Revisiting the External Financial Dependence index in light of the rise of Corporate Net Lending: What do we really measure?

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Abstract

This paper revisits the External Financial Dependence (EFD) index elaborated by Rajan and Zingales (1998). According to the original formulation, the industry values of the EFD index are meant to reflect technological characteristics of the industries and it is assumed to be stable in time and across countries. Despite the popularity of the EFD index, there have been reduced attempts to extend the estimations to other countries and periods. This paper fills this gap, calculating the EFD index for G7 countries between 1980 and 2015 and to test the assumptions of stability of the index. The paper finds that these assumptions find little support. Moreover, the EFD index is discussed in relation to the rise of corporate net lending in developed countries. It is argued that the EFD index can be considered a proxy of net lending as there are considerable theoretical and empirical similarities between the concepts.

1. Introduction

The concept of External Financial Dependence (EFD) refers to the capacity of firms (or industries) to fund their investment via internal funds. To measure this concept, in a very influential paper Rajan and Zingales (1998) developed the External Financial Dependency (EFD) index. By linking the cash flow generated by private companies with their investment, the EFD index is meant to grasp the need of external funds of the corporate sector to cover its expenditure in fixed capital. The fundamental idea behind this formulation is that the EFD index is meant to reflect structural technological features of the industries, as some industries are considered to be more reliant on external finance than other. In the original estimation (Rajan & Zingales, 1998) the values of the EFD index are estimated using data for listed American firms in the 1980s under two key assumptions, namely that the level of industry EFD is steady (or at least that it does not change considerably) in time and across countries. These assumptions are crucial for the literature that employs the EFD index. In fact, numerous studies use the values of the EFD index calculated by Rajan and Zingales for American firms in the 1980s as a good universal proxy for other countries and periods industries' EFD.

Despite the wide use of the EFD, the increasing availability of data and the popularity of Rajan and Zingales paper, it is surprising how little debate was generated in the literature on the foundation of the EFD index. On the theoretical level, the validity of the two assumptions of stability of the index is usually not discussed in detail. On the empirical ground, there have been only limited attempts (Hsu, Tian, & Xu, 2014; Kroszner, Laeven, & Klingebiel, 2007; Raddatz, 2006) to recalculate the EFD. This paper fills these gaps, by discussing the theoretical foundations and extending the original calculations of the EFD index. Using data on listed firms deriving from the Worldscope database, we estimate the EFD index to G7 countries and embracing a period that runs from 1980 to 2015 and evaluates to what extent the assumptions of stability of the index in time and space find empirical validity.

Moreover, the paper relates the discussion about the EFD index with the growth of corporate net lending recorded in the last decades. Similarly to the EFD index, corporate net lending relates a measure of liquidity of the firm (in this case, corporate savings) with physical investment. Despite this resemblance, the scopes of the two indicators (net lending and EFD index) are embedded in radically different perspectives. While it is acknowledged that level of net lending is not constant in time and it is widely accepted that it can change between countries, the EFD index lies on the assumptions that the industry's EFD does not vary in time and space. It is therefore relevant to study more closely this relationship and to ask how it is possible that two measures that appear to be so similar have such different applications. This paper explores this issue in detail, investigating the relation between the measure of net lending and the EFD index from the theoretical and empirical perspective. This analysis is key in order to establish to what extent the EFD can be considered an equivalent measure of corporate net lending. A close degree of similarity between the EFD index and corporate savings and a high degree of variation of the EFD index in time would indicate that the EFD index is a proxy of corporate net lending, and not an invariable measure of the technological needs of external finance of non-financial corporations as intended by the literature that relies on it. On the other hand, it can be established that the two concepts effectively grasp different phenomena only to the extent that they are sensibly different, both on the definitional and on the empirical ground. If the EFD can be considered a proxy of net lending, there would emerge important consequences for the literature connected with the EFD index, as the interpretation of the EFD index as a measure able to grasp structural technological features of the industry would be jeopardized.

To address these aspects, the paper describes in detail the EFD index elaborated by Rajan and Zingales, the key assumptions supporting its construction and their relevance for the existing literature (section 2). Subsequently, section 3 critically assesses the EFD index. Specifically, section 3.1 provides theoretical insights that criticise the assumptions of stability of the index in time and across countries. Section 3.2 compares the definitions of EFD and net lending to highlight the elements of similarity and differences between the two. It will be maintained that the accounting differences between the two indicators are minimal, as the variable of liquidity employed in the EFD index is very close to the definition of savings used in the calculation of net lending. Then, section 3.3 reproduces the EFD index expanding the original calculations. After calculating industries' values for G7 countries for four different periods, the hypotheses of stability in space and time of the original index are tested. The results reveal that these assumptions find limited or no support in empirical estimations. Furthermore, the resemblance between the EFD index and net lending is assessed empirically in section 3.4, by reproducing a new version of the EFD index that utilises savings instead of cash flow. The firm-level values of this new EFD index are compared with those obtained using the same variables as in Rajan and Zingales (1998). This comparison allows to conclude that the two measures reach analogous values, indicating that the EFD index can be interpreted as a proxy of corporate net lending and not as a measure that reflects structural and unmodifiable technological characteristics of the industry. These findings have important consequences for economic analysis and for the literature that employs the EFD index. These implications are discussed in section 4 which resumes the main findings of the paper.

2. The relevance of EFD index.

2.1. Description of the EFD index.

The EFD index was first introduced by Rajan and Zingales in a paper published in 1998 (Rajan & Zingales, 1998). In this work, Rajan and Zingales explore the link between industries' external financial dependence, the countrywide financial development and economic growth. The authors maintain that industries that are more financial dependent grow at a faster pace in countries that have more financially developed markets. As there are some industries that are more financially dependent than others, the presence of more developed financial sectors enhance growth. In order to test the degree of dependency of the firm, the authors propose the External Financial Dependency index.

This index is meant to be able to grasp the external finance dependency of each industry and reflects the "amount of desired investment that cannot be financed through internal cash flows generated by the same business" (Rajan and Zingales 1998: 564). The EFD index is calculated as follows. For each firm, its "dependence on external finance is defined as capital expenditure [...] minus cash flow from operations divided by capital expenditures" (Rajan & Zingales, 1998, p. 564). Therefore, for each firm *i* it can be expressed as:

$$\mathrm{EFD}_i = \frac{(\mathrm{KE}_i - \mathrm{CF}_i)}{\mathrm{KE}_i} = 1 - \frac{\mathrm{CF}_i}{\mathrm{KE}_i} \qquad (1)$$

Where KE_i is capital expenditure and CF_i is the cash flow from operations. The index is computed at the firm level using the total cash flow and capital expenditure over a period of ten years in order to smooth "temporal fluctuations and reduce the effects of outliers" (Rajan & Zingales, 1998, p. 564) so that annual peaks are absorbed over a longer time span. The original Rajan and Zingales estimation of the index was realized using data of American listed non-financial corporations during the 1980s. Once firm-level EFD values for the 1980s are estimated, the industry-level values of the index are obtained by taking the median of the individual values of the index for companies belonging to each industry. Hence, following this procedure there will be as many values of the index as the number of industries analysed.

It is important to highlight that, according to Rajan and Zingales, the EFD index is meant to reflect sectoral technological features of each industry: "[w]e assume that there is a technological reason why some industries depend more on external finance than others" (Rajan and Zingales 1998: 563). From this perspective, some sectors are inherently more dependent from external finance than others. There are two central assumption behind the measure that support the validity of the index.

- The first assumption is that, in a context of perfect capital mobility, external dependence does not vary across space. In the authors' words, "technological differences persist across countries, so that we can use an industry's dependence on external funds as identified in the United States as a measure of its dependence in other countries" (Rajan and Zingales 1998: 563). Since the capital market in the US is virtually frictionless, firms can raise as much funds as they wish, so that the EFD index for American firms should be a good proxy of the "real" financial dependency of the firm. Hence, the amount of external finance used by large firms in the United States is likely to be a

relatively pure measure of their demand for external finance (Rajan and Zingales 1998: 564).

- The second assumption regards the invariability of the index along time. According to this assumption, in a frictionless financial environment, industries do not change their demand for external finance. Hence, calculations obtained for the 1980s are meant to be a good proxy of the structural demand for external funds.

