to decrease significantly after LOI decile 5, an empirical pattern that is similar to that described in Figure 8.1 and Appendix 1, which describes the full sample.

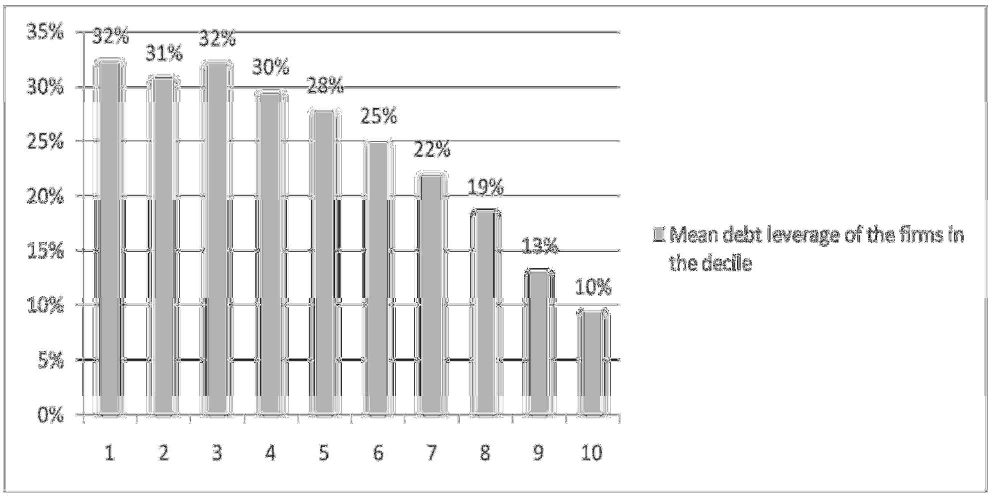
Figure 8.5- Distribution of firms and debt leverage in industries that Titman and Wessels (1988) and Banerjee et al (2008) supposed to be selling durable (SIC codes between 3,400 and 4,000)

Panel A: Distribution by LOI decile of the firms in industries with SI Codes between 3,400 and 4,000



LOI Decile

Panel B: Mean debt leverage by LOI decile of firms in industries with SI Codes between 3,400 and 4,000



LOI Decile

Table 8.4 shows that the relationship between the tangibility of the flows of products sold by firms to their customers and the proportion of debt in the firms' capital structures is quite similar both for the full sample, and for the sub sample of firms with industry code (SIC) between 3,400 and 4,000 used by Titman and Wessels (1988), and Banerjee et al (2008). The results were obtained using Fama and MacBeth (1973) regressions with Newey and West (1987) t-values, and several control variables. As described by model 1, *LOI* is strongly negatively correlated with leverage both in the full sample (coefficient: -0.234; t-value: -6.18) and the sub sample (-0.279: -5.02). Model 2 and Model 3 show that both in the full sample and in the sub sample, the identifier variables denoting physical good intensity (lower three LOI deciles) are strongly positively correlated with leverage, whilst the identifier variables denoting intangible product intensity (higher three LOI deciles) are strongly negatively correlated with debt as a proportion of the capital structure. Therefore, these findings give us further empirical reasons to corroborate the LOI-Leverage hypothesis studied in previous chapters, and demonstrate the empirical non-verification of the prediction of the product market literature.

Table 8.4- The tangibility of the flows of products sold and a firm's capital structure: comparing the full sample with the sub-sample of industries picked by Titman and Wessels (1988), and Banerjee et al (2008)

	Full Sample			Sub sample of firms with Industry Code (SIC) between 3,400 and 4,000		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	0.323***	0.232***	0.268***	0.252***	0.141***	0.172***
	(23.93)	(9.63)	(15.07)	(11.89)	(3.53)	(5.11)
LOI	-0.234***			-0.279***		
	(-6.18)			(-5.02)		
Decile 1		0.018***			0.043***	
		(4.78)			(4.22)	
Decile 2		0.024***			0.053**	
		(3.22)			(2.68)	
Decile 3		0.026***			0.051***	
		(3.86)			(3.97)	
Decile 8			-0.065***			-0.076***
			(-8.52)			(-7.89)
Decile 9			-0.095***			-0.077***
			(-7.45)			(-4.46)
Decile 10			-0.153***			-0.124***
			(-5.68)			(-4.56)
INTANGIBLE_ASSETS	0.163***	0.144**	0.156***	0.445***	0.441***	0.432***
	(2.77)	(2.43)	(2.77)	(10.36)	(10.42)	(9.99)
SIZE	0.021***	0.026***	0.022***	0.017***	0.021***	0.020***
	(8.54)	(7.58)	(8.59)	(6.87)	(6.84)	(6.51)
CAPEX_PPE	-0.139	-0.058	-0.074	0.159*	0.193**	0.213***
	(-1.07)	(-0.53)	(-0.63)	(1.96)	(2.53)	(2.92)
PROFITABILITY	-1.147***	-1.122***	-1.155***	-0.954***	-0.917***	-0.949***
	(-5.54)	(-5.15)	(-5.65)	(-6.15)	(-5.53)	(-5.86)
MARKET_TO_BOOK	0.002	-0.003	0.002	0.009***	0.005**	0.008***
	(0.96)	(-0.78)	(1.02)	(4.74)	(2.36)	(4.1)
R Squared	0.234***	0.212***	0.238***	0.280***	0.255***	0.267***
T-Value of R-Squared	(10.82)	(7.95)	(12.15)	(20.23)	(16.37)	(20.78)
Observations	107,070	107,070	107,070	30,880	30,880	30,880
Firms	10,162	10,162	10,162	2,443	2,443	2,443
Beginning Year	**1966**	**1966**	**1966**	**1966**	**1966**	**1966**
End Year	**2006**	**2006**	**2006**	**2006**	**2006**	**2006**

Notes:

1- The variables were defined as follows: *LOI* is the proxy for the level of operating intangibility identifying the proportion of intangible related expenses amongst total operating expenses as defined on equation (5.3); *SIZE* is measured through the logarithm of the firm's sales, after sales values have been deflated by the consumer price index; *CAPEX_PPE* are the capital expenditures in the tangibles property, plant and equipment expressed as a fraction of total assets, PROFITABILITY is the net income divided by total assets; *LEVERAGE* is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt sheets, *MARKET_TO_BOOK* is the market-value divided by the book value of the equity; the *INTANGIBLE_ASSETS* variable is the ratio of intangible assets to total assets; and

2- The 10,162 firms in sample were grouped into deciles according to the mean LOI computed using all sample observations. The entire sample was subdivided into ten sets. Thus, firms with analogous mean levels of operating intangibility were grouped together. Each decile has approximately the same number of firms, namely, 1,016 or 1,017 firms. When a firm is classified in one decile, all its observations will be classified in that decile. The variables *Decile* [1-3; 8-10] are identifier variables that indicate observations from firms classified in the respective LOI decile in the full sample

3- The econometric models in Table 8.4 were computed using Fama and MacBeth regressions and Newey and West t-values.

4-The symbols *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively. Coefficient estimates and *t*-statistics are reported in the table.

8.4.3 Robustness checks

The regressions in Table 8.3 and 8.4 use Fama and MacBeth regressions with Newey and West t-values. A substantial part of the analysis is based on identifier variables that provide a description of the respective individual effects. Similar results were obtained when identifying the individual effects in regressions in random effects models by general least squares or maximum likelihood estimators by firm. Furthermore, the set of industries hand picked by Francis and Schipper (1999), and Core et al (2003) could be used to provide a similar example to the industries hand picked by Collins et al (1997) and examined in Table 8.3. (results not tabulated here).

8.5- Conclusion of the chapter

The widely adopted assumption of industry homogeneity has been refuted empirically. Using the Level of Operating Intangibility to classify organizations and industries, this chapter has presented two situations where such an assumption could not be verified by the sample. First, intangible intensity studies that were said to have analyzed supposedly intangible industries (cf. Core et al 2003; Collins et al 1997; Francis and Schipper 1999) were found to have identified heterogeneous samples that included a number of physical good intensive firms. Second, the prediction that firms selling durable goods have a lower proportion of debt than others (cf. Titman 1984; Titman and Wessels 1988; Banerjee et al 2008) was contradicted by scrutiny of the industries claimed to be exclusively selling durable goods. The homogeneity assumption is shown to have led researchers to incorrect conclusions because in those subjectively chosen industries the physical good intensive firms are much fewer than the intangible product intensive firms, and indeed tend to have a larger proportion of debt in their capital structure.

It is striking to observe the self assurance of a literature in neoclassical economics regarding products or organization that rarely, if ever, quotes studies from other disciplines that are deeply concerned with exactly the same themes, such as management and organization studies, economic sociology, or heterodox economics. As demonstrated in this paper, the standard industrial classification (SIC) code can no longer be used as an excuse for neoclassical economics not to embrace interdisciplinary conversations with other scientific disciplines that, for the study of some empirical phenomena, are much more advanced that neoclassical economics itself. As explained by the intangible flow theory (see chapter 2), the major problem is not the mathematical/quantitative methods used by neoclassical economics, as those are relevant instruments at the disposal of scientists, but an idealization of these methods leading to a belief that the mathematical/quantitative tools should eliminate any other form of scientific inquiry.

This chapter presents a concrete example: to use a mathematical/quantitative method as a justification for the false claim that firms and products within industries are homogeneous is a misuse of the mathematical/quantitative method, not a problem of the mathematical/quantitative method in itself. If neoclassical economics can only use mathematical/quantitative tools of reasoning to posit its hypotheses, then it cannot be technologically prepared to reach intangible elements that cannot be precisely identified or realized by the mind; and cannot be appraised at an actual or approximate value such as work flows, service flows, communicational flows or information flows.

The Level of Operating Intangibility has revealed itself to be a stable variable by firm, as its variation within each LOI decile was relatively small, and especially small if compared with the variability within highly heterogeneous industries. Therefore, the Level of Operating Intangibility might well be an identifiable economic characteristic of organizations. This is of interest for researchers, practitioners, accounting authorities and other stakeholders. In particular, accounting standard setters might be interested in actively facilitating further analysis. As it stands, the LOI variable has been examined through an imperfect proxy. However, in order to study and understand organizations, one could certainly benefit from having intangible related expenses being discriminated in more detail in the income and cash flow statements, given their significant statistical associations with the other economic characteristics of firms.

9- Operating Intangibility around the World

9.1 Introduction

Upon this point of the thesis, the five hypotheses (which associate the tangibility of a firm's flows of products with other economic characteristics of organizations) were demonstrated in a large USA based sample with many observations from 10,162 firms over a large period of 41 years (1966-2006). Several econometric tests were implemented to confirm the empirical results. Furthermore, a scrutiny of specific industries shown that the neoclassical economic assumption of intra industry homogeneity (i.e.: firms registered under the same industry code are either homogeneous or sell homogeneous products) was not empirically verified. Within each industry, a great heterogeneity of firms and products can exist.

However, one might had doubts regarding the problem of geocentrism of the findings, because the previous results are exclusively related to firms listed in North American stock exchanges. Could it be that the previous empirical findings describe phenomena that are only observed in USA, or even Europe, but not in the rest of the World? Could it be that the results were only applicable to countries where, not all, but the majority of the population have a Christian/Catholic cultural background, and the same results would not observable in countries were, not all, but the majority of population is Muslim, Buddhist, or Jewish? Would these results be applicable in countries outside the G-20 group, which includes the most industrialized countries? Or, would these results be applicable in countries having different accounting systems to USA's FASB? Or, are these results still applicable in the twenty first century? Or, would these results be replicable only in the

English speaking world?

To address these questions, this chapter studies a different database to the merged CRSP/Compustat database studied in previous chapter, namely, the Worldscope database obtained from the Datastream service. The current chapter focuses its attention in 14 countries with numerous observations in the Worldscop database: Australia, Canada, China, France, Germany, Israel, Japan, Malaysia, Singapore, South Africa, South Korea, Sweden, Taiwan, and UK. The criterion for choosing these countries was objective: the countries with larger firm constituent list in Worldscope/Datastream database, The results obtained in the international sample are also compared to the results for USA firms obtained when using the merged CRSP/Compustat Database. Therefore, this thesis follows a total of 15 countries, all of them having relatively sophisticated financial markets.

9.2 Sample selection and variables used

9.2.1 Identification of country heterogeneity

The criterion for identifying the countries in the Worldscope database was objective. Intangible flow theory is a grounded, practice oriented and heterodox theory, which is not trying to define how firms should behave in practice, but trying to understand how and why firms conduct their ongoing production of economic, social and embedded actions (on these matters see Charmaz 2006; Goulding 2002; Feldman and Orlikowski, 2011, and Lawson 2006). Following the intangible flow theory spirit, the countries selected for this chapter could describe set of countries with larger firm constituent list in Worldscope database.[29] The

[29] Exception being Israel, which was chosen for having a different cultural background from the other countries

countries selected correspond to those that according to the database, information exist about more than 800 firms, with the exception of India that very unfortunately does not have information necessary to compute LOI, and USA that have been studied in the CRSP/Compustat sample; and the inclusion of the Israel sub sample as a case study of a country where the majority, but certainly not all, of the population is Jewish.

The analysis starts on year 2000 because for most countries the number of usable observations before 2000 is relatively low. The time period of 2000-2009 corresponds to the first decade of the twenty first century, which addresses one of the questions above. The choice over countries with larger samples was made taking in careful consideration the problem of the robustness of findings, giving that smaller samples could render results that were less conclusive. Furthermore, smaller country samples might be organized around fewer geographical business clusters, as in the concept proposed by Porter (1998) where a business cluster is understood as a geographic concentration of interconnected businesses, suppliers, and associated institutions in a particular field (see also Romanelli and Khessina 2005). The eventual interconnectedness of firms will be interesting to study in future research, but at this stage we are looking for heterogeneous samples in order to study the associations of the level of operating intangibility with other economic characteristics of firms.

Therefore, the 15 country sub samples (including the USA sub sample studied in previous chapters) offer us a framework to address the questions put in the introduction of this chapter. It contains 6 countries located either in Europe or North America (Canada, France, Germany, Sweden, UK and USA), and 9 countries outside that geographical area (Australia, China, Israel, Japan, Malaysia, Singapore, South Africa, South, Korea, and Taiwan).

The majority of the population is not Christian/Catholic in 7 of the international sample countries (China, Israel, Japan, Malaysia, Singapore, South Korea, and Taiwan).

The sample contains 10 countries that are part of G-20 group, which includes the most industrialized countries in the World (Australia, Canada, China, France, Germany, Japan, South Africa, South Korea, UK and USA), and 5 countries that are not included in the G-20 group, although having relatively sophisticated capital markets (Israel, Malaysia, Singapore, Sweden, and Taiwan).[30]

The FASB accounting norms are applicable specifically in the USA's economy and not followed in the other 14 countries. Nevertheless, there has been a significant effort of harmonizing accounting norms over the world in the past years.

Finally, 5 countries in the sample have English as the first speaking language (Australia, Canada, South Africa, UK and USA), and 10 countries have other first speaking language (China, France, Germany, Israel, Japan, Malaysia, Singapore, South Korea, Sweden, and Taiwan).

9.2.2 Observations and firms used by country

Table 9.1 describes the observations used from the Worldscope/Datastream

[30] Nonetheless, Sweden is represented in the G-20 group through the European Union representative.

database. For the time period 2000-2009, the sample contains 194,625 observations with calendar date, that is, with a specific date attributed. After setting the data criteria that allow producing the variables necessary for this study, 120,380 observations are available due to the elimination of missing and irregular observations. Missing or irregular observations are those that either have no values for the variable required for this study, or have inscriptions that are not numerical quantifications of the variable, such as '.'. After removing observations not defined in the country's major currency 115,883 observations remain. Eliminating observations where LOI could not be computed results in a sample of 115,397 observations. After removing the outlier observations in the variables size, capital expenditures, market to book and capital structure we obtain the final sample with a very large data set of 105,635 firm/year observations and 18,874 firms from 14 countries.[31]

Although in absolute terms the number of observations is not distant and the number of firms is higher to the observations and firms used in CRSP/Compustat sample, it is necessary to note that the international sample contains the sub samples of 14 countries that can be very distinct in terms of political landscape, economic framework, society characteristics, cultural background, accounting norms, etc. Therefore, the Worldscope/Datastream sample used should not be seen as an aggregated sample, but as a set of sub samples representing 14 different country sub samples.

The dimension of the final sub samples ranges from the 1,265

[31] For Australia, the Worldscope/Datastream database does not contain observations where LOI could be computed in the year 2000. Therefore, the Australia Sample corresponds to the time period 2001-2009.

observations/259 firms in France and 1,494 observations/266 firms in Sweden, to the 14,341 observations /2,873 firms in UK and 28,542 observations/4,223 firms in Japan.

Table 9.1- Firm/Year observations in the international sample containing observations from 14 country sub samples obtained in the Worldscope database
Panel A: Full Sample

	Firm/Year Observations
Sample Selection	Total Sample
>>>Observation with calendar date for period (2000-2009) in DATASTREAM database	194,625
>>>After setting criteria for the data necessary to the study, which eliminates irregular and missing observations	120,380
>>>After eliminating observations not defined in the country's currency	115,883
>>>After eliminating observations where the LOI could not be computed, or was outside the interval [0,1] and irregular observations after computation	115,397
>>>Final sample after eliminating outliers on the variables Size, Capital Expenditures, Profitability, Market to Book and Capital Structure	105,635
>>>Number of Firms in the Final Sample	18,874

Panel B: Sub samples by country

Sample Selection	Firm/Year Observations Australia	Canada	China	France	Germany	Israel	Japan	Malaysia	Singapore	South Africa	South Korea	Sweden	Taiwan	UK
>>>Observation with calendar date for period (2000-2009) in DATASTREAM database	15,042	22,639	19,457	8,961	9,740	3,384	39,866	9,981	6,192	4,144	13,128	4,335	14,062	23,694
>>>After setting criteria for the data necessary to the study, which eliminates irregular and missing observations	5,527	10,413	13,133	1,394	5,014	2,771	31,198	6,368	3,925	1,442	10,811	1,658	10,795	15,931
>>>After eliminating observations not defined in the country's currency	5,500	10,038	9,919	1,391	5,006	2,194	31,194	6,335	3,837	1,431	10,809	1,658	10,754	15,817
>>>After eliminating observations where the LOI could not be computed, or was outside the interval [0,1] and irregular observations after computation	5,381	9,985	9,894	1,379	4,968	2,183	31,192	6,331	3,829	1,407	10,802	1,628	10,748	15,670
>>>Final sample after eliminating outliers on the variables Size, Capital Expenditures, Profitability, Market to Book and Capital Structure	4,928	9,140	9,056	1,265	4,551	2,001	28,542	5,796	3,506	1,291	9,888	1,494	9,836	14,341
>>>Number of Firms in the Final Sample	1,229	1,990	1,542	259	877	415	4,223	945	638	287	1,722	266	1,608	2,873

Table 9.2 describes the number of observations available for each sample country by year.

Table 9.2- Observations available for each country sub sample by year.