These assumptions are at the foundations of the theoretical construction and empirical estimation of the EFD index. However, they do not imply that all firms in a given industry will have simultaneously the same external dependence level. The authors recognize that firms at a different stage of the life cycle tend to have different external dependence needs. Younger companies that are in an earlier stage of the product cycle are expected to be more dependent on external finance than more established firms. Following this rationale, there can be differences in the overall value of the EFD index across countries. Notably, firms in developing countries are expected to be in a different life cycle (less mature) than American companies. For this reason, the authors estimate the index for American firms during the 1970s arguing that the "younger" life cycle corresponding to this decade will be more appropriate to grasp the technological characteristics of less developed countries: "given that our sample is biased toward developing countries, one might think that the US industry in the 1970's might be a better proxy for the position of developing countries" (Rajan and Zingales 1998: 565). Therefore, the only technological difference between firms in developed and developing countries is that the former is in a more mature stage cycle compared developing countries.

Furthermore, Rajan and Zingales recognize that there might be shocks that influence the need of external dependence. However, these shocks are not supposed to have a permanent role in the modification of the levels of EFD. They further assume that even if shocks affect differently countries around the world, the impact on the individual industry in different countries would be the same because "the determinants of the cash flow to capital are similar worldwide" (Rajan and Zingales 1998: 565). This means that if there is a shock in sector *x* in country *j*, the impact would affect equally sector *x* in other countries. This is crucial because it rules out the possibility that technological shocks can alter permanently the EFD across countries. Overall, this discussion can be resumed with the idea that the EFD index calculated for the American firms during the 1980s is a good universal proxy of the external dependency of the industries worldwide.

The values for the EFD index obtained by Rajan and Zingales for each of the industries are detailed in Table 1. It can be appreciated that most of the values are comprised between 0 and 1. Five industries record values below zero and four have values higher than one. With a negative EFD index the industry is considered to be virtually not dependent on external finance, as the cash flow generated by the firm is sufficient to cover their capital expenditure.

Table 1. Rajan and Zingales index of external dependency.

Industry	Value	Industry	Value
Tobacco	-0.45	Furniture	0.24
Pottery	-0.15	Metal products	0.24
Leather	-0.14	Basic excluding fertilising	0.25
Spinning	-0.09	Wood	0.28
Footwear	-0.08	Transportation equipment	0.31
Nonferrous Metals	0.01	Petroleum and Coal	0.33
Apparel	0.03	Motor vehicle	0.39
Petroleum refineries	0.04	Textiles	0.40
Non. metal Products	0.06	Machinery	0.45
Beverages	0.08	Ship	0.46
Iron and Steel	0.09	Other industries	0.47
Food products	0.14	Glass	0.53
Pulp, paper	0.15	Electric machinery	0.77
Synthetic resins	0.16	Professional goods	0.96
Paper and Products	0.18	Radio	1.04
Printing and Publishing	0.20	Office and computing	1.06
Other chemicals	0.22	Plastic products	1.14
Rubber products	0.23	Drugs	1.49
Average	0.29		
Source: Rajan and Zingales, 1998			

2.2. The EFD in the literature. Applications and alternative estimations.

The EFD index had a deep influence in the financial and economic literature. The original paper by Rajan and Zingales counts more than 9,500 citations.[1] Although not all these works engage with the EFD index, the measure has been employed in a wide range of applications.

One of the most prominent features that emerge is that the majority of the studies do not replicate the estimation of the EFD index with new data but use the very same industry values obtained by Rajan and Zingales in their calculations for American firms during the 1980s. Among the studies that employ the values of the index obtained by Rajan and Zingales, Cetorelli and Gambera (2001) study the link between banking market structure on growth on a sample

[1] At January 2020.

of 42 developed and developing countries. Using a sample of 56 countries, Beck (2003) maintains that countries with a more developed financial system record a better performance in those industries with higher EFD. Braun and Larraín (2005) investigate the relationship between external dependency and output contraction in periods of economic slowdowns. They use the average of the two periods (1970s and 1980s) to run their regressions. In Raddatz (2006) the EFD index is implemented as a proxy of liquidity needs of the corporate sector, to test whether the growth of the financial sector reduces output volatility. Fisman and Love (2007) revisit the contribution of Rajan and Zingales in order to test the conclusions of the original paper by discussing the role that growth opportunities can play in the original model. Other studies focus exclusively on developing countries. For example, Fernández et al. (2013) use the values of the EFD index calculated by Rajan and Zingales to study the influence of bank competition on banking crisis in 30 developing countries.

These are just some of the works that have employed the EFD index for different empirical analysis. Independently from the variety of applications, it is important to stress that most of this literature accepts the assumption of constancy of the index across countries and in time. Sometimes, these assumptions are stated explicitly: "External finance dependence reflects technological characteristics of an industry that are relatively stable across space and time" (Igan et al., 2016: 15)[2] while in some cases these assumptions are tacitly accepted. In the latter case, it can be inferred that the two key assumptions are presumed to be valid, since the EFD index is often implemented to analyze other countries than the US covering periods different from the 1980s. Some authors rise concerns about potential problems that could arise from the application of EFD values obtained from American firms to other countries can be found in the literature. Cetorelli and Gambera state that "it is […] worthwhile remarking that our results are shielded by a potentially important objection. External financial dependence in the data set is measured on US sectors" (Cetorelli and Gambera 2001: 632). In response to this point, they maintain that countries with similar economic development have similar industry structure, so that it is possible to extend results to non-American firms. However, it should be noted that the

[2] Similar statements can be found also in other papers. For example, Fernández et al. maintain that "[a]n important assumption underlying it is that external dependence reflects technological characteristics of the industry that are relatively stable across space and time." (Fernández et al. 2013: 26) and Dell'Ariccia et al. state that "[an]n important assumption underlying our approach is that external dependence reflects technological characteristics of the industry that are relatively stable across space and time" (Dell'Ariccia, Detragiache, and Rajan 2008: 96).

authors apply the values of the EFD also to countries that can be hardly considered to have a similar economic development to the US (e.g. Colombia, India, Pakistan, Peru, among others).

Although most of the studies use the same estimation of Rajan and Zingales, there are few works that attempted to reproduce the EFD index. Raddatz (2006) estimates a new EFD index following the same methodology of Rajan and Zingales, covering a similar sample of firms and during the 1980s. The most relevant difference with the original analysis is that Raddatz increases the number of industries under consideration, from the original 36 to 70. As to the industry-values of the EFD index, results are mostly line with the original ones although 17 industries have negative EFD indexes (compared to 4 in the original paper), while only two sectors record values higher than one.

Kroszner et al. (2007) employ the EFD index in order to study how banking crisis affect the activity of sectors depending on their level of external dependence among 18 countries. The authors admit that "financial dependence for US firms in the 1980s may not be a valid benchmark for other countries, especially developing countries that may use different technologies" (Kroszner et al. 2007: 203). In order to deal with this aspect, they implement three set of indexes. The first one calculates the EFD index for American firms in the 1970s and between 1980 and 1999. This is coherent with Rajan and Zingales's argument that an estimate of earlier periods may be more a good benchmark for the external financial dependency of developing countries. The second estimates the EFD index for Canadian firms, in order to catch possible differences with American firms' results. Lastly, they create a new dependency index that is equal to the average EFD index of 18 developed countries during the 1990s.

It is worth looking at their estimations in more detail. Table 2 illustrates the values of the EFD calculated by Raddatz et al. for 36 American industries between 1980 and 1999 and for the 18 countries during the nineties. A first aspect to highlight is that the estimations for American firms for the period 1980-1999 show that the external financial dependency is considerably lower compared to Rajan and Zingales estimations. The average EFD index in of Rajan and Zingales calculations is 0.29 (see Table 1) while in the case of Kroszner et al. it is -0.05. This means that in the latter case firms are considerably less dependent on external finance than in the original measurement. The fact that the values of the index are lower when extending the period of analysis may suggest that American firms became less dependent on external finance from the eighties to the nineties. More than half of the industries record a negative index during

the period 1980-1999. A negative value of the EFD index implies that the industry is virtually not dependent on external finance as the cash flow is high enough to cover capital expenditure. This is a remarkable point, as it implies that most of the industries generate enough cash flow to finance their capital expenditure and it suggests that the EFD index can vary from one decade to the other.

Table 2. Alternative estimations of the EFD index. Kroszner et al. (2007) calculations.