Year	Australia	Canada	China	France	Germany	Israel	Japan	Malaysia	Singa -pore	South Africa	South Korea	Sweden	Taiwan	UK
2000		542	100	112	277	46	1761	309	162	76	377	106	306	1331
2001	428	603	111	117	316	58	1822	455	272	104	449	118	581	1508
2002	466	697	962	110	365	70	2077	522	319	118	654	157	761	1458
2003	462	761	998	105	406	77	3119	547	330	137	770	149	907	1387
2004	507	859	1074	94	417	89	3193	591	367	127	824	153	1099	1402
2005	589	1120	1018	132	519	300	3268	639	395	134	1240	160	1149	1486
2006	567	1197	1104	138	554	346	3343	685	404	138	1319	161	1198	1546
2007	606	1205	1163	149	587	346	3432	693	411	141	1352	167	1258	1544
2008	664	1114	1219	147	559	329	3368	681	412	160	1430	158	1265	1399
2009	639	1042	1307	161	551	340	3159	674	434	156	1473	165	1312	1280
Total	4928	9140	9056	1265	4551	2001	28542	5796	3506	1291	9888	1494	9836	14341

9.2.3 Variables used

The variables constructed for this chapter were created to replicate the tests conducted on the American merged CRSP/Compustat sample, with the necessary adaptations to another database that does not have the exact same fields, and even when it does, they may follow relatively different accounting practices. Nonetheless, recall that the issue of whether different accounting practices could not verify the hypothesis is a subject under study in this chapter.

We will follow six main variables, that is a LOI proxy that can be replicated in all country sub samples, and the other five economic characteristics of firms and industries studied in this thesis. A discussion of alternative proxies for LOI was made on chapters 6 and 7. Unfortunately, it is not possible to decompose LOI in order to identify R&D expenses in most countries due to missing data on this variable. Moreover, previous findings shown that the inclusion or exclusion of amortizations and depreciation expenses in the LOI proxy denominator was not an empirically relevant questions. Thus, the variables used in this chapter are:

LOI: is a proxy for the proportion of total intangible related expenses incurred in the system of producing and selling products to customers, computed as the ratio of selling, general and administrative expenses to total of operating expenses.

SIZE: is the logarithm of sales after the monetary value of sales have been compared to 2007 prices through the Consumer Price Index of the respective country.

CAPEX: is the value of the capital expenditures in property, plant and equipment expressed as a fraction of total assets,

PROFITABILITY is quantified as net income before extraordinary items/preferred dividends divided by total assets. The non inclusion of extraordinary items is decided to avoid the effects that different country policy towards extraordinary items could have on the empirical results.

MARKET_TO_BOOK is the market-value of equity, as listed on the country's respective stock market, divided by the book value of equity.

LEVERAGE is the book value of total debt divided by the sum of total assets.

9.3 Descriptive statistics

9.3.1 Comparing the economic characteristics of the firms in the country sub samples

Descriptive statistics for the 14 country sub samples are displayed on table 9.3 and represented visually on figure 9.1. Although each of the sub samples has firms registered in the stock market of the respective country, it is difficult to identify into which extent each country sub sample represents the respective economy. For instance, this study is focused in public listed firms, but many firms do not have shares that are traded on stock exchanges. Furthermore, although informative, there might be some reservations when comparing the values obtained for the variables inter-countries. Nonetheless, the variables can be concretely studied within each country sub sample.

China (17%), Malaysia (16%), South Korea (16%), and Taiwan (15%) sub samples have the lowest mean level of operating intangibility for the sub samples represented in the time period 2000-2009. On one hand, this may identify the lower cost for service production in those countries, especially in China, Taiwan and Malaysia. But this cannot be the only explanation, because the costs of goods within an economy cannot be isolated from the embedded intangible costs of producing and selling them. Furthermore, these findings may also denote economies that are more centred (or more dominant) in tangible good production.

If the costs of intangible work in the country sub samples of China and Malaysia cannot be compared with the same costs in country sub samples of Australia, Canada and UK, which are the sub samples with higher level of operating intangibility (36%, 33% and 48% respectively), the costs of service production in Germany and Japan country sub samples can eventually be compared. Nonetheless, the mean level of operating intangibility of the firms in Germany and Japan sub samples is much lower (25% and 23%), which may denote a higher focus on intangible intensive products for the firms in the Australia, Canada and UK sub samples.

The variable size cannot be compared directly because it is expressed in different currencies. Therefore, it can only be studied within each country sub sample. However, given that capital expenditures are expressed proportionally to the total assets, they can be approximately compared. The countries with higher rate of capital expenditures are Canada (10%), China (6%) and South Africa (6%). The country with clearly lower rate of investments in equipment and facilities is Japan (3%). A total of 12 out of 14 countries remain in the interval [4%, 6%].

Profitability, also computed as a proportion of total assets reveals much more inter country variability. There are three country sub samples where the mean profitability of the firms for the period 2000-2009 was clearly on the red alert, namely, Australia (-11%), Canada (-7%) and UK (-3%). The country sub samples having the firms that apparently performed better in terms of mean profitability were France (10%) and South Africa (7%). The mean profitability of the other 9 countries belonged to the interval [-1% , 4%]. These values might also reflect different accounting systems.

Apart Malaysia, where the market value of equity was close to the book value of equity (ratio of 1.08; this sub sample has also one of the lowest mean level of operating intangibility), all the other country sub samples clearly had higher market valuation on average to the same accounting equity item during the this time period. South Korea and Japan, the following mean value countries had a mean market value superior in 21% and 40% to the book values of equity, respectively. The countries with higher market valuation were China, with a superior market value of 258%; Sweden with a premium of 162% and Australia with a premium of 146%. In total, 8 out of 14 country sub samples had a market value that was 100% or more in excess to the book value of equity.

In terms of proportion of debt in the total capital structure, there are two country sub samples where the mean leverage is higher, namely China with debt representing 27.3% of total assets, and Israel, with debt representing 32.1%. Although not for the space of this thesis, it would be an interesting question to investigate why this two countries diverge from the overall debt rations of the other 12 countries. The other 12 out of 14 country sub sample have mean debt ratios that can be classified in the interval [15%, 23.5%].

Table 9.3 Descriptive statistics by country sub sample*

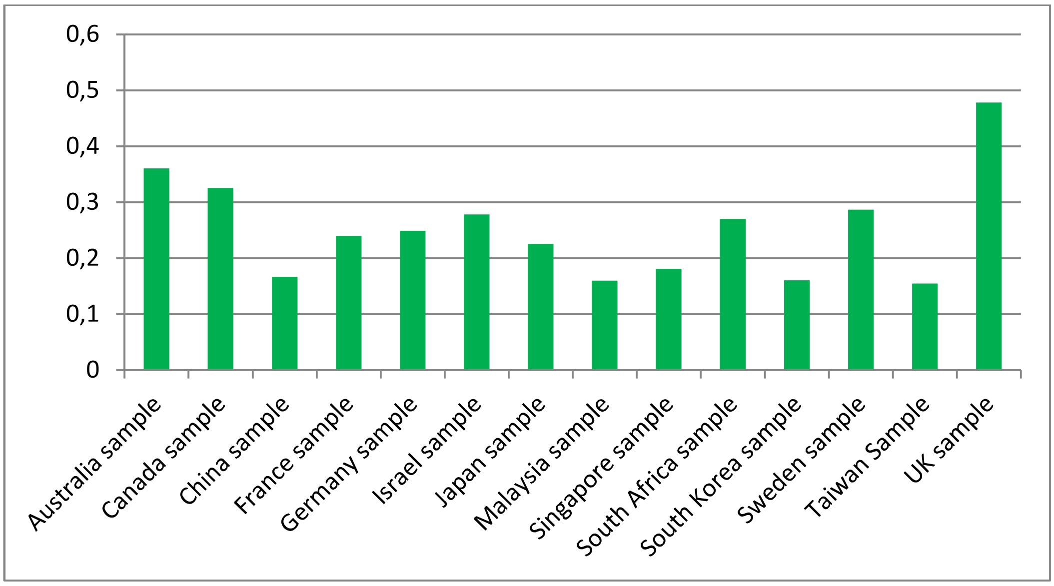
	Australia		Canada		China		France		Germany		Israel		Japan	
Variable	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
LOI	0.36	0.29	0.33	0.28	0.17	0.13	0.24	0.23	0.25	0.20	0.28	0.22	0.23	0.16
SIZE	10.05	2.66	10.39	2.69	13.81	1.16	2.70	13.31	11.90	2.27	12.50	1.87	17.48	1.46
CAPEX_PPE	0.06	0.10	0.10	0.12	0.06	0.06	0.05	0.03	0.04	0.05	0.04	0.05	0.03	0.03
PROFITABILITY	-0.11	0.38	-0.07	0.27	0.03	0.05	0.10	0.03	-0.01	0.15	0.02	0.10	0.02	0.05
MARKET_TO_BOOK	2.46	2.82	2.43	2.95	3.58	2.66	2.01	1.69	2.25	2.11	1.73	1.47	1.40	1.34
LEVERAGE	15.83	17.69	18.22	19.07	27.32	16.04	17.74	20.73	19.59	18.47	32.14	22.81	22.46	19.02

	Malaysia		Singapore		South Africa		South Korea		Swedenn		Taiwan		UK	
Variable	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
LOI	0.16	0.13	0.18	0.14	0.27	0.24	0.16	0.15	0.29	0.22	0.15	0.12	0.48	0.30
SIZE	12.04	1.32	11.59	1.34	13.74	2.44	18.72	1.60	14.14	2.20	14.97	1.37	9.79	2.54
CAPEX_PPE	0.04	0.05	0.05	0.06	0.06	0.06	0.05	0.06	0.04	0.05	0.05	0.05	0.04	0.05
PROFITABILITY	0.03	0.08	0.03	0.11	0.07	0.11	0.01	0.12	0.00	0.18	0.04	0.08	-0.03	0.20
MARKET_TO_BOOK	1.08	0.84	1.42	1.15	2.11	1.94	1.21	1.12	2.62	2.25	1.49	0.97	2.32	2.99
LEVERAGE	21.94	17.17	19.14	15.46	15.17	15.03	23.32	18.07	23.22	19.26	21.54	15.96	15.18	16.13

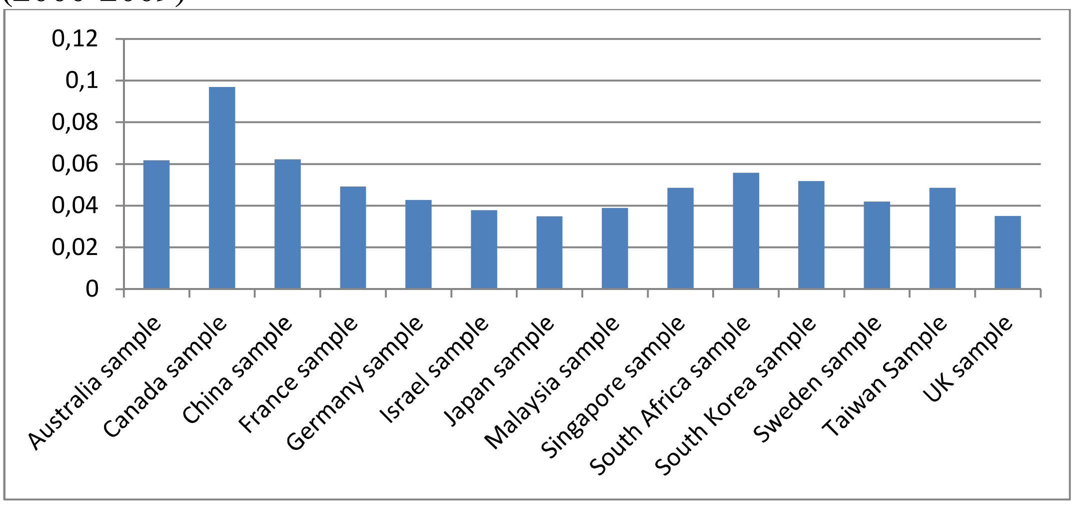
Notes: 1- Table 9.3 presented mean values and standard deviations for 13 countries sub samples over the period 2000-2009. The variables were defined as follows: *LOI:* is a proxy for the proportion of total intangible related expenses incurred in the system of producing and selling products to customers, computed as the ratio of selling, general and administrative expenses to total of operating expenses. *SIZE:* is the logarithm of sales after the monetary value of sales have been compared to 2007 prices through the Consumer Price Index of the respective country. *CAPEX:* is the value of the capital expenditures in property, plant and equipment expressed as a fraction of total assets, *PROFITABILITY* is quantified as net income before extraordinary items/preferred dividends divided by total assets. The non inclusion of extraordinary items is decided to avoid the effects that different country policy towards extraordinary items could have on the empirical results. *MARKET_TO_BOOK* is the market-value of equity, as listed on the country's respective stock market, divided by the book value of equity. *LEVERAGE* is the book value of total debt divided by the sum of total assets.

Figure 9.1 Graphical comparisons of the economic characteristics of firms over the period 2000-2009 in the international sample.

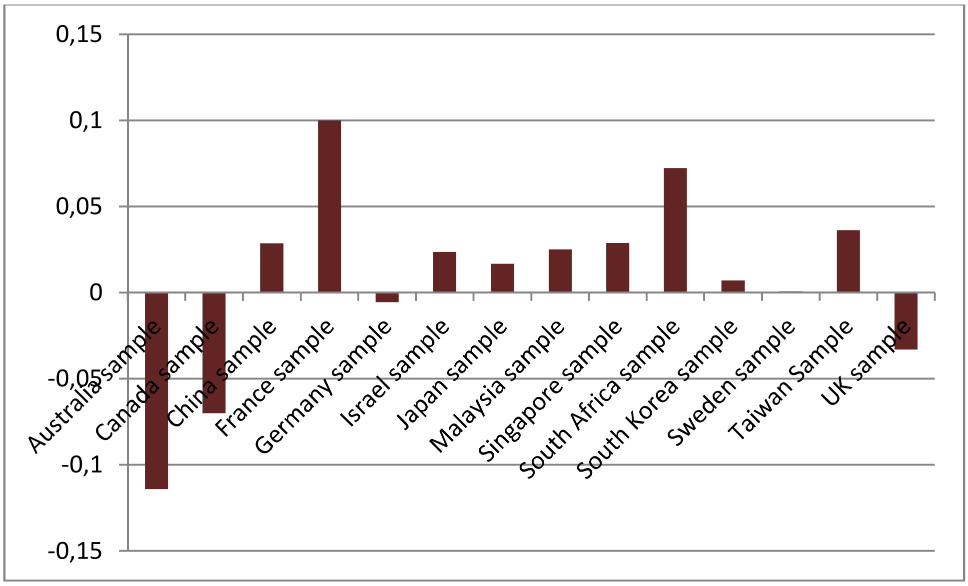
Panel A: Mean Level of Operating Intangibility (2000-2009)



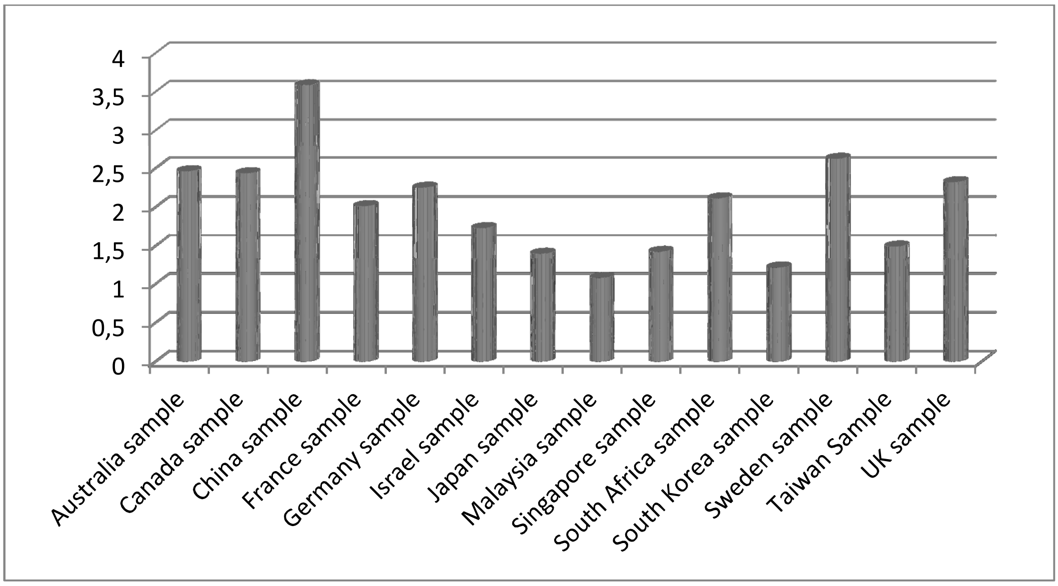
Panel B: Mean Capital Expenditures in Equipment and Facilities (2000-2009)



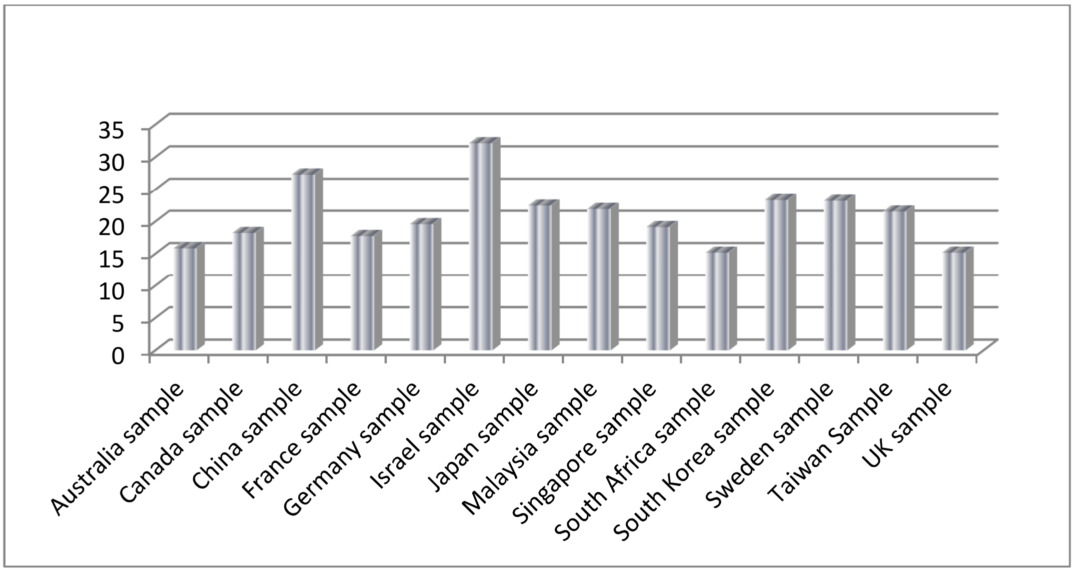
Panel C: Mean Profitability (2000 – 2009)



Panel D: Mean Market to Book Valuation (2000 – 2009)



Panel E: Mean proportion of debt in the capital structure (2000-2009)