Industry	EFD index 1980-1999 US only	EFD index non-crisis countries 1990s	Industry	EFD index 1980-1999 US only	EFD index non-crisis countries 1990s
Tobacco	-1.14	-0.25	Furniture	-0.38	-0.02
Pottery	-0.41	-0.17	Metal products	-0.25	0.08
Leather	-0.95	-0.14	Basic chemicals	-0.19	-0.01
Spinning	-0.05	0.14	Wood	0.05	0.24
Footwear	-0.74	-0.21	Transportation equip.	-0.08	-0.04
Non-ferrous Metals	-0.12	0.18	Petroleum and Coal	0.13	-0.11
Apparel	-0.21	0.07	Motor vehicle	0.06	0.04
Petroleum ref.	-0.02	-0.19	Textiles	0.01	0.43
Non-metal Prod.	-0.29	0.00	Machinery	-0.04	0.03
Beverages	0.03	0.03	Ship	0.38	0.19
Iron and Steel	0.05	0.26	Other manufacturing	0.28	0.31
Food products	-0.15	0.05	Glass	0.03	0.02
Pulp, paper	-0.07	0.06	Electric machinery	0.24	0.25
Synthetic resins	0.03	0.07	Professional goods	0.72	0.26
Paper Products	-0.35	0.04	Radio	0.70	0.33
Printing and Pub	-0.42	-0.04	Office & computing	0.54	0.60
Other chemicals	-0.30	-0.03	Plastic products	-0.02	1.55
Rubber products	-0.02	-0.09	Drugs	2.43	1.36
Average:	-0.05	0.15			

Source: Kroszner et al. (2007)

Another relevant study that calculates a new version of the EFD index is that of Hsu et al. (2014). The authors employ the EFD index to prove that industries that are more dependent on external finance are more innovative in countries that have a more developed equity market. The most significant difference with the original calculation, is that Hsu et al. include *R&D* expenditure together with fixed capital expenditure. The rationale behind its inclusion is that industries, especially more innovative ones, may need to face sizeable intangible capital expenditure.

A peculiar aspect of Hsu et al. (2014) calculations is that all the values are above the unity (Table 3). This contrasts with Rajan and Zingales estimations where most of the values were comprised between zero and one. Additionally, the ranking of the industries seems sensibly

different from that of Rajan and Zingales. The difference in values can be imputed to various reasons. To start with, the formula in the calculation differs from that of Rajan and Zingales. While the latter calculate the cash flow and capital expenditure for the whole period, Hsu et al. (2014) compute yearly values of the index for each company and then calculate the median of the yearly values. Moreover, the inclusion of R&D expenditure does not make the two indexes fully comparable. However, since both investment and R&D are strictly positive magnitudes, EFD values should be lower (not higher) should be higher than Rajan and Zingales estimates. An additional aspect to consider is that this index is calculated over the period 1976-2006.

Table 3. EFD index by industry (SIC 2). Hsu et al. (2014) calculations.

Industry	Value	Industry	Value
Chemicals	1.028	Rubber and plastic	1.203
Petroleum refining	1.035	Primary metals	1.203
Stone, Clay, Glass, and Concrete	1.102	Measuring and Controlling Instr.	1.205
Paper	1.104	Leather and leather products	1.237
Printing and Publishing	1.124	Furniture and fixtures	1.241
Machinery and computer equip.	1.126	Fabricated metal products	1.286
Textile Mill	1.131	Tobacco	1.290
Electronic and electrical equip.	1.168	Miscellaneous manufacturing	1.304
Food	1.174	Transportation equipment	1.309
Lumber and wood, except furniture	1.177	Apparel	1.474

Source: Hsu et al. (2014)

Table 2 resumes the main characteristics of the works that have elaborated EFD indexes. Altogether, the evidence proceeding from this review concerning other estimations of the EFD index suggests that there may be significant differences in the values of the index. It can be argued that the different estimation strategy (e.g. Hsu et al., 2014) or the different period considered (e.g. Kroszner et al., 2007a) may have contributed to reach different results from Rajan and Zingales'. Nonetheless, this evidence contrasts with the idea that the measure elaborated by Rajan and Zingales is a *universal* proxy for the EFD. Surprisingly, however, there is little or no discussion around the theoretical foundations behind the construction of the EFD index, especially with respect to the two assumptions of invariability across space and in time. The remaining of this paper deals with these aspects.

Table 4. Summary of the main of the EFD elaborated in the literature.

Reference	Coverage	Notes
Rajan and Zingales (1998)	1980-1989	Sample: Listed American firms. Methodology: Median of the whole period Data source: Compustat
Raddatz (2006)	1980-1989	Sample: Listed American firms Methodology: Median of the whole period Data source: Compustat and CRSP
Krozsner et al. (2007)	1980-1999	Sample: Listed American firms. Methodology: Median of the whole period Data source: Compustat
	1990-1999	Sample: Listed firms from 18 developed-non-crisis countries Methodology: Median of the whole period Data source: Worldscope
Hsu et al. (2014)	1976-2006	Sample: Listed American firms. Methodology: Median of the median of yearly values R&D expenditure added to KE Data source: Compustat

Source: Own elaboration

3. Critical revision of the EFD index

3.1. Some theoretical aspects concerning the EFD index.

The first aspect to consider is the fundamental character of the EFD index as a measure of technological features of the industries that are uniform across countries (i.e. the EFD index identifies "an industry's technological demand for external financing. Under the […] assumption that such a technological demand carries over to other countries", Rajan and Zingales, 1998: 560). If the index is meant to grasp technological features of the industries and if it is assumed that the index is steady across countries and in time, it can be deducted that, from this perspective, technological features of the industries are assumed to be static. As mentioned above, the only variations that are admitted regard developing countries whose companies may be in a different life cycle (i.e. less mature) than American ones in the 1980s. The solution followed to avoid this problem is to rely on the estimations for American firms during the 1970s, which are expected to be grasp the specificities of these countries. Note that the only variation admitted in the values of the EFD is related to the life cycle of the firm. The corollary is that the technology employed is the same worldwide, at most it can be found at different stages of maturity. These differences vanish as firms move to a more mature stages of

production, which are represented by the EFD values of American firms during the 1980s. From this picture there are different elements that deserve attention.

The first aspect to highlight is that, in our view, the idea that technology and techniques of production are stable in time and between different countries is a limiting assumption. The technique employed in different countries may well differ, not only because of the life cycle of the industry. For example, rice production in Italy is very different from rice production in India. As the technique in use is different, so will be the ratio of cash flow over capital expenditure of the industry and therefore the EFD level. Under these circumstances, it is hard to believe that the EFD will be the same in both countries. As a possible counterargument, it could be argued that the EFD is obtained from data of listed companies and since these companies tend to be technologically more advanced than the average, the difference between countries may be not that significant. In other words, listed textiles (or any other industry) companies in developed countries will be more similar to listed textiles companies in developing countries than non-listed and listed companies belonging to the same industry in developing countries. If this was the case, the EFD estimation in different countries would be similar. However, the original construction EFD index does not differentiate between listed and non-listed companies. The EFD index (developed for listed companies only) is meant to be a good feature of the industry's technological feature, independently of their listed status. Therefore, if there was a significant gap between listed and unlisted firms, it would not be possible to use the EFD values obtained for listed firms to derive industry-level results.

A second point to consider is that the technique in use changes not only across countries, but also within the same country. Let's think again about agriculture and its evolution. This sector has been traditionally viewed to be labour intensive compared to other industries. However, the last decades witnessed a radical change in the technique employed in agriculture. Nowadays, the technique of many crops, particularly in developed countries, are considered to be capital intensive. In some crops/countries most of laborers have been substituted by machines that can be operated by a little amount of the labor force. Within this radical modification of the technique, it can be hardly conceived that the external needs of capital for agriculture, and therefore the EFD on the industry, have hold constant. Another example that may alter the ratio between cash flow and capital expenditure could be represented by the process of robotization and automatization of the productive processes. It is not our aim to discuss the different impact that this process might have on different industries. However, it is safe to suppose that this

process will have different impact on different industries. These modifications are expected to alter the use of fixed capital in different industries and, consequently, the EFD index that would derive from it. These examples show that technologies may change radically so that technical change can alter the need in the quantity and type of capital goods employed, so that the EFD can change in time, contradicting the assumptions of stability.

Another factor that can potentially influence the level of EFD as defined by Rajan and Zingales is outsourcing. As it is well known, outsourcing and global value change is a wronging phenomenon of contemporary economies (Milberg & Winkler, 2013). The basic idea behind the rise of outsourcing is that companies realize a lower number of in-house operations than they used to do in the past, increasing the amount of intermediate goods involved in the production process and can take place within the home country of the company or in a third country (Contractor et al. 2010). The tangible outcome of this process is the increase of externalization and the increase of the quota of indirect inputs of production. Since there are fewer inputs produced internally to the firm, it is to expect that the process of outsourcing and increase in intermediate inputs can have tangible impact on capital investment of the company. Companies/industries that are more involved in outsourcing than others may have a bigger impact on the degree of capital intensity of their production processes, so that it is to expect that the capital expenditure would be affected and so it would the EFD index.