9.3.2 The yearly behaviour of the Level of Operating Intangibility over the first decade of the twenty first century in the country sub samples

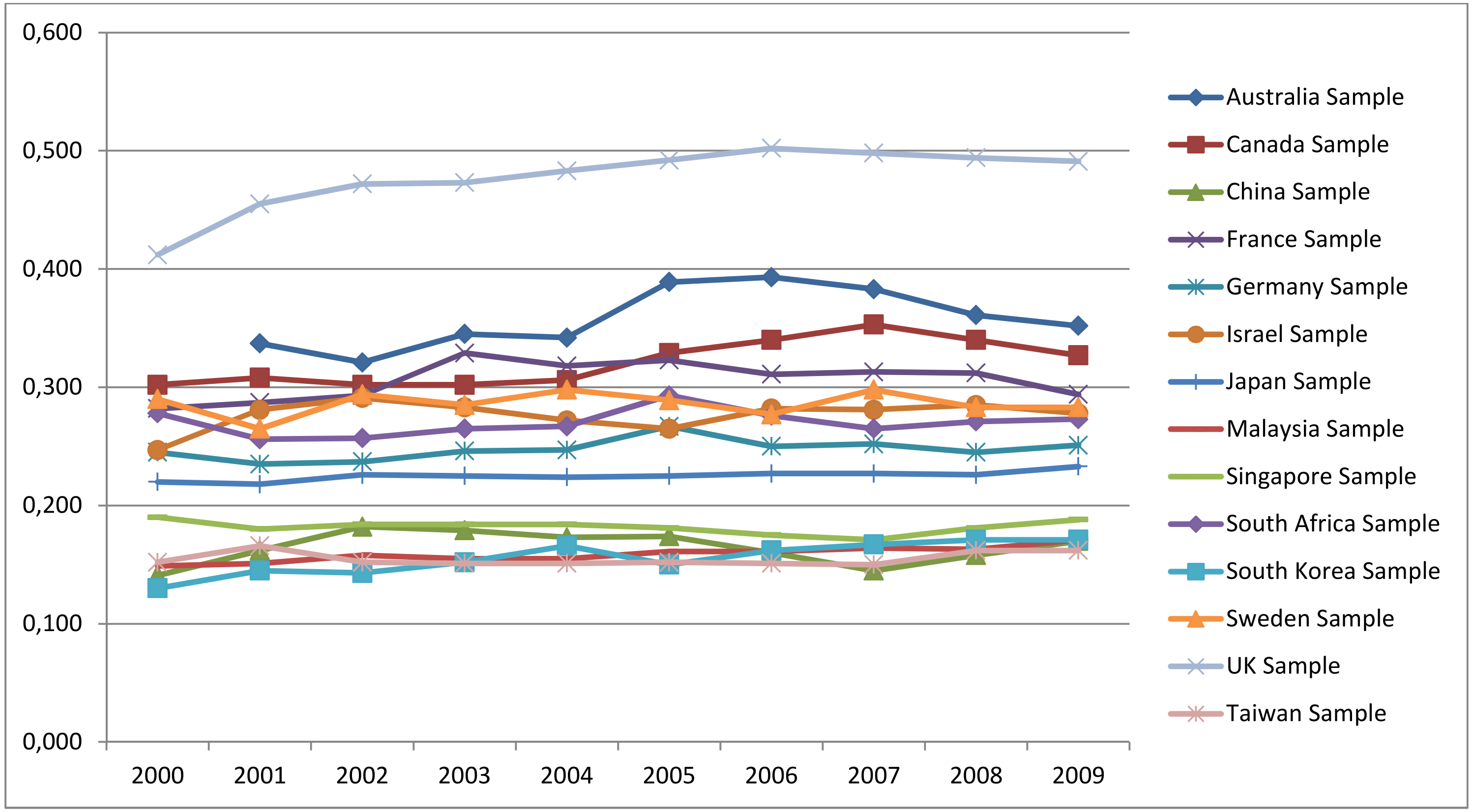
Table 9.4 and figure 9.2 display the values for the level of operating intangibility in the 14 country sub samples during the first decade of the twenty first century (2000 – 2009). As it was previously found in chapter 8, the level of operating intangibility appears to have the properties of an economic characteristic capable of describing a firm, the organizations registered in an industry, and as shown in the current chapter, the firms within an economy sample. As it is clearly observable in the graph of figure 9.2, over the first decade of the twenty first century, the level of operating intangibility exhibited high level of stability by remaining under a limited range of values for each country sub sample.

Further research might find interesting to explore periods in history where an economy may have significantly changed its mean level of operating intangibility, in order to further understand causes and consequences that may be present in those situations. Apparently, a sudden change in the level of operating intangibility did not occurred in the first decade of the twenty first century for the country sub samples under study.

Table 9.4: Mean LOI by year in the period 2000-2009 for each country sub sample

Sample\Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Australia Sample		0.337	0.321	0.345	0.342	0.389	0.393	0.383	0.361	0.352
Canada Sample	0.302	0.308	0.302	0.302	0.306	0.329	0.340	0.353	0.340	0.327
China Sample	0.141	0.162	0.182	0.179	0.173	0.174	0.160	0.145	0.158	0.170
France Sample	0.282	0.287	0.293	0.329	0.318	0.323	0.311	0.313	0.312	0.294
Germany Sample	0.245	0.235	0.237	0.246	0.247	0.267	0.250	0.252	0.245	0.251
Israel Sample	0.247	0.281	0.291	0.283	0.272	0.265	0.282	0.281	0.285	0.278
Japan Sample	0.220	0.218	0.226	0.225	0.224	0.225	0.227	0.227	0.226	0.233
Malaysia Sample	0.149	0.151	0.158	0.155	0.155	0.161	0.161	0.164	0.163	0.171
Singapore Sample	0.190	0.180	0.184	0.184	0.184	0.181	0.175	0.171	0.181	0.188
South Africa Sample	0.278	0.256	0.257	0.265	0.267	0.293	0.276	0.265	0.271	0.273
South Korea Sample	0.130	0.145	0.143	0.152	0.166	0.150	0.162	0.167	0.171	0.171
Sweden Sample	0.290	0.265	0.294	0.285	0.298	0.289	0.277	0.298	0.283	0.283
Taiwan Sample	0.152	0.166	0.152	0.151	0.151	0.152	0.151	0.150	0.162	0.162
UK Sample	0.412	0.455	0.472	0.473	0.483	0.492	0.502	0.498	0.494	0.491

Figure 9.2: Mean LOI by year in the period 2000-2009 for each country sub-sample



9.4 Hypothesis testing in the country sub samples

The hypothesis tests conducted in the international sample is alligned with the statistical tests implemented in the past chapters. Besides the Spearman's and Pearson's correlation coefficients (Appendix 4), the analysis of hypotheses will rely on advanced fixed effects models controlling for firm and year fixed effects (Table 9.5.A), and Fama Macbeth models with standard error rectified with the Newey- West procedure (Table 9.5.B). Table 9.6 sumarizes the hypothesis verification in the 14 country sub samples over the period 2000-2009 (first decade of the twenty first century), along with the findings on the USA sample described in the previous chapters, which are also considered. Those, the results bellow consider the findings of 15 country sub samples.

9.4.1 Size

The hypothesis describing that the size of a firm tends to decrease with a decrease in the tangibility of its product flows, as measured by its level of operating intangibility, was universally verified in the 15 country sub samples. All tests resulted in very high levels of significance, at the 1% degree or better.

9.4.2 Investment Profile

This time period contains a serious economic crisis in the western world post 2007 and a large stock market crash post 2001. This events could have affected the investment profile of firms. However, despite this facts, the hypothesis inquiring whether investments in property, equipment and facilities of a firm tend to decrease with a decrease in the tangibility of its product flows, as measured by its level of operating intangibility, was strongly verified in 11 out of 15 countries. Results were inconclusive in China, Taiwan, and and Germany sub samples because neither the fixed effects or the Fama Macbeth models rendered levels of significance at the 10% rank or better. The hypothesis was not verified in Japan sub sample according to the results of the fixed effects and Fama Macbeth models.

It is curious that the capital expenditures hypothesis is not verified in Japan sub sample because past literature has noted a certain tendency of Japanese firms to expense capital expenditures as extraordinary items (Shuto 2007; Herrmann et al 2003). This possibility would be consistent with the fact that the Japan sub sample is the only one with a yearly mean investiment in capital expenditures bellow 4% of total assets. The tendency for earning manipulation and lower quality in the financial statements of chinese firms have also been proposed by Wang et al (2008) and Liu and Lu (2007). A problem that could eventually also be put to the nearby neighbour Taiwan.

However, accounting practices and policies might not be the only explanation for the inconclusive results in Germany, Japan or China. A lesser heterogeneity in the investmentsin capital expenditures, or the characteristics of firms in these countries would also explain the results. Alternativelly, the results could be derived from economies that decided to procede to a tangibilization of their economic production during this period, as for instance the software firm Microsoft decided in the last years to start selling tangible computer periferics such as keyboards, mouses and web cams.

Nonetheless, given the very strong results in the other 11 countries, we cannot exclude possible impacts of different accounting policies. Japan only authorized some companies to disclose accounting norms in accordance to IFRS in Decemebr 2009[32], on a merely voluntary basis, and the Chinese Accounting Standards for Business Enterprises (CAS), approved in 2007, although in an effort to converge with IFRS, still have an ongoing process in order to converge with the IFRS norms.[33]

9.4.3 Profitability

As observable in figure 8.1 and table 8.2 of last chapter, the profitability hypothesis was the one appearing to have the weakest empirical support in the USA merged CRSP/Compustat sample. Nonetheless, in the international sample, it resisted much better than expected. It was strongly verified in 11 out of 15 countries.

The profitability hypotheses was not verified in Australia and South Africa sub samples, and inconclusive in Singapore and UK sub samples. Note, however, that Australia and UK were two out of three country sub samples with worse mean profitability (equal or bellow – 3%) in the period 2000-2009, and that South Africa was one of the two country sub samples with higher mean profitability. Thus, the non verification of profitability hypothesis in those sub samples might be associated with extreme values in terms of profitability. On the other hand, this was a time period that observed significant changes in the accounting norms, which might have affected findings in respect to profitability.

[32] http://www.iasplus.com/country/japan.htm#framework
[33] http://www.iasplus.com/country/useias.htm#Note1

9.4.4 Market valuation

The hypothesis describing that the market-to-book ratio of a firm tends to increase with a decrease in the tangibility of its product flows, as measured by its level of operating intangibility was verified in 14 out of 15 country sub samples. All tests resulted in very high levels of significance at the 1% degree or better. The results were only unclear in South Africa, where specificities of the stock market may interfere in the relation between LOI and market valuation. Although expected, it is at all levels impressive that stock markets all over the World seem to attribute extra valuation to firms selling intangible intensive products. This does not mean that the results in South Africa are not important. On the contrary, they can be very important to understand what is happening in the other countries. As happens for all the other hypothesis, we can gain with further research on this topic.

9.4.5 Proportion of debt in the capital structure

The hypothesis describing that the proportion of debt in a firm's capital structure tends to decrease with a decrease in the tangibility of its product flows, as measured by its level of operating intangibility, was universally verified in the 15 country sub samples. All tests resulted in very high levels of significance at the 1% degree or better.

Table 9.5: Results of Fixed Effects and Fama-Macbet tests about the Operating Intangibility Hypothesis around the world

Panel A: Fixed Effects Procedure

Variables	LOI	LOI	LOI	LOI	LOI	LOI	LOI	LOI	LOI	LOI	LOI	LOI	LOI	LOI
Sample	Australia	Canada	China	France	Germany	Israel	Japan	Malaysia	Singa-pore	South Africa	South Korea	Sweden	Taiwan	UK
Intercept	0.808***	0.890***	0.780***	0.503***	0.523***	0.961***	0.554***	0.538***	0.611***	0.925***	0.390***	0.684***	0.638***	1.213***
	(48.23)	(81.12)	(53.07)	(15.5)	(34.18)	(33.88)	(49.03)	(36.3)	(30.85)	(26.86)	(20.72)	(20.72)	(52.16)	(153.19)
SIZE	-0.041***	-0.049***	-0.043***	-0.013***	-0.021***	-0.050***	-0.020***	-0.031***	-0.037***	-0.043***	-0.012***	-0.026***	-0.032***	-0.068***
	(-24.98)	(-49.41)	(-40.14)	(-5.58)	(-16.55)	(-21.97)	(-30.36)	(-24.42)	(-21.26)	(-17.17)	(-12.00)	(-11.61)	(-39.06)	(-83.09)
CAPEX_PPE	-0.543***	-0.438***	0.021	-0.390***	-0.066	-0.344***	0.204***	-0.050***	-0.073**	-0.668***	-0.130***	-0.264***	0.012	-0.592***
	(-14.49)	(-24.23)	(1.00)	(-3.01)	(-1.09)	(-3.95)	(7.35)	(-1.42)	(-1.91)	(-6.51)	(-4.68)	(-2.79)	(0.59)	(-15.73)
PROFITABILITY	0.025***	-0.086***	-0.140***	-0.276***	-0.061***	-0.270***	-0.093***	-0.091***	-0.020	0.135***	-0.081***	-0.258***	-0.111***	0.011
	(2.33)	(-9.14)	(-5.20)	(-4.39)	(-3.17)	(-6.21)	(-4.78)	(-3.84)	(-0.91)	(2.46)	(-5.95)	(-9.14)	(-7.01)	(1.15)
MARKET_TO_BOOK	0.012***	0.009***	0.003***	0.032***	0.007***	0.017***	0.018***	0.011***	0.010***	-0.002	0.024***	0.025***	0.017***	0.004***
	(9.28)	(11.07)	(7.73)	(10.59)	(5.75)	(6.04)	(25.00)	(5.49)	(5.08)	(-0.58)	(17.59)	(12.49)	(13.15)	(6.64)
LEVERAGE	-0.002***	-0.003***	-0.001***	-0.003***	-0.002***	-0.002***	-0.001***	-0.006***	-0.001***	-0.002***	-0.001***	-0.003***	-0.001***	-0.003***
	(-9.69)	(-21.4)	(-12.25)	(-8.13)	(-13.42)	(-12.11)	(-13.8)	(-5.60)	(-5.07)	(-5.20)	(-11.79)	(-14.02)	(-14.24)	(-28.65)
R-squared	0.229	0.410	0.209	0.208	0.122	0.300	0.059	0.126	0.149	0.269	0.083	0.394	0.191	0.460
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Years	(2001-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)
Observations	4,922	8,836	9,047	1,203	4,551	1,998	28,381	5,793	3,505	1,210	9,618	1,482	9,813	14,253
Firms	1,229	1,990	1,542	259	877	415	4,223	945	638	287	1,722	266	1,608	2,873

Panel B: Fama Macbeth with Newey-West procedure

Variables	LOI	LOI	LOI	LOI	LOI	LOI	LOI	LOI	LOI	LOI	LOI	LOI	LOI	LOI
Sample	Australia	Canada	China	France	Germany	Israel	Japan	Malaysia	Singapore	South Africa	South Korea	Sweden	Taiwan	UK
Intercept	0.806***	0.881***	0.709***	0.502***	0.506***	1.032***	0.539***	0.525***	0.609***	0.935***	0.367***	0.689***	0.626***	1.209***
	(50)	(58.57)	(15.58)	(14.3)	(23.34)	(47.06)	(15.17)	(22.61)	(32.51)	(23.44)	(10.06)	(11.24)	(27.88)	(126.58)
SIZE	-0.041***	-0.048***	-0.038***	-0.014***	-0.020***	-0.054***	-0.019***	-0.030***	-0.037***	-0.044***	-0.011***	-0.027***	-0.031***	-0.068***
	(-33.75)	(-47.46)	(-11.37)	(-18.37)	(-14.16)	(-55.97)	(-8.81)	(-16.03)	(-23.49)	(-15.5)	(-5.98)	(-7.78)	(-17.09)	(-93.01)
CAPEX_PPE	-0.539***	-0.443***	0.081	-0.550**	-0.046	-0.281	0.217***	-0.035	-0.069	-0.630***	-0.142***	-0.369**	0.023	-0.625***
	(-7.44)	(-31.45)	(1.48)	(-3.03)	(-0.98)	(-1.76)	(6.21)	(-0.86)	(-1.67)	(-5.63)	(-5.02)	(-2.96)	(0.44)	(-6.03)
PROFITABILITY	0.027*	-0.098***	-0.293	-0.276***	-0.108	-0.319**	-0.024	-0.098**	-0.044	0.113	-0.080***	-0.247***	-0.134***	0.013
	(2.29)	(-3.77)	(-1.36)	(-4.69)	(-1.58)	(-3.21)	(-0.32)	(-2.47)	(-0.84)	(1.18)	(-5.36)	(-8.35)	(-4.94)	(0.66)
MARKET_TO_BOOK	0.012***	0.009***	0.005**	0.035***	0.009***	0.025***	0.022***	0.010**	0.011***	-0.000	0.030***	0.029***	0.020***	0.005***
	(13.91)	(5.01)	(2.93)	(12.23)	(6.12)	(6.21)	(4.73)	(3)	(3.7)	(-0.27)	(17.08)	(10.62)	(3.71)	(3.26)
LEVERAGE	-0.002***	-0.003***	-0.001***	-0.003***	-0.002***	-0.003***	-0.001***	-0.000**	-0.001***	-0.002***	-0.001***	-0.003***	-0.001***	-0.003***
	(-8.63)	(-44.42)	(-11.18)	(-4.56)	(-22.03)	(-5.08)	(-10.58)	(-2.84)	(-7.7)	(-6.56)	(-28.09)	(-8.59)	(-23.12)	(-35.29)
R-squared	0.240***	0.414***	0.227***	0.248***	0.141***	0.400***	0.070***	0.130***	0.165***	0.296***	0.094***	0.436***	0.191***	0.461***
t-value of R-squ.	(20.14)	(49.71)	(29.39)	(13.72)	(10.24)	(8.63)	(7.25)	(9.08)	(21.75)	(9.17)	(16.84)	(8.35)	(7.77)	(27.74)
Years	(2001-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)	(2000-2009)
Observations	4,922	8,836	9,047	1,203	4,551	1,998	28,381	5,793	3,505	1,210	9,618	1,482	9,813	14,253
Firms	1,229	1,990	1,542	259	877	415	4,223	945	638	287	1,722	266	1,608	2,873

Table 9.6: Verification of the 5 Operating Intangibility Hypotheses in the Sub Samples of 15 different country sub samples from around the World.