In light of these considerations, the idea that the EFD index is able to capture technological reasons that are unmodifiable, seems to be too restrictive. Technical change could well alter the proportions of cash flow to capital expenditure, modifying the EFD index. Note that this discussion on changes in technologies is independent from the assumption of a perfectly competitive market and frictionless financial environment.

A further critique to the idea of invariability of the EFD index spread from a closer look to the original values. In the estimation of Rajan and Zingales (Table 1) there are four industries that show a value higher than one.[3] Given the formula of the EFD index (equation (1)) and since capital expenditure can only be a strictly positive measure, firms can have an EFD index higher than 1 only in the case their cash flow is negative. Since the EFD index is supposed to reflect invariable technological features of the industry, it is impossible that an industry can structurally

[3] Radio, Office and computing, Plastic products and Drugs.

record negative cash flow. These values may suggest that the values recorded are temporary, but that do not depend on definitive stages of production. In light of these considerations, there are different reasons, both theoretical and of empirical nature, to believe that the EFD index is not a universal measure that is steady in time and space.

3.2. Assessment of the EFD in relation to the rise of corporate net lending.

An additional source of inquiry relates with the emergence of corporate net lending. Traditionally, the private corporate sector is assumed to be a net borrower from the rest of the economy (Cesaroni, De Bonis, and Infante 2017: 5). Recently, however, the corporate sector has become net lender in most developed countries (Gruber & Kamin, 2015). Net lending (net borrowing) is equal to corporate savings minus investment in physical assets. The growth of net lending implied that corporate savings became greater than investment.

There is a growing amount of literature that study the rise of net lending and investigates the causes behind this phenomenon (Brufman, Martinez, & Pérez Artica, 2013; Cesaroni et al., 2017; Dao & Maggi, 2018; De Souza & Epstein, 2014; Saibene, 2018; Villani, 2019). It is not the intention of this paper to discuss the causes that contributed to the rise of net lending. What is relevant to highlight here is that, similarly to the EFD index, corporate net lending relates a measure liquidity of the firm (savings in the case of net lending, cash flow in the case of the EFD index) with the expenditure in physical capital. Despite this similarity, the scopes of the two indicators (net lending and EFD index) and the related literature is rooted in radically different perspectives. The literature on corporate net lending shows that the level of net lending (net borrowing) of the firms is not steady and it can fluctuate in time and may well vary across different countries. Contrarily, as it has been discussed above, the assumptions behind the construction of the EFD index imply that industry EFD values are fundamentally stable in time and space. In other words, the rise of net lending indicates that firms' internal funds (identified with savings) are enough to cover their capital expenditure. On the contrary, the estimates of the EFD index entail that capital expenditure *structurally* exceed firms' internal funds (identified with cash flow). From this consideration it can be grasped immediately that it is to ask how it is possible that two concepts that appear to be similar (as they both compare a measure of liquidity to investment) rely on such different scopes.

To discuss in more detail this aspect, consider the definition of net lending and EFD index. Corporate net lending for each firm *i* is equal to:

$$\mathrm{NL_i} = \mathrm{Savings_i} - \mathrm{KE_i} \qquad (2)$$

Where again KE is capital expenditure. If the difference between savings and investment is positive firms will be net lenders, otherwise they will be net borrowers.

By comparing equation (2) with equation (1) it can be immediately appreciated that the only relevant difference between these equations is represented by the measure of liquidity employed, savings in the case of corporate net lending and cash flow in the case of the EFD index. Therefore, it is reasonable to establish that the two measures will differ as long as corporate savings and cash flow are substantially different measure.

To disentangle this aspect, let's compare the definitions of savings and cash flow at the firm-level. Corporate savings are equal to firms' net income plus depreciation and amortization (D&A)[4], that is:

$$\mathrm{Savings}_i = \mathrm{Net\ Income}_i + \mathrm{D\&A}_i \qquad (3)$$

Net income is defined in the Worldscope manual as "the income after all operating and non-operating income and expense, reserves, income taxes, minority interest and extraordinary items" (Worsldscope, 2013, p. 556).

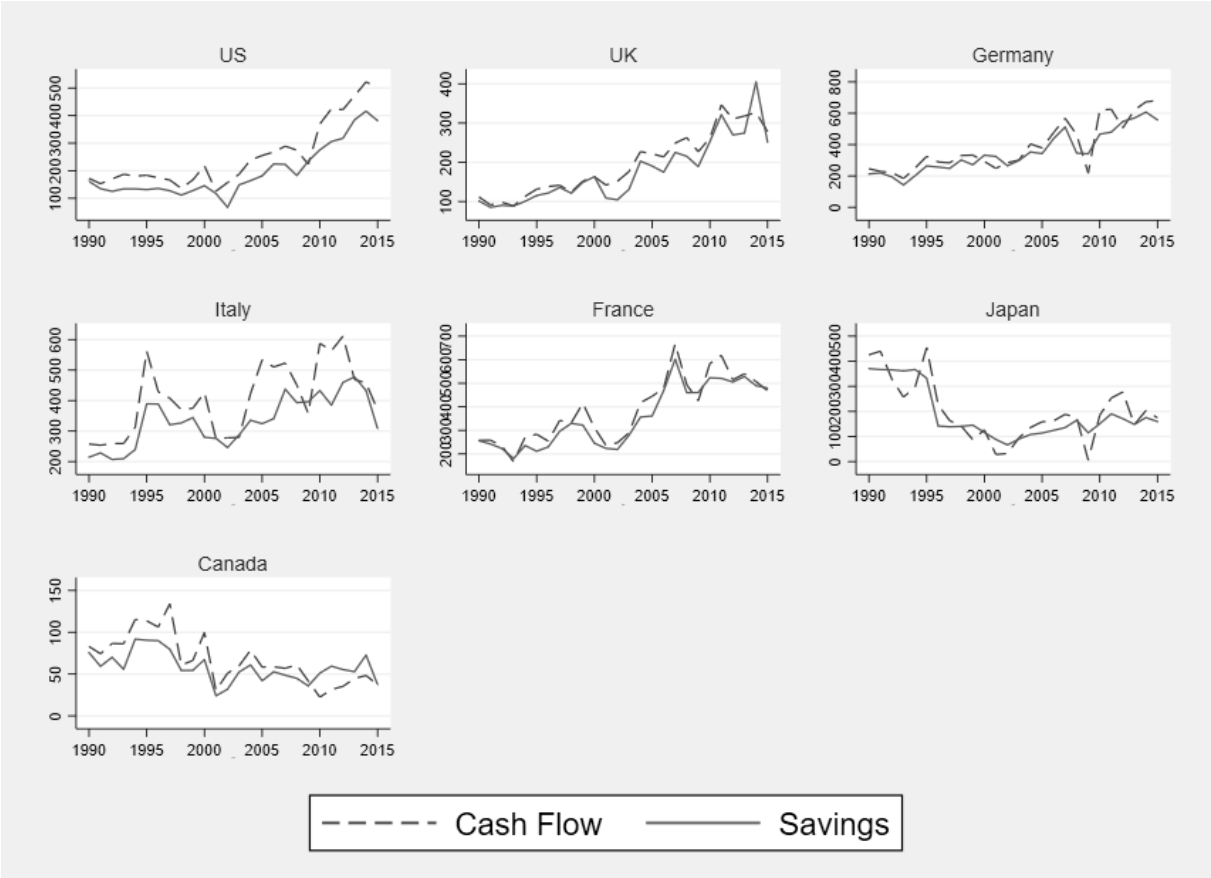
Cash flow involved in the original formulation of the EFD index is equal to "cash flow from operations […] plus decreases in inventories, decreases in receivables, and increases in payables" (Rajan and Zingales 1998: 564). Cash flow from operations is defined by the Worldscope manual as "the sum of net income and all non-cash charges or credits" (Worsldscope 2013: 485). By reviewing these definitions, it can be immediately acknowledged that the definition of net income and that of cash flow from operations are very similar. Cash flow from operations is largely constituted by net income, and it only differs from net income as it also includes non-cash charges or credits. A further divergence between savings and cash flow is that the former adds depreciation and amortization to net income, while the latter adds changes in inventories, receivables and payables to the definition. Despite these differences, savings and cash flow are largely constituted by net income. This represents a first element that suggests that saving and cash flow (and therefore net lending and the EFD index) might be analogous measures. In order to establish to explore more in detail this link, Figure 1 illustrates

[4] Other authors discount dividend payments from corporate savings at the firm-level. For a discussion on the rationale of different definitions of corporate savings see Villani (2019).

the evolution of corporate savings and cash flow in each G7 country. The figure clearly shows that these two variables are highly correlated with each other. Both the general trend and the absolute values of cash flow and savings are akin in all countries, suggesting that the two variables are highly correlated.