	Australia	Canada	China	France	Germany	Israel	Japan	Malaysia	Singa -apore	South Africa	South Korea	Sweden	Taiwan	UK	USA (primary sample)
H1: Size	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)
H2: Capex	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Unclear	Yes (FE, FM, SC, PC)	Unclear	Yes (FE, SC, PC)	No (FE, FM, SC, PC)	Yes (FE, SC, PC)	Yes (FE, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Unclear	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)
H3: Profitability	No (FE, FM)	Yes (FE, FM, SC, PC)	Yes (FE, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, PC)	Yes (FE, FM, SC, PC)	Yes (FE, SC, PC)	Yes (FE, FM, SC, PC)	Unclear	No (FE, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Unclear	Yes (FE, FM, SC, PC)
H4: Market to Book	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Unclear	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)
H5: Capital Structure	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)	Yes (FE, FM, SC, PC)
Observations	4,922	8,836	9,047	1,203	4,551	1,998	28,381	5,793	3,505	1,210	9,618	1,482	9,813	14,253	107,070
Number of Firms	1,229	1,990	1,542	259	877	415	4,223	945	638	287	1,722	266	1,608	2,873	10,162
Years	2001/2009	2000/2009	2000/2009	2000/2009	2000/2009	2000/2009	2000/2009	2000/2009	2000/2009	2000/2009	2000/2009	2000/2009	2000/2009	2000/2009	1966/2006

Notes: 1- The table describes whether the hypotheses were verified in the 14 countries sub samples. 2- In blankets are the tests that have a significant level at the 5% degree or better. 3- The tests are FE=fixed effects; FM= Fama Macbeth with Newey West Standard Errors; SC= Spearman's Correlation; and PC=Pearson's Correlation.

9.5 Conclusion of the chapter

This chapter studied the possibility that the hypothesis studied in previous chapter could be merely a USA phenomenon, in the sense that the non empirical verification of the separability assumption could be merely a feature of corporations listed in USA. The 14 studied country sub samples, selected for having the largest firm constituent lists on Worldscope database, offered a total 95,799 observations of 17,266 firms, over the period 2000-2009 (first decade of twenty first century), for testing. The USA sample obtained from the CRSP/Compustat database comprises 107,070 observations of 10,162 firms over the period 1966-2006 (four decades). As displayed on table 9.4, five hypotheses, tested on 15 sub samples, result in a total of 75 hypothesis tests. Of those, only 3 (4%) hypothesis tests were not verified, and 6 (8%) hypothesis tests were inconclusive. The remainder 66 country sub sample/hypothesis testes (88%) were strongly verified.

The empirical findings on the international sample show that operating intangibility is an economic characteristic statistically relevant in many different countries, which are not limited to the use the accounting norms of FASB, or the English speaking world, or Europe and North America, or countries with a dominant Christian/Catholic cultural background.

On the contrary, despite of different accounting methods that may be used in different countries, the results seem to be very significant in countries that do not have English as first language such as China, France, Germany, Israel, Japan, Malaysia, Singapore, South Korea, Sweden, or Taiwan. Moreover, the empirical results were strongly verified in countries outside Europe and North America such as Australia, China, Israel, Japan, Malaysia, Singapore, South Africa, South, Korea, and Taiwan. Furthermore, the results were clearly observable in countries where the majority of the population is not Christian/Catholic such as China, Israel, Japan, Malaysia, Singapore, South, Korea, and Taiwan. Observe also that the tests were implemented on 10 countries that are part of G-20 group, which includes the most industrialized countries in the World (Australia, Canada, China, France, Germany, Japan, South Africa, South Korea, UK and USA), and 5 countries that are not included in the G-20 group, although having relatively sophisticated capital markets (Israel, Malaysia, Singapore, Sweden, and Taiwan).

Therefore, the empirical evidence present in country sub samples from around the World appears to demonstrate the prediction from intangible flow theory that *corporations partially organize themselves according to the operating needs associated with the tangibility of the flows of products used to generate material cash flows through sales to customers.*

As this chapter demonstrates, we have no reason to suggest that the non empirical verification of the separability assumption could be merely a USA phenomenon. More than providing definitive answers, the major role of intangible flow theory is to provide a framework for formulating new questions about economy and society. In this sense, it would be particularly interesting to explore in upcoming research robust cases where the hypothesis are not verified, such as the capital expenditures hypothesis in Japan, apparently due to different accounting norms and practices, but other possible explanations should not be eliminated without further research. The study of less recurrent cases can provide us with greater insights about operating intangibility and why the hypotheses are verified in the majority of the large samples used. This type of scientific reasoning was used by other scientific areas such as the study of the human brain, where persons having brains operating with objective anomalies were very important for the understanding about the functioning of the human brain (see for instance Damasio 2005, 2010).

10- Discussion: the end of the separability assumption and the future of finance

The problems studied in finance rank amongst some of the most important questions in economics. How could a corporation be organized without adequate management of its financial sources? What activities could create value for firms? How do markets function and react to firms' activities? Should a firm pay more, less, or no dividends? These examples illustrate just a few of the fundamental questions studied in finance.

One must not confuse the importance of questions with the domain of answers to which neoclassical economics belongs into. However, such is the ascendancy that neoclassical explanations have over financial phenomena that one could eventually confuse finance with neoclassical economics. As explained before, neoclassical economics tends to define economy by its object of research: the study of utility maximization under conditions of scarcity (Caliskan and Callon, 2009). A single concept of instrumental rationality that maximizes would explain the behavior of persons and organizations in nearly every context. The utility and constraint functions are described mathematically, thus quantitatively, which would be in conformity with the concept of homo economicus decision maker (see for instance Thaler, 2000).

When noted that neoclassical economics only accepts mathematical/quantitative methods (Sutter 2009; Hopwood 2008; Lawson 2006; Beed and Kane 1991; Leontieff 1982), an observable immediate consequence is that neoclassical economics refuses to discuss its utility maximization models with scientific approaches that do not use mathematical/quantitative methods, which for instance traps behavioral economics into incorporating mathematical parameters in utility functions (e.g.: Camerer and Loewenstein, 2004; Rabin, 1998).

Yet, by no means have neoclassical economics a monopoly over mathematical/quantitative methods. Certainly, mathematical/quantitative methods are very relevant for science, and can be used without assuming that human and organizational behavior is always explained through utility functions, or presuming homo economicus men and women. The stance of accepting only mathematical/quantitative methods can also be seen as a device to protect utility function based explanations that would not be discussed without other utility functions. Hence, the discussion would remain within the concrete borders of neoclassical economics.

A crisis of neoclassical economics in explaining financial phenomena would not be equivalent to a crisis of finance and its important questions, as financial phenomena are and will still be very relevant whatever theories are used to explain them. This is however an age, as noted by Hopwood (2008), where curiosity is not always accepted as enough reason for researching. Notwithstanding, curiosity was an instigating friend to many scientific discoveries in different areas of knowledge and this thesis praises epistemological robustness. In a khunian sense (Khun,1996) this may be an adequate time to research innovative explanations to the dominant neoclassical economic paradigm of capital structure. Clear signs exist that seems to point that the neoclassical explanation set is suffering a crisis. As noted before, in a survey to Chief Financial Officers, Graham and Harvey (2001) found that although the executives were likely to use the mainline techniques learned in business schools to value projects and estimate the cost of equity (e.g.: NPV and CAPM), they were much less likely to follow the academically proscribed factors and theories when determining capital structure. Similar results were found on other surveys (e.g.: with practitioners from UK in Beattie et al. 2006; and different European countries in Brounen et al., 2004). These surveys did not address recent theories that executives did not had yet the time to study, but theoretical frameworks such as Modigliani and Miller (1958) that many academics have been advocating for many years.

What is worse, the non adherence of practitioners is empirically justifiable by studies contradicting major predictions of the dominant neoclassical capital structure theories. Fama and French (2005) claim that the pecking order theory might be considered “dead”, because firms issue equity without being financial constrained as predicted (Leary and Roberts, 2010, confirm it). However, the leading alternative, the trade-off theory suffers from many problems itself. For instance, firms with higher profitability tend to have less leverage, contrary to the trade-off prediction (e.g.: Rajan and Zingales, 1995; Fama and French, 2002). Rajan and Zingales (1995), Welch (2004) and Lemmon et al (2008) note our little understanding about how corporations decide over their financing decisions.

Nonetheless, the space of this thesis was not focused on doing an overall evaluation of each neoclassical based theory. The thesis concentrated in a specific neoclassical foundation of the dominant theories: the separability assumption presupposing that operating, investing and financing decisions can be isolated. Chapter 4 demonstrated that the separability assumption was fundamental for the initial work of Modigliani and Miller (1958), and was followed by the trade-off theory, pecking order theory, and market timing theory.

This thesis's role cannot be to speculate on whether several professors of finance believe that the separability assumption makes sense, little sense, or no sense at all. That the separability assumption is a foundation of the major neoclassical theories can be demonstrated as a matter of fact. Such fact can be exhibited even though one could not find hard to believe that several professors of finance would support the practitioners in claiming that they do not believe in the dominant neoclassical explanations in finance. In his book “The Myth of the Rational Market”, Fox (2009) describes several interviews with prominent scholars of finance. On page 300 it is reported that Eugene Fama, the author of the Efficient Market Hypothesis decided to stop teaching Corporate Finance, whereas others who might be expected to be more critical such as Adrei Schleifer or Malcom Baker had no other option to teach the general canon to their student until it was proven incorrect.

Thus, even those professors of finance who might not believe in the separability assumption are compelled to teach it to their students (many of them who are current or future practitioners) because the dominant neoclassical explanations have such implicit assumption in their core structure. Thus, the professors of finance who might be discontent with the current status quo have not that much of an alternative. They have to teach the separability assumption to their students, even if neither professors nor students have the capacity to believe in it.

Intangible flow theory can contribute to this important theme by offering a framework to study organizational operating activities. It reminds us that that intangibility does not necessarily remain still. On the contrary, it moves frequently, as the restaurant's options on the menu reaches the cognition and affectivity of clients. This theory offers us alternatives that allow posing new questions, but nonetheless requiring an effort of abstract reasoning from its readers. There are two major conceptions of tangibility. One is related to the sense of touch, having developed from the Latin origin of the word (tangere). The other conception of tangibility is related to the faculty of being identified with precision; that is, the capability of being identified or realized precisely in one’s mind and of being appraised at an actual or approximate value (Bateson 1979; Flipo 1988; Bienlens and Sempels 2003; Merriam Webster’s Dictionary). Thus, the precision conception implies that cash flows are tangible, just as the flows of physical goods are tangible, because even when cash flows are associated with intangible processes, the precise values of such cash flows are quantifiable. For example, when people go to a restaurant and pay electronically with a bank card, or when a company makes online financial transactions, the cash flows effectuated are precisely identifiable and quantifiable. Even when related to distinct symbolic referents and social systems, the material practice of money is one of its defining properties, as money has a pragmatic nature in the modalities of exchange and circulation (Gilbert 2005; Maurer 2006).

Economic material elements, such as cash or physical goods, flow in economies and societies, and these flows are reflected in a variety of economic phenomena, such as growth, profits, investment, inflation, interest rates, debt, market valuation, crisis, etc. The need to advance our knowledge of the dynamics of economic material flows can be related to a criticism of neoclassical economics: embeddedness. Granovetter (1985) and Callon (1998) defend the notion that economic action is embedded in structures of social relations, and therefore argue that social relations must be considered in order to understand economic actions. On the other hand, neoclassical economics tends to undermine the importance of social relations and their structures. Yet, the dynamics of social relations can be quite relevant to our understanding of economies and societies.

As explained by intangible flow theory, flows of economic material elements are consummated by human-related intangible flows that cannot be appraised precisely at an actual or approximate value and have properties that preclude them from being classified as assets or capital. In intangible flow theory, the term intangible (i.e. not tangible) is defined through the precision approach, and the term flow is defined as the movement of an element deriving from a source. Therefore, an element that is not flowing should be considered static. Previously intangible dimensions can become tangible when researchers find manners by which they can be precisely identified. There is a paradox of quantifying intangible entities. That is, when scientists develop quantitative methods for ascribing actual or approximate values to previously intangible elements, those now quantifiable elements acquire properties of tangibility, while other still non-quantifiable dimensions remain intangible. Observe that although this formulation could describe natural intangible flows, intangible flow theory focuses on human-related intangible flows deriving from a person or group of persons.

If there is, in fact, such a thing as a human-related intangible flow and if that flow is necessary to consummate the flows of economic material elements, its existence could have great implications for our understanding of economy and society. In the gestalt of neoclassical economics only mathematical/quantitative methods of reasoning are accepted (Sutter 2009; Hopwood 2008; Lawson 2006; Beed and Kane 1991; Leontieff 1982). Therefore, as explained in the 5th corollary of intangible flow theory, the intangible flow dynamics of economic phenomena are beyond the methodological capacity of neoclassical economics. The mathematical/quantitative methods can be used to describe with precision the flow of economic material elements that were consumed in a particular moment in time, but cannot be used to quantify with precision the human related intangible flows that are necessary for the consummation of the flows of economic material elements. With this dynamic explanation for the occurrence of material cash flows, we can study what products corporations exchange with their customers to generate cash in-flows.

"There are neoclassical authors, who, nevertheless, introduced the concern over products in the study of financial economic problems, which is implicit in their work. Thus the merit of Titman (1984), Titman and Wessels (1988), Kale and Shahrur (2007), and Banerjee et al (2008) must be recognized. However, one must also be aware that these authors can also be a cause of further problems, or, at least, did not go far enough, as : i) they only do a rather neoclassical-centered analysis of products that mostly ignores the literature about products in organization sciences, economic sociology and heterodox economics, and ii) they try to align the relevance of products with the neoclassical framework without noticing that if operating products are relevant for a firm's financial decision, this would not be easily compatible with the separability assumption (if compatible at all).

As explained before, these authors try to relate products and the capital structure under the framework of the trade-off theory, where products would be related to liquidation and bankruptcy costs. The leading paper is Titman (1984). Sheridan Titman is himself one of the main proponents of what is called a dynamic version of trade off theory (Hovakimian; Opler and Titman 2005, 2001). One component of the LOI proxy, that is Selling, General and Administrative expenses was also identified by some of this authors. In Titman and Wessels (1988), Kale and Shahrur (2007), Hovakimian; Opler and Titman (2001) and Kayhana and Titman (2007) and Banerjee et al. (2008) selling, general and administrative expenses divided by sales are considered to describe something called product uniqueness, therefore, related with operating decisions, which would be incompatible with the trade-off theory derived from Modigliani, Miller and Fisher assuming a separation between operating, investing and financing decisions.

Note that such variable is connected with products and operating decisions, and therefore would be congruent to the findings in this thesis However, a certain extent of naivety of these neoclassical authors when studying products is observable at several stances. A reader of their work can observe that they ignore definitions and frameworks to classify products according to their level of intangibility in organizational and sociological literature (e.g. Schostack, 1977; Zeithaml et al., 1985; Parasuraman et al., 1985; Wilson et al., 2008), or that for the process of transaction, a separation between goods and services would be artificial because goods need services to be sold and produced, and even pure services are associated to some tangibility such as the receipt.

As Rathmel (1966, p. 33) had noted previously 'when a good is purchased, the buyer acquires an asset; when a service is purchased, the buyer incurs an expense'. Thus, when Titman and Wessels (1988), Kale and Shahrur (2007), Hovakimian; Opler and Titman (2001) and Kayhana and Titman (2007) and Banerjee et al. (2008) claim that Selling, General and Administrative expenses divided by sales 'identify the uniqueness of a firm's products' because it describes selling expenses, they could learn from interdisciplinary literature to question whether might be conceptually incorrect to define the used variable that sums up selling, general, and administrative expenses as merely selling expenses (with an implicit association to selling some form of tangible goods). In doing so, they incorporate many other general and administrative expenses that are mistreated, and are not at all selling expenses. Expenses such as salaries are necessary to produce services, which are products themselves, or R&D expenses that incorporate intangibility in products. They also seem to ignore the heterogeneity of products and the fact that some products such as services have properties precluding their being considered as assets in the balance sheet, although they are reported financially in the firm's income and cash flow statement. Furthermore, for product analysis, it is not clear why sales or even total assets should be the denominator because these items compares expenses with either revenues or assets, which are two different classes of accounting rubrics. Moreover, given that Titman and Wessels (1988), Kale and Shahrur (2007), Hovakimian; Opler and Titman (2001) and Kayhana and Titman (2007) and Banerjee et al. (2008) have not clear what a product is, and that several intangible products such as services are sold to customers, they cannot observe the work of accounting in reporting intangible related expenses necessary for the production and selling of intangible and semi intangible products. The current thesis shows that concepts and theories are indeed very important, and cannot be addressed only with mathematical/quantitative methods, despite of their huge importance.

The lack of awareness that some of this neoclassical researchers display in terms of organizational, sociological and heterodox economic literature is also patent in their utilization of the industry method. To demonstrate the claim from Titman (1984) that firms selling durable goods have less leverage, Titman and Wessels (1988: 5) arbitrarily identify the durable-good-selling firms by including 'a dummy variable equal to one for firms with SIC codes between 3400 and 4000 (firms producing machines and equipment) and zero otherwise as a separate attribute affecting the debt ratios'. Later, Banerjee et al. (2008) take this classification without question in their dual typology of industries: durable goods and non-durable goods (that thus also ignores the possibility of producing non-goods products such as services). All these authors seem to truly believe that all firms registered in these industry codes were selling machines and equipment, and they do not observe what was demonstrated on chapter 7 that to hand pick industries in such manner is extremely subjective. Among the set of firms registered with same industry code can be a very heterogeneous group of firms, where some are physical good intensive, and other are selling pure intangible products such as pure services to their customers. Their papers do not identify the heterogeneity of industries, firms and products, and still assume industry homogenization. One of the contributions from the current thesis was to demonstrate that such homogeneity is not empirically observable.

For one to question the industry homogeneity assumption, it certainly helps to learn several insights about products from interdisciplinary literature, and intangible flow theory. Furthermore, organizational studies on products should also makes us suspicious of the industry homogeneity assumption because firms registered in the same industry may offer fairly heterogeneous portfolios of products to their customers. Schostack (1977) explained that products can be classified according to their intangibility, ranging from the 'most tangible' products, such as sugar or pens, to the 'most intangible' products (e.g., pure services such as consulting or teaching). Note that both goods and services are products, but services are not goods. Previous research identified dissimilarities between physical goods and intangible services and specific properties of service trading. These distinct service-related features include i) intangibility, ii) heterogeneity, iii) perishability, iv) non-separation of production and consumption (Zeithaml et al. 1985; see also Parasuraman et al. 1985 and Wilson et al. 2008), v) non-ownership of services (Lovelock and Gummeson, 2004), vi) less clearly defined boundaries between the firm and the exterior, as the service providers also span the boundaries of the organization by linking the organizational interior with the outside world (Wilson et al. 2008; Lovelock and Wirtz, 2011; Schneider and Bowen 1993; Bowen et al. 1999; Harris and Ogbonna 2002), vii) dynamic integration of the customer-service provider in the service outcome, and viii) active participation of the customer in the production of many services, contrary to what happens with the physical goods (Hubert 1995; Meuter and Bitner 1998; Meutner et al. 2000).

Moreover, the intangibility of products is not restricted to the intangibility of services. Observe, for instance, the knowledge and capabilities necessary to produce and sell a product to a customer, which were identified by the Neo-Schumpeterian theory of the organization. In particular, neoclassical mainstream economics does not seem properly equipped to handle the intangible flows of information and knowledge because, as noted by Voler et al. (2009), neoclassical economics sees information as signals, which separates information from cognition and makes a distinction between meaningful signals and noise, with the latter being understood as a lack of determined patterns. The movement of information would be similar to that of signals circulating on a circuit board. However, Polanyi (1969) explained that tacit and codified knowledge are not straightforwardly divided. Whereas tacit knowledge can be possessed by itself, codified knowledge must rely on being tacitly understood and applied. As noted by Blacker (1995), knowledge is multifaceted and complex, being both situated and abstract, implicit and explicit, distributed and individual, physical and mental, developing and static, as well as verbal and encoded. The transfers of intangible knowledge or intangible innovation processes are concrete situations involving human-related intangible motions. Moreover, such flows are not restricted to the organization's internal staff. They may involve complex networks of internal and external persons that were previously identified in management and economic sociology literature (e.g., Conway and Steward 2009; Burt 2005; Bouty 2000; Mckinlay, 2000; Law and Callon, 1992; Barnes 1979). As explained by the intangible flow theory, the inherent characteristics of many intangible products preclude them from being classified as assets, capital, or resources.

But one could say that selling, general and administrative expenses as a proportion of sales would be a measure of bankrrupcy, and thus this would be aligned with the trade-off theory, and then the neoclassical framework. Two fundamental reasons could make one to diverge from such interpretation, the first is that several firms that were on the brink of bankruptcy had lower proportion of selling general and administrative expenses. And second, the operating intangibility framework explains that as a proportion of total operating expenses, selling, general and administrative expenses increases when the tangibility of tangible physical goods and amortizations and depreciation with tangible assets decreases. Therefore selling general and administrative expenses are directly related with operating products, hence, operating decisions, which is not easily compatible with the separability assumption of neoclassical economics.

Because neoclassical economics is focused on mathematical/quantitative methods of reasoning, when it comes to concepts, such literature is relatively unclear, which applies to the concept of bankruptcy costs. Nonetheless, one must observe that firms with low mean level of operating intangibility in the USA sample have registered for Chapter 11 or Chapter 7 in Bankruptcy code, which casts doubt that increase in operating intangibility, could measure bankruptcy costs. Chapter 11 allows firms to reorganize other bankruptcy law, whereas Chapter 7 described the process for final liquidation of the firm. In those firms we can find firms with high mean LOI in sample such as Napster (mean LOI 63.6%, standard deviation 12%, 5 observations), or Midway Games (mean LOI 42.6%, standard deviation 7 %, 6 observations), but also firms with much lower LOI such as Chrysler (mean LOI 5.9%, standard deviation 1 %, 12 observations); or Delta Airlines (mean LOI 15.9%, standard deviation 1.7%, 18 observations). Thus, direct associations between operating intangibility and default or default costs are not immediately clear. We can find successful and less successful firms at every LOI decile.

However, the association of selling, general and administrative expenses with the tangibility of physical goods can be factually demonstrated within the operating intangibility framework, which considers total operating expenses. This relationship is clear in the definition previously presented in (5.1):

$$\text{Level of Operating Intangibility= LOI=}\frac{\text{Total Intangible Related Expenses}}{\text{Total Operating Expenses}} =$$

$$= 1 - \frac{\text{Total Non-Intangible Related Expenses}}{\text{Total Operating Expenses}} =$$

= (Expenses with services for sale + expenses with internally consumed services + expenses with conception, improvement and marketing of products (outputs)+ other intangible related expenses)/total operating expenses=

=1-(cost of goods sold + amortizations and depreciations of tangible long term assets +other tangible related expenses)/total operating expenses

(5.1)

That is, when the proportion of intangible related expenses increases, conversely, the tangible related expenses decrease. Therefore, operating decisions are demonstrable. Even if such decision may or may not have a latter effect on potential bankruptcy costs, the association with operating decisions is not compatible with a separability assumption supposing that operating decisions have no influence on the capital structure. This thesis shown that not only operating decisions have implications for the capital structures, but they are also reflected in several economic characteristics that are known to be related with the capital structure such as size; investments in property, equipment and facilities; less profitability; and market valuation.

A certain extent of abstract reasoning is necessary to capture the intangible flow theory and operating intangibility framework. One has to make an effort of imagining firms, see what firms are selling and producing, and how this may affect the way they need to be organized to generate material cash in-flows through sales of products to customers. For example, if a firm is producing cars or planes, it might need large factories, with great investments in buildings, machines and trucks, and considerable needs for external financing, whereas if a firm is selling pure services such as consultancy, it might do rather well with just a few employees in an open office space and limited needs for external financing. To go back to the example of the restaurant, when the restaurant register in its accounting the costs of food, drinks sold, and the payments to their staff, the restaurant does not do this simply to register bankruptcy costs, but to register operating costs.

What difference would be in current finance theory if in the 80s of the previous century, Titman and his colleagues instead of forcing to accommodate operating products with the dominant neoclassical theories could have tried exhibit points of incongruity? Would the western economies be doing differently nowadays?"

If one does not confuses finance with neoclassical economics, the awareness that the empirical association between operating, investing and financing decisions is not compatible with the separability assumption followed in neoclassical economics can only be great news for finance. It is now possible to tell to practitioners that they were right at least in establishing a missing link in past neoclassical theories: the link between operating, investing and financial decisions. Such link may be observable in the real life organizations. These findings can also be incorporated in the class baggage of those academics who were supportive of the findings in practitioners surveys, but had no previous framework for empirically demonstrating the implicit association between operating, investing and financing decisions. We can offer a framework to inhabit financial studies with people, operating activities and operating products.

The eventual end of Modigliani, Miller and Fisher World sustaining separability would be by no means the end of finance. Researchers in finance ought to be studying financial phenomena, not empirically unverified claims based on former theories. One has to be concerned with what Merton (1957) defined as goal displacement, that is, instead of studying financial phenomena, researchers in finance risk becoming trapped into studying neoclassical economic theories, which from means of explaining financial phenomena are transformed into ends by themselves.

One suggestion of this thesis is to strongly put back operating activities in the analysis. However, not just because operating activities can justify neoclassical economic theories, which we have seen they cannot given the separability assumption. Clearly, the separability assumption would have us looking in another way. Operating activities might be very important by themselves and need to be deeply studied. How can we still ignore the relevance of operating activities which are the principal mechanisms that firms have to generate cash in-flows. According to intangible flow theory, cash flows are tangible because they can be precisely identified. In product transactions with organizations, customers exchange tangible cash flows with other flows that might be tangible, such as flows of physical goods, semi intangible flows, or intangible flows, such as flows of services or information. This thesis suggests that firms need to organize themselves to accommodate the operating needs inherent to the tangibility of the product flows with customers. As predicted, it was shown that the tangibility of product flows was statistically reflected in several economic characteristics of firms. The results were demonstrated in large samples of many different countries.

Hence, there is an advance to our understanding of how economic material elements such as cash and physical goods flow in economy and society. The relation between operating products and cash flows seems to be strong, and can have implications in the study of several important financial phenomena such as understanding how firms generate cash flows (fundamental for discounted cash flow models), investment appraisal, price formation, etc. We are just in the beginning and know little on the subject. Plenty research is necessary in the future and interdisciplinary cooperation with organization sciences, sociology, heterodox economics and accounting can be very fruitful in understanding financial phenomena.

The question that therefore arises is whether sometime in the future academics of finance may realize that they could stop telling to their students what would occur in Modigliani, Miller and Fisher World. Such is a World that does not exist, and have some stances that are very hard if not impossible to be tested (Myers, 2001). Evidence shows that practitioners and some academics do not believe in such framework. In scientific fields other than financial economics the fact that some stances are difficult (if not impossible) to test for veracity would be considered a fatal flaw. The argument against considering claims that cannot be tested/refuted as scientifically valid is carefully presented in Popper's (2008). Importantly, it is now possible to exhibit that the fundamental neoclassical assumption of separation among operating, financing and investing decisions is not empirically verified. So, why not implement scientific approaches for studying relationships among operating, financing and investing decisions instead?

Conclusion

This thesis was developed upon the fertile ground of an old lesson from the Greek philosopher Socrates. To advance our knowledge, the greater obstacle is not ignorance aware of its fragility, but the self sufficiency of an apparent knowledge. Currently, neoclassical economics explanations have dominant status in addressing economic phenomena. Yet, as neoclassical economics only accepts mathematical/quantitative research instruments, it is insufficiently equipped to deal with the intangible flow dynamics of economic phenomena, and, presents itself as an obstacle to contributions that might arise from scientific areas outside its realm, such as organization sciences, accounting, economic sociology, or heterodox economics.

Solutions such as describing organizations as homogeneous black boxes, referring to human beings as assets or capital, or treating firms registered under the same industry code as selling homogenous products are implemented to expediently accommodate the study of organizations and human beings with the mathematical/quantitative research methods accepted by neoclassical economics, not because any previous demonstration. However, those comparisons could be defined by what Mackenzie (2007) calls as performative functions in the sense that they intervene in the production of the reality they claim to represent. Moreover, these comparisons could work as a stoppage for the study of well delimited research questions by non neoclassical economics research.

To eventually complement its methodological limitations, neoclassical economics has been trying to impose in social sciences several propositions that are scientifically unproven and ethically questionable, such as describing organizations as homogeneous black boxes, referring to human beings as assets or capital, or treating firms registered under the same industry code as selling homogenous products. These 'solutions' are implemented to expediently accommodate the study of organizations and human beings with the research methods accepted by neoclassical economics. However, those flawed comparisons intervene in the production of the reality they claim to represent, and actively sabotage the study of well delimited research questions by non neoclassical economics research.

One should note that most macro and micro economic phenomena, such as growth, profits, investment, inflation, interest rates, debt, market valuation, crisis, etc. are related to flows of economic material elements, such as cash or physical goods. Intangible flow theory and its five corollaries explains that flows of economic material elements are consummated in economy and society by human related intangible flows, such as service flows, work flows, communication flows, information flows, or knowledge flows, which have properties precluding them to be considered assets, capital or resources.

The demonstration of human-related intangible flows and respective proof that intangible flows are necessary to consummate flows of economic material elements may have implications for our understanding of economy and society. Given that in the explanatory set proposed by neoclassical economics only mathematical/quantitative research methods are accepted, it results that, as explained by the theory's 5th corollary, the intangible flow dynamics of economic phenomena is far beyond the methodological capacity of neoclassic economics.

Intangible flow theory is very supportive of mathematical/quantitative methods. Those methods are very relevant for empirical analysis of hypotheses and samples, and the natural sciences can give very precious help in providing methods for quantifying several dimensions of current intangibility. Scientific work bases itself on highly intangible concepts, and the concept of natural intangible flow may also be of use for the natural sciences.

It is the belief that the mathematical/quantitative methods should eliminate all other forms of scientific inquiry that is problematic. Hence, intangible flow dynamics can cause rigorous problems for the approach in which things are done and explained in neoclassical economics, and, if research methods might be compared with technology, intangible flow dynamics could reveal the methodological obsolescence of neoclassical economics.

The methodologies employed by neoclassical economics can observe monetary flows, which can be considered tangible through the precision approach to define tangibility. Therefore, although social scientists discuss meanings, uses, and symbols of money, the material practice of money is one of its defining properties, even if related to distinct symbolic referents and social systems (Gilbert 2005; Maurer 2006). Human beings are able to know the precise amount of money that has been moved in a precise interval of time (not imaginary projections of eventual future cash flows), regardless of the type of monetary transaction conducted (e.g.: coins and notes, credit card, check, bank transference, etc.). In the same manner, through the cash flow statement, a corporation presents a precise report of its complete cash movements during each fiscal period. The inherent tangibility of cash flows is an important component of intangible flow theory.

Nevertheless, as shown on the second chapter, an apparently simple economic transaction such as the sale of a restaurant meal for two people requires concrete and complex human related intangible flows to be consummated. As explained by corollaries 1 to 4, a very vast and complex conjunct of intangible flows may be associated to the occurrence of economic material elements. Complexity is a property naturally associated to intangible flows, because as described by the paradox of measuring intangibility, the elements of previous intangibility for which scientists can find quantitative methods to attribute well defined quantities, and therefore, can be precisely appraised at an actual or approximated value have properties of tangibility, whereas the other dimensions remain intangible.

To study concrete cases of intangible flow dynamics in economy and society, the thesis has focused its attention on embedded organizational phenomena that are both economic and social processes. In particular, the thesis studied the principal mechanisms that corporations have to generate material cash in-flows, namely, the transaction of products with their customers.

The cash flows generated through a firm turnover are fundamental for its survival, growth, profitability, self funding or obligations payments. The current thesis inquired whether we can use product flows to exhibit concrete cases of intangible flow dynamics consummating the flows of economic material elements: cash in-flows generated through sales to customers. As a result of such an inquiry, a development of intangible flow theory was introduced: *corporations partially organize themselves according to the operating needs associated with the tangibility of the flows of products used to generate material cash flows through sales to customers*. For instance, firms that produce heavy physical goods, such as cars or planes, may be required to have different economic characteristics to firms that exclusively sell highly intangible products, such as services or software.

A corporate decision involving products is an operating decision. If operating decisions are reflected in the economic characteristics of firms, such association is quite relevant for economics because large building blocks of neoclassical economic theory assume a separation between operating, investing, and financing decisions. Therefore, although stated in one sentence, the prediction described on the last paragraph addresses one very important assumption in neoclassical economics work, and particularly in financial economics studies, the assumption that this thesis calls the separability assumption.

It is well known that practitioners who do the financial management of real life corporations answer in surveys that they do not believe or follow the neoclassical explanations (Graham and Harvey 2001; Beattie et al 2006; Brounen et al, 2004). Furthermore, empirical findings have been contradicting major predictions of the dominant capital structure theories (e.g.: Fama and French 2005; Leary and Roberts, 2010, Rajan and Zingales, 1995; Fama and French, 2002). Still, it is not frequently noted that all major neoclassical theoretical formulations for a firm capital structure, namely, the trade-off theory, the pecking order theory, the market timing theory and even the product market literature, are all derived from the seminal work of Modigliani and Miller (1958), and based upon the separability assumption. Miller (1988 a, p. 103), who is one half of Modigliani and Miller, credits his joint work with Modigliani for introducing the current dominant view in finance that uses a metaphor of the 'corporation as a black box' into which are put operating activities. As expressed by Miller (1988), he and Modigliani opted for 'Irving Fisher's view of the firm- now the standard one in finance, but then just becoming known – [that] impounds the details of technology, production and sales in a black box and focuses on the underlying net cash flow. The firm for Fisher was just an abstract engine transforming current consumable resources, obtained by issuing securities, into future consumable resources payable to the owners of the securities' (Miller, 1988). Subsequent neoclassical theoretical frameworks follow such a view of the firm.

The current thesis suggests that the abstraction of the firm used by neoclassical economics might convey a serious logical flaw: the underlying net cash flows on which the capital structure theories decided to focus are mainly generated by the firms' operating activities that theorists decided to neglect. This has two important consequences: the exclusion of those operating elements with intangible flow dynamics put inside the black box from the concerns of the dominant theories in financial economics, and the respective negligence of accounting information because the reporting of a firm's operating activities would be considered inconsequential for financial economics under the neoclassical framework.

Intangible flow theory can assist in creating a method to describe operating decisions of firms, and thus addressing such an important issue. Logically, if operating decisions are statistically correlated with financing and investing decisions, then the dominant separability assumption of neoclassical economics cannot be considered as valid.

Nevertheless, intangible flow theory must be able to solve this problem by being faithful to its spirit. As explicated before, intangible flow theory is a grounded theory, developed out of a collection of facts, and formalized for subsequent testability of its predictions, a crucial goal of the grounded theory method (see Charmaz 2006, and Goulding 2002). It is also a theory that aims to explain the practice observed in organizational phenomena assuming that social life is an ongoing production and thus emerges through people's recurrent actions (as described by Feldman and Orlikowski, 2011). Intangible flow theory can as well be classified as a heterodox economic theory (see Lawson 2006).

In order to develop the intangible flow theory by identifying the tangibility of products (outputs) flows sold by a firm, the concept of 'operating intangibility' was introduced as: *'the dynamic set of intangible flows integrated into a firm's operating productive system that is necessary to generate material cash flows through sales to customers* '. This theoretical framework measures the '*level of operating intangibility*' (LOI) as the proportion of intangible-related expenses among total operating expenses. Therefore, we have a solution to our problem because, although the intangible flows cannot be measured with precision, due to their inherent properties, the material expenses related to the production and consumption of intangible flows can be quantified.

Chapter 5 discussed a proxy for the level of operating intangibility along with possible alternatives, and exemplified its implementation with well know corporations, a few industries, and real life financial statements. The concept of operating intangibility should not be confused with the proxy used to measure it. The proxy has evident limitations related to the fact it is computed with the information available. Also, it aggregates several intangible related expenses, though, in some cases, it could be useful to dissect out particular types of expenses and study the effects of each with more detail. Nevertheless, the income/cash flow statement approach makes it possible to compute an LOI proxy value for nearly any firm. And perhaps, given the strong statistical significance associated with the LOI proxy, accounting regulators may support academics and practitioners in the future by introducing guidelines to lead firms to provide more detailed data involving the reporting of operating expenses.

The introduction of the concept of operating intangibility enabled the testing of the theoretical prediction that: firms partially organize themselves according to the operating needs associated with the tangibility of the flows of products (outputs) used to generate material cash flows through sales to customers. The empirical results provide evidence for the theoretical framework developed from intangible flow theory and its relevance for research and organizational practice. The Level of Operating Intangibility has revealed itself to be a stable variable by firm, as its variation within each LOI decile was relatively small, and especially small if compared with the variability within highly heterogeneous industries. Therefore, the Level of Operating Intangibility might well be an identifiable economic characteristic of organizations.

The flows of economic material elements (such as physical goods and/or cash) were found to be associated with the human related intangible flows that are required for their consummation. Concretely, the five hypotheses empirically show that the decrease in the tangibility of a firm's product flows, as measured by LOI, was associated with five expected characteristics of intangible-product-intensive firms: i) smaller size of the cash flow generated through sales; ii) lower capital expenditures in property, equipment, and facilities; iii) lower profitability; iv) higher stock market valuation of equity (market-to-book); and v) less debt as proportion of the capital structure.

In addition to capturing a distinctive feature of firms that has not been captured by previous methods, the LOI method overcomes the inherent subjectivity of industry codes, providing a new way of classifying and comparing firms and industries based on publicly available data of registered firms. Furthermore, Intangible flow theory is an actual alternative to formulations that refer to people as human capital or human assets. Comparisons of people with assets or capital cannot be accepted without scientific evidence for the purpose of convenience in terms of parameterization and homogenization of human beings through the mathematical/quantitative research methods accepted by neoclassical economics.

Furthermore, one must not forget that to refer to people as assets or capital, or to compare organizations with black boxes raise serious ethical issues. One cannot ignore the issue of the dignity of human beings in economic studies. Nonetheless, even if one were to ignore such important considerations, this thesis would exhibit that a separation between human beings and human related intangible flows is quite useful to predict empirical associations between a firm's tangibility of product flows, and its economic characteristics. The findings support the argument that intangible flow dynamics may enhance our understanding of organizations in future research, both theoretical and empirical.