Once established that corporate savings and cash flow are practically substitute measures, it is straightforward to conclude that net lending and the EFD index fundamentally capture the same phenomenon.[5] If this is the case, given equations (2) it is to expect an inverse relationship between net lending and the EFD. Negative values of *NL* would indicate that the firm is net borrower, i.e. that corporate savings are insufficient to cover their capital expenditure. Similarly, if cash flow is insufficient to cover physical investment, the EFD index will be positive.

Figure 1. Cash Flow and Savings by country. Average values by firm (millions of US$).



[5] Further evidence of this assertion will be provided in Section 0 below.

3.3.Reproduction of the EFD index.

This subsection presents the results of the new estimations of the EFD index. Section 3.1 of this paper critically discussed the theoretical foundations of the EFD index, proposing different mechanisms that may alter the values of the index, undermining the validity of the stability assumptions. Given these considerations, it is relevant to reproduce the EFD index including new countries and years, in order to establish to what extent these assumptions are valid. Moreover, if the EFD index is an indicator of net lending as proposed in section 3.2, it is to expect that the assumptions of invariability of the index do not necessarily hold, as the EFD index will be subject to the same factors that influence the evolution of net lending.

The new EFD index is calculated for G7 countries within a period of 35 years, from 1980 to 2015. Methodologically, the fundamental idea is to replicate the original estimations by Rajan and Zingales (1998) following as closely as possible the steps employed by the two authors. As in the original calculations, the values of cash flow and capital expenditure for each firm are calculated over a period of ten years (six years in the case of the last period, 2010-2015) in order to reduce fluctuations that may arise from temporary shocks. After estimating the individual level of the EFD index over a decade, the industry EFD value is the median of the firm-level EFD values in each period.[6] Following this procedure, for each country we are able to obtain industry values of the EFD index over four periods.

A difference with the original calculation lies in the industrial classification followed in the analysis. In this study industries are organized according to the SIC 1987 system, while Rajan and Zingales follows the ISIC classification. This difference is due to data source, respectively Worldscope and Compustat, that provide data according to different industrial classifications. This implies that the industry level EFD index obtained here are not strictly comparable with those of Rajan and Zingales. This aspect, however, does not harm the validity of the analysis, as one of the objectives is to test the assumptions of stability of the index in time and across countries. If these assumptions are valid, it is to expect the sectoral values not to vary significantly across countries and space, even using the SIC 1987 classification.[7] As in Rajan and Zingales, the analysis employs data from listed non-financial corporations only.

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[6] Observations the top and bottom 5% of distribution were winsorized to deal with the presence of outliers.
[7] Note that the Worldscope variables involved in the replication of the EFD index are the same employed by Kroszner et al. (2007) in their estimations.

Table 5 below shows the 26 industries involved in the estimation of the new EFD index. Twenty industries belong to Manufacturing, while the remaining six sectors are represented by Primary, Mining, Construction and Services (Transportation and Public Utilities, Wholesale and Retail Trade).

Table 5. Industry classification.

SIC1987 Code	Industry – Extended name	Industry – Shortened name
0700-098\	Agriculture, forestry and fishing	Primary
1000-149\	Mining	Mining
1500-179\	Construction	Construction
2000-2099	Food and Beverages	Food
2100-2140	Tobacco Products	Tobacco
2200-2299	Textiles	Textiles
2300-2399	Fabricated textiles	Other textiles
2400-2499	Lumber and Wood Products	Wood
2500-2599	Furniture	Furniture
2600-2699	Paper products	Paper
2700-2799	Printing and Publishing	Printing
2800-2899	Chemicals	Chemicals
2900-2999	Petroleum and coal products	Petroleum
3000-3099	Rubber and Plastic	Rubber
3100-3199	Leather products	Leather
3200-3299	Glass	Glass
3300-3399	Primary Metal products	Basic metals
3400-3499	Fabricated metal industries	Fabricated Metals
3500-3599	Industrial machinery and equipment	Machinery
3600-3699	Electronic & other electric equipment	Electronic
3700-3799	Transportation equipment	Transp. equipment
3800-2899	Instruments and related equipment	Instruments
3900-3999	Miscellaneous industries	Other manufacturing
4100-497\	Transportation and Public Utilities	Tr. and Public Utilities
5000-519\	Wholesale trade	Wholesale
5200-599\	Retail trade	Retail

There are some aspects concerning data availability to consider. The number of observations for changes in receivables, payables and inventories reported by Worldscope (needed in the construction of the cash flow variable) is low during the 1980s. In order not to lose a consistent number of observations, the sum of these three elements for those years with no observations were given a value of zero. x

Figure A1. Cash flow including and omitting changes in Receivables, Payables and Inventories. Average values by firm.

As it can be seen in Table A.1 in the appendix, there are no relevant differences between the evolution of cash flow including and omitting changes in receivables, payables and inventories. This aspect suggests that the omission of the changes of receivables, payables and inventories in those years for which there are no observations does not affect significantly the volume of cash flow and, therefore, the values of the EFD index.[8]

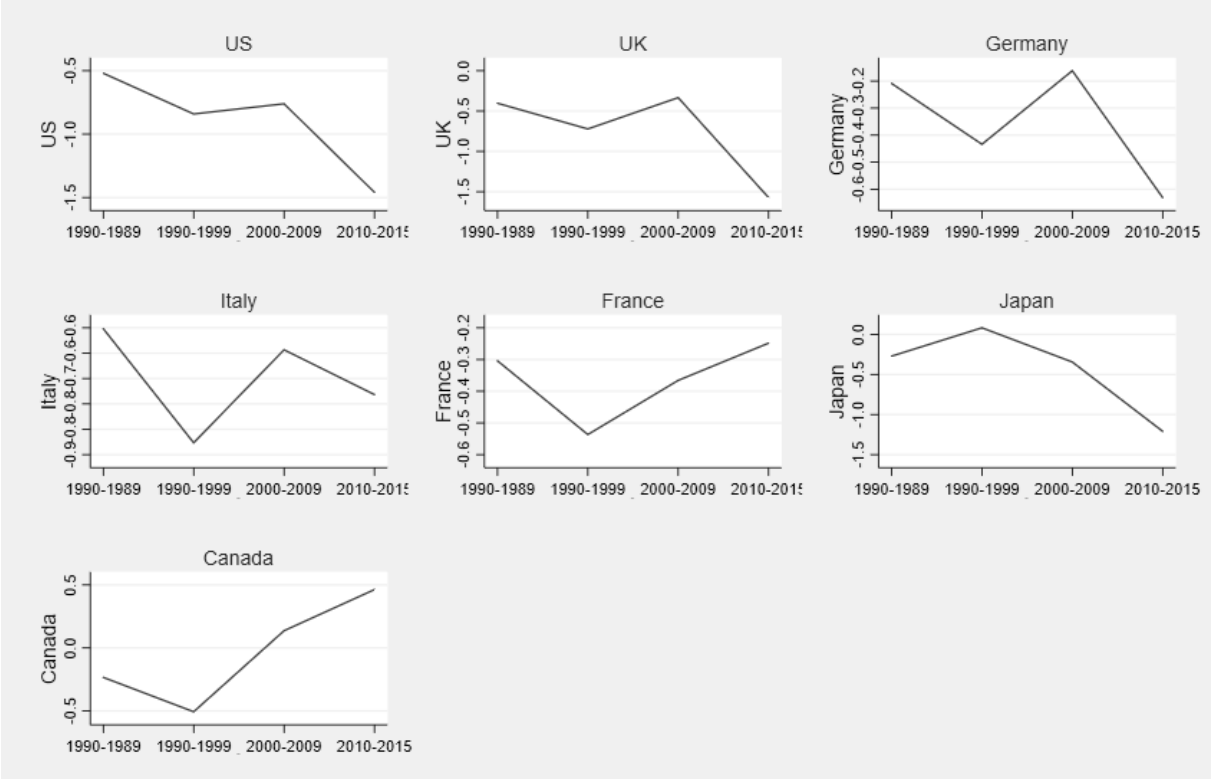
As a first approximation to the new estimations of the index, Figure 2 illustrates the evolution of the average values for the 26 industry values of the EFD index in G7 countries. There are two important aspects that can be highlighted from this figure. The first one is that the average values of the industry EFD index are negative throughout the four periods analyzed. This pattern is common to all G7 countries, with only few exceptions, represented by Japan in the 1990s and Canada in the 2000s and between 2010 and 2015. The second aspect is that in most countries the EFD index tends to become increasingly more negative. This trend is partially interrupted in the period 2000-2009 when the average of the index gets closer to zero in all countries except Japan. This effect can be partly imputed to the role played by the global crisis that affected the volume of cash flows of firms more than it affected their capital expenditure, leading to an increase in the values of the index.