The empirical tests also refuted the widely adopted neoclassical assumption of industry homogeneity, which presupposes that organizations registered under the same industry code are either homogeneous or sell homogeneous products. Using the ‘Level of Operating Intangibility’ to classify organizations and industries, the thesis presented two situations where such an assumption could not be verified by the sample. First, intangible intensity studies that were said to have analyzed supposedly intangible industries (cf. Core et al 2003; Collins et al 1997; Francis and Schipper 1999) were found to have identified heterogeneous samples that included a number of physical good intensive firms. Second, the prediction that firms selling durable goods have a lower proportion of debt than others (cf. Titman 1984; Titman and Wessels 1988; Banerjee et al 2008) was contradicted by inspection of the industries claimed to be exclusively selling durable goods. The homogeneity assumption is shown to have led researchers to incorrect conclusions because in those subjectively chosen industries the physical good intensive firms are much fewer than the intangible product intensive firms, and indeed tend to have a larger proportion of debt in their capital structure.

Hence, these results exhibit the problematic subject matter identified on the theory's 5th corollary: an idealization of mathematical/quantitative methods leading to a belief that these research tools should eliminate any other form of scientific inquiry. To use a mathematical/quantitative method as a justification for the false claim that firms and products within industries are homogeneous is a misuse of the mathematical/quantitative method, not a problem of the mathematical/quantitative method in itself. If neoclassical economics can only use mathematical/quantitative tools of reasoning to posit its hypotheses, then it cannot be methodologically prepared to reach intangible elements that cannot be precisely identified or realized by the mind; and cannot be appraised at an actual or approximate value such as work flows, service flows, communicational flows, or information flows.

One word put about the statistical significance of the empirical findings. The statistical results, which were confirmed by many different econometrical tests, were conducted on two very large samples. A first sample of USA firms was obtained in the CRSP/Compustat database, and comprises 107,070 observations of 10,162 firms over the period 1966-2006 (four decades). A second sample, called international sample, includes 14 country sub samples, selected for having the largest firm constituent lists on Worldscope database. The international sample enabled for testing a total 105,635 observations of 18,874 firms, over the period 2000-2009 (first decade of twenty first century). The objective choice of large country sub samples was based upon taking in cautious consideration the problem of the robustness of findings, giving that smaller samples could render results that were less conclusive. Furthermore, smaller country samples might be organized around fewer geographical business clusters, as in the concept proposed by Porter (1998) where a business cluster is understood as a geographic concentration of interconnected businesses, suppliers, and associated institutions in a particular field (see also Romanelli and Khessina 2005). It will be interesting to study in future an eventually higher interconnectedness of firms in smaller sub sample countries, but at this stage we are looking for heterogeneous samples to study the associations of the level o operating intangibility with other economic characteristics of firms.

As displayed on table 9.4, five hypotheses, tested on 15 country sub samples, result in a total of 75 hypothesis tests. Of those, only 3 (4%) hypothesis tests were not verified, and 6 (8%) hypothesis tests were inconclusive. The remainder 66 (88%) were strongly verified. Therefore, the empirical findings exhibit that operating intangibility is an economic characteristic statistically relevant in many different countries, which are not limited to the use the accounting norms of FASB, or the English speaking world, or Europe and North America, or countries with a dominant Christian/Catholic cultural background.

Despite of different accounting methods that may be used in different countries, the results seem to be very significant in countries that do not have English as first language such as China, France, Germany, Israel, Japan, Malaysia, Singapore, South Korea, Sweden, and Taiwan. Moreover, the empirical results were strongly verified in countries outside Europe and North America such as Australia, China, Israel, Japan, Malaysia, Singapore, South Africa, South Korea, and Taiwan. Furthermore, the results were clearly observable in countries where the majority of the population is not Christian/Catholic such as China, Israel, Japan, Malaysia, Singapore, South, Korea, and Taiwan. Observe also that the tests were implemented on 10 countries that are part of G-20 group, which includes the most industrialized countries in the World (Australia, Canada, China, France, Germany, Japan, South Africa, South Korea, UK and USA), and 5 countries that are not included in the G-20 group, although having relatively sophisticated capital markets (Israel, Malaysia, Singapore, Sweden, and Taiwan).

More than providing definitive answers, the major role of intangible flow theory is to provide a framework for formulating new questions about economy and society. In this sense, it would be particularly interesting to explore in upcoming research robust cases where the hypothesis are not verified, such as the capital expenditures hypothesis in Japan, apparently due to different accounting norms and practices. However, other possible explanations should not be eliminated without further research. Furthermore, given the high stability of LOI over the years across the same sub sample, it would be interesting to explore time periods in history where a significant change in the level of operating intangibility occurred for a firm or a country, for instance. As occurs in other scientific areas, less common or unusual cases can give us with greater insights about operating intangibility, and why the hypotheses are verified in the majority of the large samples used. For instance, persons having brains operating with objective anomalies were very important for the understanding about the functioning of the human brain of people without those anomalies (see for instance Damasio 2005, 2010).

These findings are of interest for researchers, practitioners, accounting authorities and other stakeholders. As noted earlier, the neoclassical economic theory is missing two great opportunities, at least. The first is to embrace an interdisciplinary cooperation with those scientific fields that specialize in studying products, such as organization sciences, economic sociology, or heterodox economics. The second opportunity is to further understand the usefulness of accounting information for studying a firm's products.

It is striking to observe the self assurance of neoclassical economics literature regarding human beings, products, operating decisions or organization that rarely, if ever, quotes from studies in research produced outside its real that is deeply concerned with exactly the same themes. As demonstrated in this thesis, the comparison of organizations with black boxes, the metaphors of human beings with assets or capital, and standard industrial classification (SIC) codes can no longer be used as excuses for neoclassical economics not to embrace interdisciplinary conversations with other scientific disciplines that, for the study of some phenomena, are much more advanced that neoclassical economics itself.

The accounting information describing firms' operating activities could become enormously valuable via the LOI approach. Nonetheless, non-financial/qualitative information will remain critical to furthering our understanding of the economic characteristics of organizations, particularly with respect identifying the importance of products in generating material cash in-flows.

Considering the fact that the production and sales of products are themselves concrete embedded social and economic processes, the present empirical findings support the embeddedness critique which defends that neoclassical economics undermines the importance of social relations and their structures, despite economic actions being embedded in social relation structures (Granovetter 1985; and Callon 1998). Thus, we have gained a solid argument in favour of using approaches outside the realm of neoclassical economics to study economic phenomena. Indeed, doing so may be very important for advancing our understanding of economies and societies. The possibility that neoclassical economics might not be fit for purpose must not be ignored by those who are interested in understanding economic phenomena such as growth, profits, investment, inflation, interest rates, debt, market valuation, crisis, etc.

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Appendixes

Appendix 1 – Expenses Included in Selling, General and Administrative Expenses (Item 189) according to CRSP/COMPUSTAT Merged Database Guide

1. Accounting expense
2. Advertising expense
3. Amortization of research and development costs
4. Bad debt expense (provision for doubtful accounts)
5. Commissions
6. Corporate expense
7. Delivery expenses
8. Directors' fees and remuneration
9. Engineering expense
10. Extractive industries' lease rentals or expense, delay rentals, exploration expense, research and development expense, and geological and geophysical expenses, drilling program marketing expenses, and carrying charges on nonproducing properties
11. Financial service industries' labor, occupancy and equipment, and related expenses
12. Foreign currency adjustments when included by the company
13. Freight-out expense
14. Indirect costs when a separate Cost of Goods Sold figure is given
15. Labor and related expenses (including salary, pension, retirement, profit sharing, provision for bonus and stock options, employee insurance, and other employee benefits when reported below a gross profit figure)
16. Legal expense
17. Marketing expense
18. Operating expenses when a separate Cost of Goods Sold figure is given and no Selling, General, and Administrative Expense figure is reported
19. Parent company charges for administrative services
20. Recovery of allowance for losses
21. Research and development companies' company-sponsored research and development
22. Research and development expense
23. Research revenue that is less that 50% of total revenues for 2 years
24. Restaurants' preopening and closing costs
25. Retail companies' preopening and closing costs and rent expense
26. Severance pay (when reported as a component of Selling, General and Administrative Expenses)
27. State income tax when included by the company
28. Strike expense
29. Stock-based compensation when reported below a gross profit figure

Appendix 2- Descriptive Statistics by LOI decile

Panel A: Full sample

Variable	**Mean**	**Std. Dev.**	**25 th Pctl.**	**Median**	**75th Pctl.**
LOI	0.27	0.17	0.15	0.24	0.37
LOI_EXC_A&D	0.29	0.18	0.16	0.25	0.39
LOI_EXC_R&D	0.24	0.14	0.14	0.22	0.33
R&D_IN_LOI	0.03	0.07	0.00	0.00	0.03
RD_TO_SALES	0.03	0.14	0.00	0.00	0.02
RD_TO_TOTALS_ASSETS	0.03	0.05	0.00	0.00	0.03
INTANGIBLE_ASSETS	0.06	0.11	0.00	0.00	0.06
SIZE	5.55	1.79	4.22	5.43	6.75
CAPEX_PPE	0.06	0.06	0.02	0.05	0.09
PROFITABILITY	0.03	0.10	0.01	0.04	0.08
LEVERAGE	0.32	0.24	0.11	0.31	0.49
MARKET_TO_BOOK	2.18	1.85	1.00	1.61	2.66

Panel B: Descriptive statistics by LOI decile.

Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
	Decile 1		Decile 2		Decile 3		Decile 4		Decile 5	
LOI	0.068	0.034	0.120	0.037	0.166	0.043	0.210	0.048	0.253	0.054
LOI_EXC_A&D	0.074	0.043	0.131	0.050	0.179	0.056	0.224	0.066	0.267	0.065
LOI_EXC_R&D	0.065	0.034	0.115	0.038	0.157	0.045	0.198	0.051	0.237	0.058
R&D_IN_LOI	0.003	0.008	0.006	0.015	0.010	0.020	0.012	0.025	0.017	0.033
RD_TO_SALES	0.002	0.006	0.005	0.013	0.010	0.021	0.013	0.027	0.017	0.034
RD_TO_TOTALS_ASSETS	0.002	0.006	0.005	0.011	0.008	0.020	0.011	0.024	0.015	0.034
INTANGIBLE_ASSETS	0.045	0.091	0.049	0.095	0.054	0.099	0.058	0.104	0.054	0.104
SIZE	6.409	1.546	6.066	1.683	5.952	1.711	5.755	1.763	5.447	1.785
CAPEX_PPE	0.089	0.074	0.082	0.070	0.076	0.066	0.068	0.062	0.062	0.059
PROFITABILITY	0.043	0.067	0.042	0.071	0.042	0.076	0.042	0.075	0.039	0.082
LEVERAGE	0.357	0.213	0.351	0.217	0.355	0.216	0.342	0.224	0.332	0.236
MARKET_TO_BOOK	1.764	1.391	1.766	1.440	1.863	1.577	1.898	1.551	1.979	1.622
	Decile 6		Decile 7		Decile 8		Decile 9		Decile 10	
LOI	0.300	0.062	0.353	0.073	0.417	0.077	0.511	0.084	0.697	0.113
LOI_EXC_A&D	0.316	0.071	0.373	0.084	0.441	0.088	0.540	0.094	0.739	0.120
LOI_EXC_R&D	0.279	0.069	0.322	0.085	0.368	0.100	0.430	0.113	0.516	0.157
R&D_IN_LOI	0.020	0.036	0.029	0.049	0.043	0.064	0.066	0.080	0.122	0.103
RD_TO_SALES	0.022	0.044	0.034	0.059	0.053	0.084	0.085	0.103	0.194	0.162
RD_TO_TOTALS_ASSETS	0.019	0.041	0.030	0.055	0.050	0.092	0.090	0.183	0.252	0.510
INTANGIBLE_ASSETS	0.058	0.109	0.062	0.119	0.064	0.118	0.069	0.122	0.087	0.136
SIZE	5.418	1.796	5.320	1.738	4.954	1.647	4.639	1.710	4.451	1.631
CAPEX_PPE	0.054	0.059	0.047	0.059	0.049	0.057	0.049	0.054	0.044	0.044
PROFITABILITY	0.038	0.083	0.029	0.091	0.025	0.110	0.017	0.133	-0.030	0.181

LEVERAGE	0.343	0.247	0.343	0.252	0.278	0.238	0.207	0.222	0.109	0.172
MARKET_TO_BOOK	2.172	1.821	2.215	1.752	2.564	2.046	2.966	2.287	3.921	2.723

Notes:

1- The tables above offer descriptive statistics about the economic characteristics of the firms in the sample. Panel A reports the full sample, and panel B describes the firms in each LOI decile.

2- The LOI measures are defined as follows: a) *LOI* is the general proxy for the Level of Operating Intangibility, defined as selling, general and administrative expenses (excluding amortizations and depreciations) divided by total operating expenses; b) *LOI_EXC_A&D* is an alternative proxy where selling, general and administrative expenses (excluding amortizations and depreciations) are divided by total operating expenses excluding amortizations and depreciations; c) *R&D_IN_LOI* is the ratio of R&D expenses to total operating expenses; d) *LOI_EXC_R&D* is equal to *LOI* minus *R&D_IN_LOI*.

3- The measures of intangible intensity used in prior literature are defined as follows: 1) *RD_TO_SALES* is R&D divided by sales; 2) *R&D_TO_TOTAL_ASSETS* is R&D divided by total assets; 3) *INTANGIBLE_ASSETS* is the ratio of intangible assets to total assets on the balance sheet.

4- The variables identifying economic characteristics of corporations are defined as follows: 1) *SIZE* is the logarithm of the market-value of equity, 2) *CAPEX_PPE* is the value of the capital expenditures in property, plant and equipment expressed as a fraction of total assets, 3) *PROFITABILITY* is measured as net income divided by total assets, 4) *LEVERAGE* is the book value of total debt divided by the sum of the book values of shareholders' equity and total debt, and 5) *MARKET_TO_BOOK* is the market-value of equity divided by the book value of equity.

5- The 10,162 firms in sample were grouped into deciles according to the mean LOI computed using all sample observations. The entire sample was subdivided into ten sets. Thus, firms with analogous mean levels of operating intangibility were grouped together. Each decile has approximately the same number of firms, namely, 1,016 or 1,017 firms. When a firm is classified into one decile, all its observations will be classified in that decile. The variables Decile [1-10] are identifier variables that indicate observations from firms classified into the respective LOI decile in the full sample .

Appendix 3-Descriptive LOI Statistics by Industry

Rank #	Two Digits SIC Industry	Obs.	Mean LOI	Std. Dev.	25 th Pctl.	Median	75th Pctl.
1	12 COAL MINING	165	0.081	0.069	0.039	0.057	0.094
2	46 PIPELINES EXCEPT NATURAL GAS	52	0.088	0.071	0.024	0.092	0.119
3	41 LOCAL/SUBURBAN TRANSIT & HWY PASSENGER	25	0.108	0.060	0.074	0.088	0.120
4	16 HEAVY CONSTRUCTION EXCEPT BUILDING	462	0.108	0.087	0.064	0.091	0.125
5	33 PRIMARY METAL INDUSTRIES MFRS	1,971	0.111	0.072	0.066	0.090	0.139
6	42 MOTOR FREIGHT TRANSPORTATION/WAREHOUSE	354	0.116	0.079	0.063	0.099	0.148
7	29 PETROLEUM REFINING & PLASTICS MFRS	1,010	0.117	0.092	0.051	0.096	0.157
8	44 WATER TRANSPORTATION	477	0.124	0.078	0.078	0.111	0.150
9	14 MINING & QUARRYING-NONMETALLIC MINERALS	252	0.126	0.056	0.096	0.109	0.139
10	10 METAL MINING	892	0.127	0.090	0.068	0.105	0.157
11	83 SOCIAL SERVICES	99	0.129	0.085	0.080	0.098	0.140
12	15 BUILDING CONSTRUCTION-GEN CONTRACTORS	662	0.133	0.107	0.072	0.116	0.148
13	58 EATING & DRINKING PLACES	1,441	0.135	0.127	0.066	0.093	0.146
14	17 CONSTRUCTION-SPECIAL TRADE CONTRACTORS	213	0.141	0.084	0.084	0.117	0.187
15	37 TRANSPORTATION EQUIPMENT MFRS	3,085	0.145	0.073	0.092	0.136	0.186
16	02 AGRICULTURAL PRODUCTION-LIVESTOCK	19	0.145	0.048	0.114	0.127	0.201
17	26 PAPER & ALLIED PRODUCTS MFRS	1,829	0.150	0.085	0.090	0.124	0.190
18	22 TEXTILE MILL PRODUCTS MFRS	964	0.153	0.079	0.094	0.134	0.189

19	24 LUMBER & WOOD PRODS EXCEPT FURNTR MFRS	785	0.155	0.082	0.096	0.136	0.191
20	99 NONCLASSIFIED ESTABLISHMENTS	169	0.155	0.067	0.112	0.152	0.194
21	32 STONE CLAY GLASS & CONCRETE PRODS MFRS	1,246	0.155	0.084	0.103	0.141	0.189
22	45 TRANSPORTATION BY AIR	574	0.156	0.066	0.115	0.155	0.191
23	40 RAILROAD TRANSPORTATION	166	0.158	0.068	0.111	0.146	0.195
24	13 OIL & GAS EXTRACTION	3,863	0.160	0.112	0.079	0.133	0.213
25	51 WHOLESALE TRADE-NONDURABLE GOODS	1,567	0.166	0.141	0.078	0.130	0.212
26	63 INSURANCE CARRIERS	544	0.172	0.096	0.116	0.147	0.214
27	49 ELECTRIC GAS & SANITARY SERVICES	896	0.182	0.109	0.117	0.164	0.219
28	70 HOTELS ROOMING HOUSES & CAMPS	284	0.183	0.105	0.113	0.159	0.258
29	34 FABRICATED METAL PRODUCTS MFRS	2,530	0.194	0.092	0.132	0.182	0.244
30	54 FOOD STORES	1,184	0.196	0.065	0.170	0.197	0.229
31	07 AGRICULTURAL SERVICES	59	0.199	0.114	0.118	0.153	0.260
32	50 WHOLESALE TRADE-DURABLE GOODS	3,060	0.203	0.110	0.128	0.193	0.253
33	30 RUBBER & MISCELLANEOUS PLASTICS MFRS	1,780	0.205	0.096	0.138	0.188	0.253
34	47 TRANSPORTATION SERVICES	298	0.210	0.148	0.116	0.163	0.247
35	25 FURNITURE & FIXTURES MFRS	995	0.212	0.091	0.153	0.194	0.253
36	55 AUTOMOTIVE DEALERS & SERVICES STATIONS	380	0.218	0.109	0.124	0.217	0.304
37	78 MOTION PICTURES	555	0.223	0.154	0.125	0.186	0.284
38	52 BUILDING MATERIALS & HARDWARE	199	0.230	0.078	0.188	0.215	0.253
39	79 AMUSEMENT & RECREATION SERVICES	672	0.231	0.129	0.167	0.218	0.287
40	20 FOOD & KINDRED PRODUCTS MFRS	3,336	0.232	0.137	0.112	0.224	0.327
41	23 APPAREL & OTHER FINISHED PRODUCTS MFRS	1,453	0.238	0.088	0.175	0.231	0.289