These two aspects are of crucial importance for this research as they imply that, according to Rajan and Zingales definition of EFD, industries that record negative values of the index are virtually *not* financial dependent from external financial sources, since a negative index indicates that the level of cash flow is higher than the expenditure in capital expenditure. In other words, firms tend to generate enough cash flow to cover their capital expenditure. Moreover, the variability of the trend of the EFD index represents a preliminary evidence that disputes the idea of stability of the index across countries and time. According to the assumption

[8] As a further test, the EFD index was calculated omitting changes in receivables, inventories and payables for all observations (even where data were available) and the results obtained with this procedure were compared with the originals. The two series of EFD index show a high correlation for all period and countries, which leads to conclude that the presence of missing values for changes in receivables, inventories and payables do not have a significant impact on the values of the index.

of stability of the index in time the average values of the EFD index are supposed not to fluctuate in time, contrarily to what depicted in Figure 2.

Figure 2. Evolution of the industry average values of the EFD index.



Given the formulas of corporate net lending (Savings – Capital Expenditure) and the EFD index (1 – Cash Flow/Capital Expenditure) and in light of the similarity between savings and cash flow, a rise in net lending should correspond to a *decrease* in the EFD index. This inverse relationship seems to be broadly confirmed by Figure 2. The general rise of corporate net lending recorded since the 1990s (see Dao and Maggi, 2018; Villani, 2019) coincides with the decrease in the average values of the EFD index.

To provide a more detailed picture, Table 6 presents the values of the EFD for the 26 industries in each country. [9] As mentioned above, given the different industrial classification it is not possible to draw an exact correspondence between the results elaborated by Rajan and Zingales.

[9] Some cells are empty because of the lack of observations for some industries.

However, it is relevant to stress that, in contrast to the original estimations, the EFD index tends to be negative for most of the industries. This pattern is shared by all countries, as the industries that record a negative index are the great majority in most of the periods.

Table 6. New estimations of the EFD values by industry, country and period. Each value is the median of the firm-level EFD index in a certain industry.

	US				UK				Germany				Italy			
Industry	1980-1989	1990-1999	2000-2009	2010-2015	1980-1989	1990-1999	2000-2009	2010-2015	1980-1989	1990-1999	2000-2009	2010-2015	1980-1989	1990-1999	2000-2009	2010-2015
Primary	-0.53	-0.28	-0.16	0.01	-0.18	-0.42	0.01	0.21	-0.07	-0.45	0.12	0.43	n.a.	-2.95	0.74	-0.10
Mining	0.00	0.22	0.58	0.62	-0.23	0.36	1.16	1.17	-0.20	-0.10	-0.65	0.76	-0.93	-1.02	-1.57	0.63
Construction	-0.39	-0.88	-0.81	-1.25	-0.28	-0.77	-0.93	-0.48	-0.07	-0.03	0.29	-0.13	-1.54	-1.46	-0.38	-3.45
Food	-0.51	-0.64	-1.34	-1.64	-0.26	-0.67	-0.93	-1.41	-0.07	-0.07	0.04	-0.55	-0.14	-0.66	-0.94	-1.63
Tobacco	-1.23	-1.46	-2.38	-3.93	-1.14	-3.31	-4.44	-7.86	-0.75	-0.44	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Textiles	-0.40	-0.57	0.29	-0.88	-0.62	-0.50	-0.22	-2.81	-0.14	0.20	-0.03	-1.62	-1.36	-0.23	0.27	-2.71
Other textiles	-1.09	-1.47	-1.46	-2.26	-0.55	-0.81	0.02	-1.77	-0.41	-0.82	-1.39	-0.93	-1.50	-1.00	0.11	-0.08
Wood	-0.23	-0.74	-0.13	-2.47	0.02	-0.55	-0.96	-3.37	-0.06	-0.39	0.08	0.36	n.a.	n.a.	0.76	n.a.
Furniture	-0.99	-1.35	-1.68	-2.25	-0.57	-0.88	-0.78	-0.40	0.47	-0.21	0.01	-1.13	n.a.	n.a.	-1.03	-0.59
Paper	-0.24	-0.32	-0.74	-1.28	-0.36	-0.65	0.02	-0.79	0.01	0.06	-0.47	-1.18	-0.74	-0.07	0.93	-0.11
Printing	-0.62	-1.55	-1.57	-1.99	-0.28	-1.03	-1.16	-2.05	-0.04	0.01	0.86	0.84	-0.47	-1.58	-0.53	1.97
Chemicals	-0.73	-0.74	1.00	-0.31	-0.52	-0.62	0.41	-0.95	-0.35	-0.33	-0.21	-0.40	-0.79	-0.22	-0.43	-2.88
Petroleum	-0.32	-0.23	-0.55	-0.38	-0.14	-0.55	1.69	-0.12	-1.43	-1.03	-0.17	-0.77	n.a.	0.37	-1.11	-0.58
Rubber	-0.70	-0.71	-0.49	-1.04	-0.26	-0.62	-0.25	-1.49	0.00	-0.22	-0.59	-1.92	-1.26	-0.41	-0.91	-0.87
Leather	-0.80	-2.03	-3.13	-4.30	-0.43	0.09	1.81	-2.25	n.a.	-4.75	0.61	-1.39	n.a.	n.a.	-2.99	-3.27
Glass	-0.40	-0.65	-0.47	-0.52	-0.26	-0.47	-0.55	-1.80	-0.20	-0.16	-0.33	-0.64	-0.54	-0.84	-0.80	-0.32
Basic metals	-0.19	-0.34	-0.91	-0.90	-0.39	-0.63	-0.67	-1.55	-0.14	-0.08	-0.38	-0.47	-0.32	0.09	-1.36	-0.80
Fabricated Metals	-0.79	-1.00	-1.37	-2.17	-0.74	-0.93	-1.61	-2.04	-0.28	-0.07	-0.20	-0.73	-0.80	-0.39	-0.88	-0.89
Machinery	-0.45	-1.20	-0.99	-1.73	-0.59	-0.87	-0.40	-1.80	-0.22	-0.35	-0.56	-1.77	-0.25	-1.27	-0.65	-1.32
Electronic	-0.33	-0.92	-0.20	-1.11	-0.69	-0.84	-0.17	-1.02	-0.04	-0.13	0.10	-0.74	-0.08	-1.79	-1.13	-1.18
Transp. equipment	-0.46	-0.95	-0.66	-1.57	-0.08	-0.86	-0.18	-1.62	-0.05	-0.20	-0.38	-1.00	-0.50	-0.63	-0.36	-0.44
Instruments	-0.58	-1.15	-0.56	-1.60	-0.62	-1.10	-0.13	-1.31	-0.05	-0.30	0.30	-1.11	-0.48	0.35	-0.82	-1.99
Other manufacturing	-0.77	-1.16	-0.64	-1.98	-0.83	-0.39	0.62	-1.27	-0.64	-0.73	-0.68	0.08	n.a.	-3.97	-2.93	7.48
Tr. and Public Utilities	-0.04	-0.18	-0.16	-0.19	-0.04	-0.31	-0.12	-0.28	0.00	-0.27	-0.30	-0.23	0.01	-0.23	0.13	-0.29
Wholesale	-0.60	-1.18	-0.87	-1.74	-0.45	-1.17	-0.66	-3.00	-0.20	-0.13	-0.15	-0.50	0.10	-0.61	1.14	-1.10
Retail	-0.11	-0.39	-0.41	-1.06	0.01	-0.26	-0.27	-0.82	-0.30	-0.29	0.04	-1.04	0.15	0.32	-1.36	-3.02
Average	-0.52	-0.84	-0.76	-1.46	-0.40	-0.72	-0.33	-1.57	-0.21	-0.43	-0.16	-0.63	-0.60	-0.83	-0.64	-0.73
N. of Ind. with EFD > 0	1	1	3	2	2	2	8	2	3	3	10	5	3	4	7	3

Note: Each value is the median of the firm-level EFD index in a certain industry.
Source: Author's calculations using Worldscope data.

	France				Japan				Canada			
Industry	1980-1989	1990-1999	2000-2009	2010-2015	1980-1989	1990-1999	2000-2009	2010-2015	1980-1989	1990-1999	2000-2009	2010-2015
Primary	-0.16	-0.20	0.30	-0.03	0.12	-0.15	-0.03	-0.47	n.a.	-2.87	-0.39	-0.47
Mining	-0.22	0.05	-0.97	0.28	-0.34	0.34	-0.15	-0.38	0.12	0.50	1.27	1.66
Construction	-0.10	-0.44	-0.65	-0.76	-0.38	-0.12	0.28	-1.38	0.25	-0.92	-0.52	-0.05
Food	-0.66	-0.54	-0.48	-0.70	-0.31	0.10	-0.46	-0.96	-0.47	-0.52	-1.16	-0.81
Tobacco	n.a.	n.a.	n.a.	n.a.	n.a.	-0.17	-1.56	-3.13	-0.19	n.a.	5.81	3.54
Textiles	-0.10	0.12	-0.34	2.12	-0.80	0.35	0.49	-0.54	-0.43	0.01	-1.06	-1.25
Other textiles	-1.12	-0.60	-0.73	-0.66	-1.19	-0.12	0.12	-1.08	-0.13	-0.65	-0.50	0.23
Wood	0.01	-0.99	-0.06	-0.51	-0.53	-0.17	-0.26	-1.18	-0.13	-0.32	0.14	-0.58
Furniture	-0.44	-1.27	-0.28	-1.46	-0.43	0.59	-0.23	-1.94	n.a.	-0.11	-0.58	0.82
Paper	0.14	-0.11	-0.14	-0.26	0.68	0.00	-0.29	-0.61	0.20	-0.19	-0.40	-1.06
Printing	0.00	-0.89	-0.42	0.97	-0.15	-0.08	-0.46	-1.14	-0.53	-0.66	-0.69	-1.69
Chemicals	-0.51	-0.53	-0.96	-0.47	-0.23	-0.03	-0.58	-1.44	-0.61	-0.34	1.56	3.12
Petroleum	-0.17	-0.29	-1.15	0.95	-0.28	0.01	-0.79	-0.88	0.09	0.03	-0.23	0.75
Rubber	-0.24	-0.30	-0.29	-0.80	0.00	0.21	-0.28	-1.02	0.20	-0.09	-0.17	-1.40
Leather	-0.59	-1.94	0.59	0.34	-0.53	0.47	-0.89	-3.25	n.a.	-0.44	1.32	n.a.
Glass	-0.67	-0.41	-0.57	-0.49	0.00	0.04	-0.04	-0.81	-0.19	-0.33	0.39	-1.92
Basic metals	-0.39	-0.23	0.11	-0.74	-0.13	0.41	-0.38	-0.86	-0.15	-0.08	-1.28	1.46
Fabricated Metals	-0.59	-0.16	-0.25	-1.25	-1.67	-0.02	-0.08	-1.35	-0.57	-1.12	-0.99	-0.64
Machinery	0.04	-0.80	-0.47	-1.44	-0.12	0.08	-0.60	-1.40	-0.36	-0.30	-0.45	2.70
Electronic	-0.41	-0.59	-0.11	-0.19	-0.16	-0.16	-0.17	-0.76	-1.01	-1.27	0.72	0.88
Transp. equipment	-0.15	-0.70	-0.59	-1.18	-0.03	0.11	-0.15	-0.78	-0.48	-0.38	-0.35	-0.55
Instruments	-0.44	-0.88	-0.70	1.89	-0.10	-0.25	-0.61	-1.34	-0.24	-0.88	3.86	8.97
Other manufacturing	-0.65	-0.66	-0.42	-0.28	-0.33	0.06	-0.48	-1.60	n.a.	-1.03	-1.13	-0.65
Tr. and Public Utilities	0.13	-0.06	-0.14	-0.28	0.25	0.19	-0.21	-0.50	0.12	-0.02	0.02	0.02
Wholesale	-0.28	-0.81	-0.29	-0.95	-0.28	0.30	-0.81	-1.78	-0.58	-0.57	-0.74	-0.42
Retail	-0.04	-0.17	-0.15	-0.30	0.14	0.15	-0.32	-0.86	-0.07	-0.13	-0.89	-1.09
Average	-0.30	-0.54	-0.37	-0.25	-0.27	0.08	-0.34	-1.21	-0.23	-0.51	0.14	0.46
N. of Ind. with EFD > 0	5	2	3	6	6	16	3	0	6	3	9	11

Note: Each value is the median of the firm-level EFD index in a certain industry.
Source: Author's calculations using Worldscope data

There are different elements of interest that emerge from the results presented so far. The EFD seems to be an equivalent measure of corporate net lending. This is evidenced by the similarity between the definitions of corporate savings and cash flow and by the evolution of these variables that follows a twin pattern. Also, there is a generalized decreasing trend (Figure 2 and Table 6) in the values of the EFD which is consistent with the rise in corporate net lending. At the same time, the negative values of the EFD index reveal that firms are virtually not dependent on external finance to cover their investment as the cash flow generally exceeds investment.

A possible counterargument might be that what really matters is not the absolute values of the index, but the ranking of the industries, from least to most dependent. This aspect relates with the assumptions of stability of the EFD across countries and in time. Hence, if these assumptions are valid, it is to expect that:

- The ranking of the EFD index of the industries in a certain period is similar across countries.
- The ranking of the EFD index of the industries within the same country does not vary from one period to the following.

These two assertions are tested, respectively, in Table 7 and Table 8.

Table 7 shows the correlation coefficients of the simple regression of the industry values of the EFD index in each country against the values obtained for of the US in the same period. American industries are taken as reference because the literature on EFD considers them to be a good proxy for other countries' EFD (see discussion in section 3.1 above). Rajan and Zingales (1998: 565–67) assert that given the different degree of maturity of the industry in different countries, the employment of values of the EFD index for American firms in the 1970s would more appropriate to grasp the reality of developing countries. However, since the analysis in this work involves on countries with similar degree of development, it is safe to compare values of the EFD index obtained in the same decade. If the assumption of stability of the EFD index across countries holds, it is to expect the coefficients of correlation between the two series of values to be positive and highly significant and that the R-squared to be close to one.

The results presented in Table 7 show that there is a high heterogeneity between coefficients of correlation. A good number of coefficients is not statistically significant, indicating that

there is no correlation between the industry EFD in the US and that in the country under analysis. The UK and Japan are the countries where there is the highest degree of positive correlation with American values. Here, three of the four coefficients are statistically significant. In France, the first and second period record a positive relationship with American firms, while the third records a negative and significant coefficient. This peculiar outcome implies that in that period the ranking of EFD by industries tended to be the opposite in France with respect to the US, which contradicts the assumption of stability of the index across countries. As to the remaining countries, the values of the EFD index in Germany and Italy bear little correlation with American values, being significant only in one period (Germany, at 5%) and two periods (Italy, at 10%). Finally, the values of the EFD values obtained for Canadian industries are not significant in any of the periods analyzed.

Overall, out of 24 coefficients, only 10 coefficients record a positive and statistical significance (only 6 of them at 1%). Moreover, the size of the coefficients and of the R-squared is often far from the unity, which indicates a poor fit of the two series of values. Importantly, the degree of statistical significance reduces with time. During the 1980s, four of the six countries record a significant correlation with American values, while this number decreases to three in the 2000s and two during the 2010s. This aspect suggests that, differently from the original assumptions, the industries of different countries do not converge towards similar levels of EFD but show a divergent trend. This evidence implies that the assumption of constancy of the index in time finds little support in the data. Note that this analysis regards listed non-financial corporations of developed countries, where it is plausible to assume little or no barrier to access to financial markets. If it is not possible to find a solid relationship between the EFD values obtained for countries with a comparable degree of development as it is the case of G7 members, it is likely that this discrepancy would hold for developing countries.

These results lead us to conclude that the assumption of stability of the index across country finds little or no evidence from the replication of the index in G7 countries. These aspects suggest that, within the sample of listed non-financial corporations there is a high heterogeneity of the ratio of cash flow over capital expenditure across different countries.