42	72 PERSONAL SERVICES	390	0.244	0.172	0.126	0.219	0.296
43	80 HEALTH SERVICES	1,285	0.246	0.153	0.124	0.212	0.338
44	65 REAL ESTATE	600	0.246	0.179	0.103	0.217	0.315
45	53 GENERAL MERCHANDISE STORES	1,044	0.247	0.066	0.207	0.246	0.285
46	01 AGRICULTURAL PRODUCTION-CROPS	208	0.250	0.153	0.112	0.218	0.395
47	08 FORESTRY	32	0.255	0.095	0.181	0.248	0.326
48	31 LEATHER & LEATHER PRODUCTS MFRS	546	0.256	0.102	0.184	0.275	0.327
49	87 ENGINEERING & ACCOUNTING & MGMT SVCS	1,505	0.258	0.151	0.147	0.233	0.358
50	64 INSURANCE AGENTS BROKERS & SERVICES	245	0.260	0.175	0.133	0.233	0.323
51	75 AUTO REPAIR SERVICES & PARKING	183	0.264	0.200	0.111	0.201	0.357
52	76 MISCELLANEOUS REPAIR SERVICES	68	0.273	0.118	0.159	0.291	0.373
53	36 ELECTRONIC & OTHER ELECTRICAL EQUIP MFRS	9,195	0.286	0.137	0.190	0.263	0.359
54	35 INDUSTRIAL & COMMERCIAL MACHINERY MFRS	7,873	0.290	0.138	0.184	0.267	0.380
55	56 APPAREL & ACCESSORY STORES	1,071	0.292	0.080	0.240	0.274	0.322
56	21 TOBACCO PRODUCTS MFRS	136	0.296	0.112	0.229	0.287	0.330
57	81 LEGAL SERVICES	9	0.300	0.020	0.292	0.305	0.312
58	59 MISCELLANEOUS RETAIL	1,979	0.301	0.139	0.212	0.277	0.400
59	39 MISCELLANEOUS MANUFACTORING INDS MFRS	1,099	0.304	0.114	0.215	0.288	0.383
60	27 PRINTING PUBLISHING & ALLIED INDUSTRIES	1,811	0.311	0.145	0.203	0.297	0.413
61	48 COMMUNICATIONS	1,853	0.317	0.138	0.218	0.310	0.403
62	57 HOME FURNITURE & FURNISHING STORES	542	0.326	0.092	0.264	0.325	0.388
63	62 SECURITY & COMMODITY BROKERS	181	0.338	0.189	0.185	0.329	0.462
64	67 HOLDING & OTHER INVESTMENT OFFICES	537	0.339	0.279	0.113	0.251	0.481

65	82 EDUCATIONAL SERVICES	264	0.344	0.196	0.168	0.353	0.474
66	60 DEPOSITORY INSTITUTIONS	12,273	0.346	0.120	0.263	0.334	0.418
67	61 NONDEPOSITORY CREDIT INSTITUTIONS	166	0.370	0.246	0.159	0.348	0.493
68	28 CHEMICALS & ALLIED PRODUCTS MFRS	6,209	0.371	0.205	0.203	0.341	0.524
69	09 FISHING HUNTING & TRAPPING	1	0.378	.	0.378	0.378	0.378
70	38 MEASURING & ANALYZING INSTRUMENTS MFRS	7,098	0.386	0.158	0.273	0.377	0.492
71	73 BUSINESS SERVICES	8,099	0.444	0.239	0.234	0.419	0.648
72	89 MISCELLANEOUS SERVICES NEC	1	0.601	.	0.601	0.601	0.601
	***LOI* - Full Sample**	107,070	0.27	0.17	0.15	0.24	0.37

*Notes:
1. In Table III, the 72 (out of 81) 2-digit SIC industries with observations in the sample used here are sorted according to their mean *LOI*. Table 3 also presents additional *LOI* descriptive statistics by industry.
2. *LOI* is the proxy for the level of operating intangibility identifying the proportion of intangible related expenses amongst total operating expenses as defined in equation (5.3)
3. As observable by the classification of industries above, instead of using industries to identify firms as in the Industry Method, the LOI uses firms to classify industries.
4. The 9 2-digit SIC industries with missing observations in the sample are not expected to have firms listed on the stock exchanges, as they mainly include governmental organizations, non-profit organizations, and small firms. The SIC codes of industries not included in Table 6 are 43 (united states postal service), 84 (museums, art galleries and gardens), 86 (membership organizations), 91 (executive, legislative and general government), 92 (justice, public order and safety), 93 (public finance & taxation policy), 94 (administration – human resource programs), 95 (administration – environmental quality programs), 96 (administration of economic programs), and 97 (national security and international affairs).

Appendix 4- Spearman's Correlations between economic characteristics in the country sub samples included in the international sample

Australia

Spearman Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations						
	loi	**size**	**capex**	**profitability**	**leverage**	**market to book**
loi	1.00000 4928	-.41774 <.0001 4928	-.25722 <.0001 4922	-0.16668 <.0001 4928	-.29926 <.0001 4928	0.10133 <.0001 4928
size	-.41774 <.0001 4928	1.00000 4928	0.20859 <.0001 4922	0.54305 <.0001 4928	0.45682 <.0001 4928	0.00122 0.9318 4928
capex	-.25722 <.0001 4922	0.20859 <.0001 4922	1.00000 4922	0.03989 0.0051 4922	0.16275 <.0001 4922	0.22739 <.0001 4922
profitability	-.16668 <.0001 4928	0.54305 <.0001 4928	0.03989 0.0051 4922	1.00000 4928	0.07510 <.0001 4928	0.06411 <.0001 4928
leverage	-.29926 <.0001 4928	0.45682 <.0001 4928	0.16275 <.0001 4922	0.07510 <.0001 4928	1.00000 4928	-0.09295 <.0001 4928
market to book	0.10133 <.0001 4928	0.00122 0.9318 4928	0.22739 <.0001 4922	0.06411 <.0001 4928	-.09295 <.0001 4928	1.00000 4928

Canada

Spearman Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations						
	loi	**size**	**capex**	**profitability**	**leverage**	**market to book**
loi	1.00000 9140	-.57064 <.0001 9140	-.24920 <.0001 8836	-0.28405 <.0001 9140	-.42369 <.0001 9140	0.14045 <.0001 9140
size	-.57064 <.0001 9140	1.00000 9140	0.05211 <.0001 8836	0.43916 <.0001 9140	0.42634 <.0001 9140	-0.03812 0.0003 9140
capex	-.24920 <.0001 8836	0.05211 <.0001 8836	1.00000 8836	0.04353 <.0001 8836	0.08701 <.0001 8836	0.12403 <.0001 8836
profitability	-.28405 <.0001 9140	0.43916 <.0001 9140	0.04353 <.0001 8836	1.00000 9140	0.06834 <.0001 9140	0.02159 0.0390 9140
leverage	-.42369 <.0001 9140	0.42634 <.0001 9140	0.08701 <.0001 8836	0.06834 <.0001 9140	1.00000 9140	-0.08574 <.0001 9140
market to book	0.14045 <.0001 9140	-.03812 0.0003 9140	0.12403 <.0001 8836	0.02159 0.0390 9140	-.08574 <.0001 9140	1.00000 9140

China

Spearman Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations						
	loi	**size**	**capex**	**profitability**	**leverage**	**market to book**
loi	1.00000 9056	-.48566 <.0001 9056	-.03582 0.0007 9047	-0.02413 0.0217 9056	-.18206 <.0001 9056	0.12917 <.0001 9056
size	-.48566 <.0001 9056	1.00000 9056	0.12731 <.0001 9047	0.17211 <.0001 9056	0.15838 <.0001 9056	-0.12174 <.0001 9056
capex	-.03582 0.0007 9047	0.12731 <.0001 9047	1.00000 9047	0.27560 <.0001 9047	0.06673 <.0001 9047	-0.06358 <.0001 9047
profitability	-0.02413 0.0217 9056	0.17211 <.0001 9056	0.27560 <.0001 9047	1.00000 9056	-.39765 <.0001 9056	0.23973 <.0001 9056
leverage	-.18206 <.0001 9056	0.15838 <.0001 9056	0.06673 <.0001 9047	-0.39765 <.0001 9056	1.00000 9056	-0.08212 <.0001 9056
market to book	0.12917 <.0001 9056	-.12174 <.0001 9056	-.06358 <.0001 9047	0.23973 <.0001 9056	-.08212 <.0001 9056	1.00000 9056

France

Spearman Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations						
	loi	**size**	**capex**	**profitability**	**market to book**	**leverage**
loi	1.00000 1265	-.13163 <.0001 1265	-.15664 <.0001 1203	0.08551 0.0023 1265	0.29429 <.0001 1265	-.25702 <.0001 1265
size	-.13163 <.0001 1265	1.00000 1265	0.19116 <.0001 1203	0.06243 0.0264 1265	0.07158 0.0109 1265	0.24038 <.0001 1265
capex	-.15664 <.0001 1203	0.19116 <.0001 1203	1.00000 1203	0.04854 0.0924 1203	0.02055 0.4764 1203	0.30435 <.0001 1203
profitability	0.08551 0.0023 1265	0.06243 0.0264 1265	0.04854 0.0924 1203	1.00000 1265	0.28655 <.0001 1265	-.21833 <.0001 1265
market to book	0.29429 <.0001 1265	0.07158 0.0109 1265	0.02055 0.4764 1203	0.28655 <.0001 1265	1.00000 1265	-.14079 <.0001 1265
leverage	-.25702 <.0001 1265	0.24038 <.0001 1265	0.30435 <.0001 1203	-0.21833 <.0001 1265	-0.14079 <.0001 1265	1.00000 1265

Germany

Spearman Correlation Coefficients, N = 4551 Prob > |r| under H0: Rho=0						
	loi	**size**	**capex**	**profitability**	**market to book**	**leverage**
loi	1.00000	-.24291 <.0001	-.05869 <.0001	0.00043 0.9768	0.10526 <.0001	-.20852 <.0001
size	-.24291 <.0001	1.00000	0.35079 <.0001	0.18084 <.0001	0.09276 <.0001	0.20071 <.0001
capex	-.05869 <.0001	0.35079 <.0001	1.00000	0.09715 <.0001	0.05817 <.0001	0.14686 <.0001
profitability	0.00043 0.9768	0.18084 <.0001	0.09715 <.0001	1.00000	0.28170 <.0001	-.17486 <.0001
market to book	0.10526 <.0001	0.09276 <.0001	0.05817 <.0001	0.28170 <.0001	1.00000	-.12338 <.0001
leverage	-.20852 <.0001	0.20071 <.0001	0.14686 <.0001	-0.17486 <.0001	-0.12338 <.0001	1.00000

Israel

Spearman Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations						
	loi	size	capex	profitability	market to book	leverage
loi	1.00000 2001	-.38623 <.0001 2001	-.20384 <.0001 1998	-0.06132 0.0061 2001	0.09135 <.0001 2001	-.30841 <.0001 2001
size	-.38623 <.0001 2001	1.00000 2001	0.29177 <.0001 1998	0.09750 <.0001 2001	0.15243 <.0001 2001	0.10357 <.0001 2001
capex	-.20384 <.0001 1998	0.29177 <.0001 1998	1.00000 1998	0.13100 <.0001 1998	0.11483 <.0001 1998	0.12324 <.0001 1998
profitability	-.06132 0.0061 2001	0.09750 <.0001 2001	0.13100 <.0001 1998	1.00000 2001	0.22875 <.0001 2001	-.23400 <.0001 2001
market to book	0.09135 <.0001 2001	0.15243 <.0001 2001	0.11483 <.0001 1998	0.22875 <.0001 2001	1.00000 2001	-.06217 0.0054 2001
leverage	-.30841 <.0001 2001	0.10357 <.0001 2001	0.12324 <.0001 1998	-0.23400 <.0001 2001	-0.06217 0.0054 2001	1.00000 2001

Japan

Spearman Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations						
	loi	**size**	**capex**	**profitability**	**market to book**	**leverage**
loi	1.00000 28542	-.19104 <.0001 28542	0.08658 <.0001 28381	0.07196 <.0001 28542	0.16331 <.0001 28542	-.08244 <.0001 28542
size	-.19104 <.0001 28542	1.00000 28542	0.17610 <.0001 28381	-0.00357 0.5463 28542	0.08948 <.0001 28542	0.07279 <.0001 28542
capex	0.08658 <.0001 28381	0.17610 <.0001 28381	1.00000 28381	0.11227 <.0001 28381	0.11358 <.0001 28381	0.10428 <.0001 28381
profitability	0.07196 <.0001 28542	-.00357 0.5463 28542	0.11227 <.0001 28381	1.00000 28542	0.38477 <.0001 28542	-.36822 <.0001 28542
leverage	0.16331 <.0001 28542	0.08948 <.0001 28542	0.11358 <.0001 28381	0.38477 <.0001 28542	1.00000 28542	0.07165 <.0001 28542
market to book	-.08244 <.0001 28542	0.07279 <.0001 28542	0.10428 <.0001 28381	-0.36822 <.0001 28542	0.07165 <.0001 28542	1.00000 28542

Korea

Spearman Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations						
	loi	**size**	**capex**	**profitability**	**market to book**	**leverage**
loi	1.00000 9888	-.24365 <.0001 9888	-.06551 <.0001 9618	-0.06832 <.0001 9888	0.19257 <.0001 9888	-.10037 <.0001 9888
size	-.24365 <.0001 9888	1.00000 9888	0.16736 <.0001 9618	0.17268 <.0001 9888	-0.20027 <.0001 9888	0.14874 <.0001 9888
capex	-.06551 <.0001 9618	0.16736 <.0001 9618	1.00000 9618	0.16416 <.0001 9618	0.10166 <.0001 9618	0.08068 <.0001 9618
profitability	-.06832 <.0001 9888	0.17268 <.0001 9888	0.16416 <.0001 9618	1.00000 9888	0.11929 <.0001 9888	-.41493 <.0001 9888
market to book	0.19257 <.0001 9888	-.20027 <.0001 9888	0.10166 <.0001 9618	0.11929 <.0001 9888	1.00000 9888	-.08989 <.0001 9888
leverage	-.10037 <.0001 9888	0.14874 <.0001 9888	0.08068 <.0001 9618	-0.41493 <.0001 9888	-0.08989 <.0001 9888	1.00000 9888

Malaysia

Spearman Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations						
	loi	**size**	**capex**	**profitability**	**market to book**	**leverage**
loi	1.00000 5796	-.35993 <.0001 5796	-.06711 <.0001 5793	-0.08360 <.0001 5796	-0.03570 0.0066 5796	-.12266 <.0001 5796
size	-.35993 <.0001 5796	1.00000 5796	0.16166 <.0001 5793	0.25188 <.0001 5796	0.12007 <.0001 5796	0.17347 <.0001 5796
capex	-.06711 <.0001 5793	0.16166 <.0001 5793	1.00000 5793	0.26160 <.0001 5793	0.19611 <.0001 5793	0.00323 0.8057 5793
profitability	-.08360 <.0001 5796	0.25188 <.0001 5796	0.26160 <.0001 5793	1.00000 5796	0.35999 <.0001 5796	-.37350 <.0001 5796
market to book	-.03570 0.0066 5796	0.12007 <.0001 5796	0.19611 <.0001 5793	0.35999 <.0001 5796	1.00000 5796	-.09653 <.0001 5796
leverage	-.12266 <.0001 5796	0.17347 <.0001 5796	0.00323 0.8057 5793	-0.37350 <.0001 5796	-0.09653 <.0001 5796	1.00000 5796

Singapore

Spearman Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations						
	loi	**size**	**capex**	**profitability**	**market to book**	**leverage**
loi	1.00000 3506	-.42421 <.0001 3506	0.00911 0.5898 3505	-0.07907 <.0001 3506	0.05801 0.0006 3506	-.13414 <.0001 3506
size	-.42421 <.0001 3506	1.00000 3506	0.08046 <.0001 3505	0.19332 <.0001 3506	-0.00394 0.8155 3506	0.20482 <.0001 3506
capex	0.00911 0.5898 3505	0.08046 <.0001 3505	1.00000 3505	0.18179 <.0001 3505	0.18786 <.0001 3505	0.03858 0.0224 3505
profitability	- 0.07907 <.0001 3506	0.19332 <.0001 3506	0.18179 <.0001 3505	1.00000 3506	0.33421 <.0001 3506	-.25249 <.0001 3506
market to book	0.05801 0.0006 3506	-.00394 0.8155 3506	0.18786 <.0001 3505	0.33421 <.0001 3506	1.00000 3506	-.09130 <.0001 3506
leverage	-.13414 <.0001 3506	0.20482 <.0001 3506	0.03858 0.0224 3505	-0.25249 <.0001 3506	-0.09130 <.0001 3506	1.00000 3506

South Africa

Spearman Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations						
	loi	size	capex	profitability	market to book	leverage
loi	1.00000 1291	-.34793 <.0001 1215	-.29163 <.0001 1285	0.08965 0.0013 1291	-0.11582 <.0001 1291	-.22098 <.0001 1291
size	-.34793 <.0001 1215	1.00000 1215	0.22571 <.0001 1210	0.00127 0.9648 1215	0.32120 <.0001 1215	0.07448 0.0094 1215
capex	-.29163 <.0001 1285	0.22571 <.0001 1210	1.00000 1285	0.08802 0.0016 1285	0.18007 <.0001 1285	0.24861 <.0001 1285
profitability	0.08965 0.0013 1291	0.00127 0.9648 1215	0.08802 0.0016 1285	1.00000 1291	0.29999 <.0001 1291	-0.21107 <.0001 1291
market to book	- 0.11582 <.0001 1291	0.32120 <.0001 1215	0.18007 <.0001 1285	0.29999 <.0001 1291	1.00000 1291	-.06817 0.0143 1291
leverage	-.22098 <.0001 1291	0.07448 0.0094 1215	0.24861 <.0001 1285	-0.21107 <.0001 1291	-0.06817 0.0143 1291	1.00000 1291

Sweden

Spearman Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations						
	loi	size	capex	profitability	market to book	leverage
loi	1.00000 1494	-.29837 <.0001 1494	-.20699 <.0001 1482	-0.12300 <.0001 1494	0.34039 <.0001 1494	-.41071 <.0001 1494
size	-.29837 <.0001 1494	1.00000 1494	0.30018 <.0001 1482	0.33335 <.0001 1494	0.04667 0.0713 1494	0.22999 <.0001 1494
capex	-.20699 <.0001 1482	0.30018 <.0001 1482	1.00000 1482	0.15235 <.0001 1482	0.03385 0.1928 1482	0.23321 <.0001 1482
profitability	-.12300 <.0001 1494	0.33335 <.0001 1494	0.15235 <.0001 1482	1.00000 1494	0.25024 <.0001 1494	-.09430 0.0003 1494
market to book	0.34039 <.0001 1494	0.04667 0.0713 1494	0.03385 0.1928 1482	0.25024 <.0001 1494	1.00000 1494	-.21859 <.0001 1494
leverage	-.41071 <.0001 1494	0.22999 <.0001 1494	0.23321 <.0001 1482	-0.09430 0.0003 1494	-0.21859 <.0001 1494	1.00000 1494

Taiwan

Spearman Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations						
	loi	**size**	**capex**	**profitability**	**market to book**	**leverage**
loi	1.00000 9836	-.46302 <.0001 9836	0.04248 <.0001 9813	0.03096 0.0021 9836	0.12927 <.0001 9836	-.22550 <.0001 9836
size	-.46302 <.0001 9836	1.00000 9836	0.07809 <.0001 9813	0.10710 <.0001 9836	0.03745 0.0002 9836	0.16372 <.0001 9836
capex	0.04248 <.0001 9813	0.07809 <.0001 9813	1.00000 9813	0.16369 <.0001 9813	0.16324 <.0001 9813	0.08057 <.0001 9813
profitability	0.03096 0.0021 9836	0.10710 <.0001 9836	0.16369 <.0001 9813	1.00000 9836	0.58459 <.0001 9836	-.43181 <.0001 9836
market to book	0.12927 <.0001 9836	0.03745 0.0002 9836	0.16324 <.0001 9813	0.58459 <.0001 9836	1.00000 9836	-.25149 <.0001 9836
leverage	-.22550 <.0001 9836	0.16372 <.0001 9836	0.08057 <.0001 9813	-0.43181 <.0001 9836	-0.25149 <.0001 9836	1.00000 9836

UK

Spearman Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations						
	loi	size	capex	profitability	market to book	leverage
loi	1.00000 14341	-.65321 <.0001 14341	-.45681 <.0001 14253	-0.24766 <.0001 14341	-0.08806 <.0001 14341	-0.40411 <.0001 14341
size	-.65321 <.0001 14341	1.00000 14341	0.49812 <.0001 14253	0.38737 <.0001 14341	0.21432 <.0001 14341	0.36088 <.0001 14341
capex	-.45681 <.0001 14253	0.49812 <.0001 14253	1.00000 14253	0.12125 <.0001 14253	0.32426 <.0001 14253	0.25376 <.0001 14253
profitability	-.24766 <.0001 14341	0.38737 <.0001 14341	0.12125 <.0001 14253	1.00000 14341	0.18626 <.0001 14341	0.03687 <.0001 14341
market to book	-.08806 <.0001 14341	0.21432 <.0001 14341	0.32426 <.0001 14253	0.18626 <.0001 14341	1.00000 14341	- 0.01664 0.0463 14341
leverage	-.40411 <.0001 14341	0.36088 <.0001 14341	0.25376 <.0001 14253	0.03687 <.0001 14341	-0.01664 0.0463 14341	1.00000 14341

Appendix 5- Would Tobin's q only describe a firm's intangible assets and growth prospects?[34]

A5.1 Reasons to inspect Tobin's q equation

The comparison of a firm's market and book values could eventually be suggested as an alternative to identifying the product (output) intangibility. Several authors claim such difference provides information about intangible assets and/or growth prospects (e.g.: Rajan and Zingales, 1995; Myers, 1977). According to Myers (1984, p. 586): 'book values reflect assets-in-place (tangible assets and working capital). Market-values reflect intangibles and growth opportunities as well as assets-in-place'. Naturally, one question would arise: could the market to book ratio replace accounting information about the intangibility of a firm's product?[35] Often used to characterize corporations, the computation of Tobin's q (Tobin, 1969) requires both market and book values. As described by Morck, et al (1989, p. 844), a high Tobin's q value is usually interpreted as indicating high level of intangible assets along with solid overall operating performance/management; a low value of q suggests the opposite. Reviews of the literature on intangibles identify q as one of the principal indicators of intangible assets (e.g.: Canibano et al 2000; Villalonga, 2000). Its role as an indicator of operating performance is illustrated in studies such as Brav et al (2008), La-Porta et al (2002), Schoar (2002), and Lang and Stulz (1994).

However, even if q were able to capture a firm's intangible assets this would not necessarily imply that q can capture product (output) intangibility. A concrete separation between assets and products has already been established. For instance, the services are intangible, heterogeneous and perishable products that must be

[34] This chapter is partly integrated in Cardao-Pito (2009).
[35] Evidently, the numerator of the market to book ratio is accounting information itself.

consumed when produced, as they cannot be stored beforehand (Zeithaml et al, 1985). Therefore, as explained by the intangible flow theory, the flows of services have properties precluding their being considered as assets or capital. Thus, as used by Tobin's q, an asset/capital good perspective would fail to capture products sold by nearly every firm. Even the most tangible good requires a service to be sold and delivered to a customer.

Nevertheless, a puzzling association between q and leverage was established by McConnell and Servaes (1995). They demonstrated empirically, in a sample of 826 firms listed on the New York Stock Exchange (NYSE) or the American Stock Exchange (AMEX), that the q-values of 'high growth' firms ($q > 1$) were *negatively* correlated with leverage (i.e. the proportion of debt in the capital structure), while those of 'low growth' firms ($q < 1$) were *positively* correlated with leverage. Is this empirical association an economic insight, or can it be derived from the q equation itself? This chapter demonstrates analytically that the correlations are partially driven by the mathematical definition of Tobin's q which mechanically captures the capital structure of firms. Specifically, it shows that when the market-value of the shareholder's equity exceeds the book value and all other variables (such as intangible assets and operating performance) are held constant, firms with less (more) debt automatically have higher (lower) Tobin's q.

To address this issue, we now provide an analytical inspection of Tobin's equation. If a mechanical association with leverage could be demonstrated, it would be possible to show that the q values are not merely explained by intangible assets or growth prospects as suggested in previous literature. Otherwise, the q values might be partially driven by the computational process itself.

A5.2 Computing Tobin's q

As defined by Tobin (1969), q is the market-value of a firm's capital goods divided by their price:

$$\text{Tobin's q} = \frac{\text{Market Value of Capital Goods}}{\text{Price of Capital Goods}} \tag{10.1}$$

The problem with this definition is that both inputs are unknown; hence proxies are used instead. The denominator is typically replaced with the book value of equity plus some additional value *b*, and the numerator with the market-value of equity plus some additional value *a*. This yields the following ratio:

$$q^{Proxy} = \frac{\text{Market Value of Capital Goods}}{\text{Price of Capital Goods}} = \\ = \frac{e_{MV} + a}{e_{BV} + b}$$

(10.2)

In Eq. 10.2, *e* is the shareholders' equity value. The subscripts indicate market-value *(MV)* and accounting book value *(BV)*. Following the balance sheet equation, the values of (*a)* and (*b)* are proportional to the total liabilities. The market and book value of total liabilities (*l*) are generally considered to be similar in magnitude. Thus, we have:

$$\begin{cases} a = xl & \text{where } 0 \le x \le 1 \\ b = yl & \text{where } 0 \le y \le 1 \\ l_{MV} \approx l_{BV} & \end{cases}$$

(10.3)

Recall that debt *(d)* is proportion to the total liabilities, and a firm's total assets are equal to the sum of equity *(e)* to total liabilities *(l).* In Tobin's original formulation, the classic market-to-book value of shareholder equity *(MBE)* may be a form of q. That is, *(MBE)* is Tobin's q calculated from the perspective of equity investors where *a*, *b, x* and *y* are equal to zero:

$$MBE = \frac{e_{MV}}{e_{BV}}$$

(10.4)

Researchers have defined (*a)* and (*b)* using several variables: total liabilities, book debt, liabilities less net assets, long-term debt, and long-term liabilities, etc. A key point is that all such proxies are either directly related to debt or highly correlated with leverage. Thus, no matter what specific values we choose for (*a)* and (*b)*, they must be highly correlated with leverage. Hence, the reasoning described in the next section is applicable no matter how q is computed. Whether one uses simple end-of-the-year book values, historical averages, or book values predicted from regressions, the variables (*a)* and (*b)* will always be correlated with leverage. Furthermore, Chung and Pruitt (1994) showed that even elaborate q proxies, such as that used by Lindenberg and Ross (1981), who slightly changed the numerator to include equity, debt, and preferred stock, while restricting the denominator to plant, equipment, and inventory, provide results that are highly correlated with less detailed q proxies. [36]

A5.3 The Immediate Effect of Debt on Tobin's q Equation

The following analysis shows that leverage (the proportion of debt in total capital) is mechanically captured in the value of q whenever the market-value of

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[36] Perfect and Wiles (1994) review studies with an approach similar to that used by Lindberg and Ross (1981)

equity is not equal to the book value. Observing Eq. 10.2, note that if *(a)* and *(b)* are equal, q is always in the interval $q \in [MBE;1)$. If both (*a)* and (*b)* converge to 0 (as in the case of no external financing), q converges to *(MBE)*. When both (*a)* and (*b)* converge to infinity (as in the case of a bankrupt firm), q converges to 1. The effect of leverage on q can be identified using partial derivatives, and the following results hold for any proxy of q. The effects of *a* and *b* are:

$$\frac{\partial q}{\partial a} = \frac{\partial\left[\dfrac{e_{MV} + a}{e_{BV} + b}\right]}{\partial a} = \frac{1}{e_{BV} + b}$$

(10.5)

And

$$\frac{\partial \mathrm{q}}{\partial \mathrm{b}} = \frac{\partial\left[\dfrac{e_{MV} + a}{e_{BV} + b}\right]}{\partial b} = \frac{-(e_{MV} + a)}{(e_{BV} + b)^2}$$

(10.6)

Since in most proxies *a* is equal to or converges to *b*, the bias effect can be approximated as:

$$Lim_{a \to b} \frac{\partial \mathrm{q}}{\partial \mathrm{a}} = Lim_{a \to b} \frac{\partial\left[\dfrac{e_{MV} + a}{e_{BV} + b}\right]}{\partial a} = \frac{-e_{MV} + e_{BV}}{(e_{BV} + b)^2} \tag{10.7}$$

Therefore, we can deduce the following from the q equation: i) if the market-value of equity (e_{MV}) is greater than the book value of equity (e_{BV}), then q decreases with leverage and ii) if the market-value of equity (e_{MV}) is less than the book value of equity (e_{BV}), then q increases with leverage. Hence, Eq. 10.7

analytically describes the same correlations observed by McConnell and Servaes (1995) for a large sample. The capital structure impacts Tobin's q equation in every case where the market-value of equity differs from the book value. [37]

Table 10.1 summarizes a numerical example. Consider a company with market-to-book ratio of shareholder equity of 3.7, obtained from a market-value of equity of 148 and a book value of 40. For simplicity, suppose that *(a)* and *(b)* are equal to the book debt. In the first case, the leverage is zero so the market-to-book value of equity is equal to q. In the second case, the value of total liabilities is 2, thus, the leverage is approximately 5%. In the subsequent steps, the debt is multiplied by two each time, while everything else remains the same. Figure 10.1 presents the evolution of the system. As the leverage increases, the shareholders' equity remains the same but the q value converges to unity.

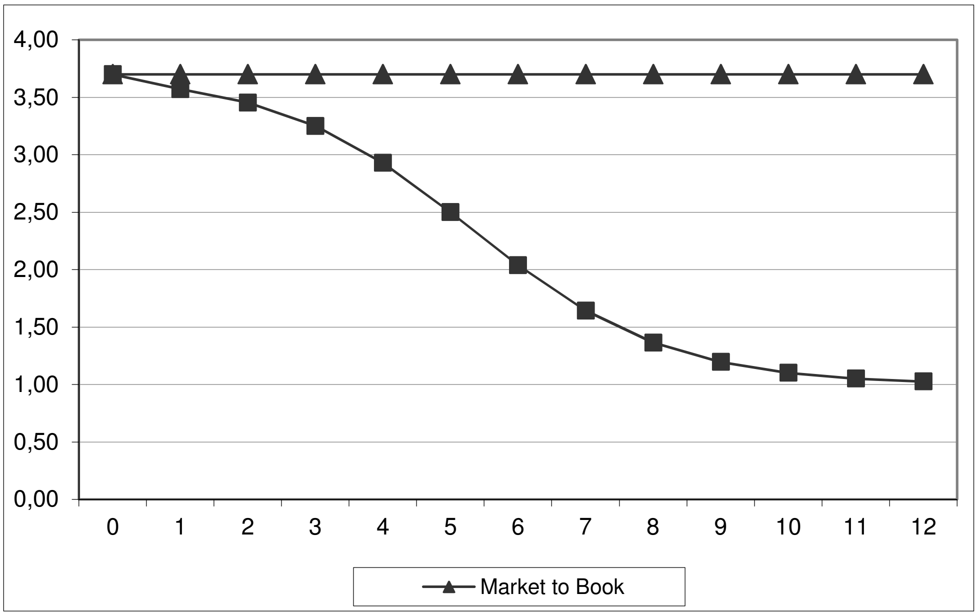
[37] As is well known, Modigliani and Miller (1958; see also Miller, 1988) have asserted that in the very extreme case of no taxes and some other conditions, leverage does not affect the firm's value. Nonetheless, the leverage effect described here is still present under their assumptions. The only requirement is that a firm's market-value of equity is not equal to its book value.

Table A5.1 - Numerical example of the mechanical debt effect on Tobin's q equation when market value of equity is larger than its book value*

	Step												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Market Equity	148	148	148	148	148	148	148	148	148	148	148	148	148
Book Equity	40	40	40	40	40	40	40	40	40	40	40	40	40
Book Debt	0	2	4	8	16	32	64	128	256	512	1024	2048	4096
Book Leverage	0%	5%	9%	17%	29%	44%	62%	76%	86%	93%	96%	98%	99%
Market to Book of Equity	3.70	3.70	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Tobin's q	3.70	3.57	3.45	3.25	2.93	2.50	2.04	1.64	1.36	1.20	1.10	1.05	1.03

*Notes: After step 1, book debt is simply multiplied by 2. The market to book of shareholders' equity ratio remains constant, but Tobin's q is clearly affected. It converges to 1 as debt increase.

Figure A5.1- Visual representation of the example in table 10.1



Thus, in the normal case where the market-value of equity is greater than the book value and all else is held constant (including intangible assets and operating performance), firms with less debt have higher values of Tobin's q. The reverse occurs in exceptional cases where the market-value of equity is smaller than the book value. Hence, the level of debt has an effect on Tobin's indicator that is independent of operating performance and intangible assets.

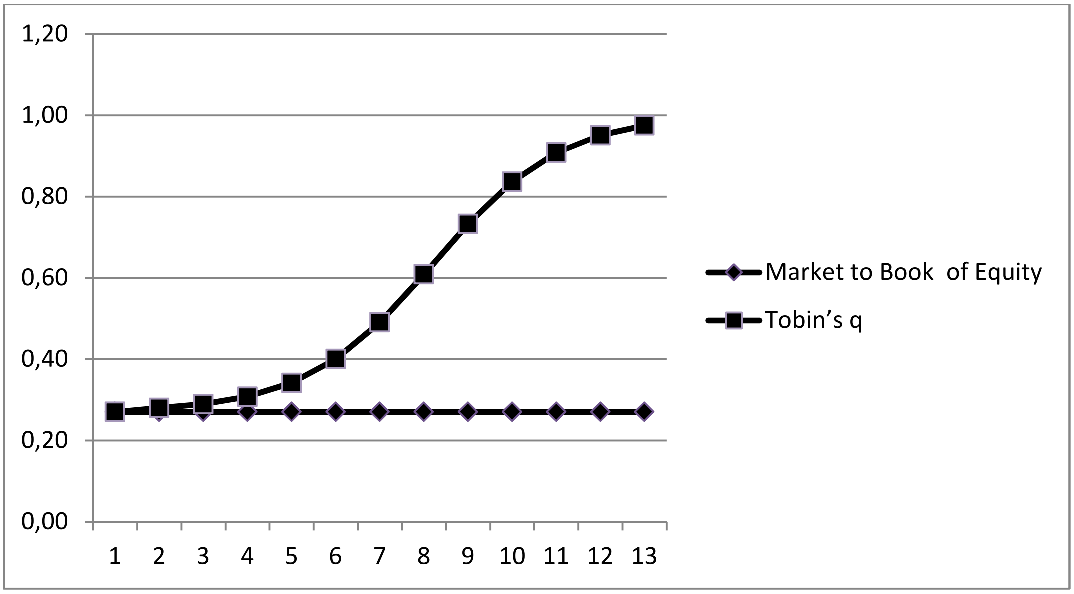
For completeness, table 10.2 and figure 10.2 exemplify the case where market-value of equity is smaller than the book value and all else is held constant (including intangible assets and operating performance). The USA sample and the international sample demonstrate that this is much less common for the market value of equity to be smaller than its book value. Naturally, the mechanical effect is also verified in this case, though with the opposite direction.

Table A5.2 - Numerical example of the mechanical debt effect on Tobin's q equation when market value of equity is smaller than its book value*

	Step												
	0	1	2	3	4	5	6	7	8	9	10	11	12
Market Equity	40	40	40	40	40	40	40	40	40	40	40	40	40
Book Equity	148	148	148	148	148	148	148	148	148	148	148	148	148
Book Debt	0	2	4	8	16	32	64	128	256	512	1024	2048	409
Book Leverage	0%	1%	3%	5%	10%	18%	30%	46%	63%	78%	87%	93%	97%
Market to Book of Equity	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Tobin's q	0.27	0.28	0.29	0.31	0.34	0.40	0.49	0.61	0.73	0.84	0.91	0.95	0.97

*Notes: After step 1, book debt is simply multiplied by 2. The market to book of shareholders' equity ratio remains constant, but Tobin's q is clearly affected. It converges to 1 as debt increase.

Figure A5.2- Visual representation of the example in table 10.2



A5.4 Conclusion of the appendix

The mechanical effect of debt on Tobin's q equation partially explains q values without the need for economic theory. Furthermore, the ability of q to identify intangibility may be partially driven by a common characteristic of intangible intensive firms: they tend to have less debt in their capital structure (e.g.: Cardao-Pito, 2010; Bah and Dumontier, 2001). Likewise, although it is common to interpret a high q value for new firms as describing future growth opportunities, many start-ups are financed primarily by equity (e.g.: Denis, 2004; Gompers et al, 1998). The question that remains is whether this mechanical effect, which was explained as indicating a firm's intangible assets and operating performance by past economic literature (e.g.: Tobin, 1969; Mork et al, 1989;

McConnell and Servaes, 1995; Canibano et al, 2000; Villalonga, 2000; Brav et al, 2008; La-Porta et al, 2002; Schoar 2002; Lang and Stulz, 1994; Chung and Pruitt, 1994; Lindenberg and Ross 1981), could have had a material impact on the decisions of investors, firms, accounting regulators, and other stakeholders?