Table 7. Coefficients of correlation between US EFD index and other countries' EFD index by period. R-squared in parenthesis.

	1980-1989	1990-1999	2000-2009	2010-2015
UK	0.761***	0.345**	0.229	0.475***
	(0.460)	(0.178)	(0.094)	(0.495)
Germany	0.103	0.268**	-0.456	0.381
	(0.013)	(0.231)	(0.064)	(0.078)
Italy	0.209*	0.118	0.269*	0.0105
	(0.162)	(0.077)	(0.114)	(0.001)
France	0.618***	0.933***	-0.883**	0.163
	(0.445)	(0.699)	(0.180)	(0.023)
Japan	0.317***	0.0984	0.971**	1.319***
	(0.266)	(0.002)	(0.207)	(0.722)
Canada	0.266	0.154	-0.0861	-0.0456
	(0.078)	(0.038)	(0.025)	(0.012)

***** significant at 10%; ****** significant at 5%; ******* significant at 1%

To test the assumption of stability in time of the index, Table 8 illustrates the coefficients of correlation of a simple regression between values of the EFD index in subsequent periods for the same country. If the assumption of invariability of the index is valid, it is to expect that coefficients close to the unity, to be highly significant and to have a high R-squared. This would entail that the degree of industrial EFD does not vary considerably in time.

The results of Table 8 show that effectively there is a high degree of correlation in the US and in the UK. In these countries, the industry values of the EFD index of one period with the following one are always statistically significant, indicating a relative stability in the industry ranking of EFD. In the rest of the countries, however, the scenario is quite different. In Canada, the first and last coefficient are significant while Germany and Japan display significant coefficients only in one case, respectively from the 1980s to the 1990s and from the 2000s and the 2010s. Note that when significant, the values of the coefficients of correlation tend to be, in most of the cases, far from the unity and usually take values around 0.4-0.5. Also, R-squared is often below 0.5, which suggests a relatively poor fit for two series of values that, according to the EFD literature, are expected to be highly correlated. Finally, the EFD values obtained in Italy and in France present no correlation from one period to the other.

This polarization in the results lead to the conclusion that the assumption of stability of the EFD in time holds in some countries, but it fails to be valid as a general rule, as most of the,

coefficients (10 over 21) are not statistically significant. This aspect suggests that it is the very concept of "maturity" that needs to be reconsidered. A steady stage of "maturity" can be obtained within a static environment, without technical change. However, as technical change operates continuously (and at different paces) in all industries, firms are constantly changing their technique of production so that there is no reason to believe the ratio of cash flow over investment is necessarily steady. In conclusion of this subsection, it can be affirmed that the assumptions of stability of the EFD index between countries and in time finds partial or no support.

Table 8. Coefficient of correlation between the industry values of the EFD in subsequent periods in the same country. R-squared in parenthesis.

Period	US	UK	Germany	Italy	France	Japan	Canada
1980s to 1990s	0.467*** (0.590)	0.268*** (0.367)	0.861*** (0.485)	0.130 (0.023)	0.179 (0.071)	-0.0424 (0.000)	0.442*** (0.312)
1990s to 2000s	0.436*** (0.545)	0.458*** (0.714)	-0.468 (0.051)	0.273 (0.055)	-0.332 (0.083)	0.0260 (0.002)	0.00645 (0.000)
2000s to 2010s	0.668*** (0.717)	0.520*** (0.535)	0.126 (0.041)	-0.113 (0.060)	-0.0513 (0.014)	0.390*** (0.464)	0.508*** (0.518)
***** significant at 10%; ****** significant at 5%; ******* significant at 1%							

3.4.Comparison between the EFD index and corporate net lending.

Section 3.2 discussed the resemblance between the concepts of EFD index and corporate net lending. To complement this theoretical discussion, the following analysis explores the empirical relationship between EFD and net lending. In order to test the similarity between the EFD index and corporate net lending, a new version of the EFD index was developed:

$$\text{EFD\_2}_{\text{i}} = \frac{(\text{KE}_{\text{i}} - \text{Savings}_{\text{i}})}{\text{KE}_{\text{i}}} = 1 - \frac{\text{Savings}_{\text{i}}}{\text{KE}_{\text{i}}} \qquad (4)$$

This formula differs from the original (equation (1)) only with respect to the unit of liquidity employed, which in this case is corporate savings. Like the expression of corporate net lending, equation (4) relates savings to capital expenditure. Differently from the standard formulation of corporate net lending, this equation sets up the relation between savings and investment as a ratio, not as the subtraction of capital expenditure from corporate savings. Despite these modifications, the standard calculation of net lending and equation (4) can be considered to grasp the same phenomenon. In the case of EFD_2, an increase in corporate

net lending is manifested in the rise of the ratio of savings over capital investment, leading to a decrease of the values of EFD_2.

After calculating EFD_2, the coefficients of correlation between the standard EFD index obtained from equation (1) and EFD_2 were estimated. If the two measures are sensibly divergent, the statistical correlation between the series is expected to be low. On the contrary, a high degree of correlation indicates that the indexes ultimately grasp the same phenomenon. As it was expected in light of the previous discussion, the coefficient of correlation are very strong in all G7 countries for all periods (Table 9).[10] Several coefficients are close to the unity, which means that the values of the index calculated employing cash flow are almost equivalent those employed using corporate savings (equation (4)).

Table 9. Coefficients of correlation between firm-level values of the EFD in each period. EFD_2 vs. standard EFD index.

Period	Full Sample	US	UK	Germany	Italy	France	Japan	Canada
1990-1999	0.734***	0.738***	0.801***	0.749***	0.414***	0.628***	0.729***	0.885***
	(0.546)	(0.542)	(0.646)	(0.614)	(0.463)	(0.642)	(0.768)	(0.625)
2000-2009	1.174***	1.217***	1.126***	0.853***	0.679***	0.938***	0.579***	1.231***
	(0.686)	(0.684)	(0.713)	(0.491)	(0.744)	(0.871)	(0.344)	(0.802)
2010-2010	1.197***	1.223***	1.163***	0.973***	0.864***	1.027***	0.629***	1.342***
	(0.717)	(0.759)	(0.722)	(0.556)	(0.604)	(0.830)	(0.524)	(0.675)

These results are crucial, as they provide statistical support to the argument presented in section 3.2 regarding the theoretical similarity between net lending and the EFD index, so that it can be concluded that EFD index is fundamentally a proxy of corporate net lending.

4. Conclusions

This paper revised the concept of EFD and discussed how it relates to the rise of corporate net lending. According to the original contribution by Rajan and Zingales (and the rich literature that employed the index), the EFD index is meant to reflect structural technological characteristics of the industries. Two keys assumptions derive from this analysis, namely

[10] Given the lack of data for the calculation of the EFD_2 during the 1980s, this decade was omitted.

that these technological reasons (identified in the industry ratio of cash flow over capital expenditure) do not change across countries with similar level of development and do not evolve in time. This study has argued that there are no *a priori* reasons to believe that the ratio of cash flow over investment need to be steady. For example, technical change, the process of automatization and outsourcing are all phenomena that can modify the ratio of cash flow over investment and therefore the EFD index.

The assumptions of stability of the EFD index have been tested empirically after estimating a new EFD index for G7 countries over a period of 35 years employing firm-level data of listed non-financial corporations obtained from the Worldscope database. To the best of our knowledge, it is the first time that the original estimations have been expanded over such a long period of time covering different countries (see section 2.2). Furthermore, the empirical analysis proposed here reveals that the assumption of invariability of the index in space and time finds only limited or no support in the empirical tests (section 3.2). The values of the EFD index obtained for American firms do not seem to be a valid proxy for the EFD in other G7 countries. Only in a minority of cases the relationship between cross-country values of the EFD index is statistically significant. Notably, the correlations tend to become not significant in more recent periods, compared to the 1980s and 1990s, indicating that the assumption of stability of the EFD index across countries is generally low and weakens with time. As to the assumption of invariability in time of the EFD index, only the US and the UK show a significant relationship of the index from one period to the other (although the coefficients of correlation and R-squared are usually not close to the unity), while the rest of the countries display very little or no statistical significance.

From the new estimation of the EFD index emerge two additional important aspects. First, the EFD index is prominently negative, revealing that, according to Rajan and Zingales definition, industries are largely not dependent on external finance since their cash flow is enough to cover their investment. Second, there is a tendency to be, on average, increasingly less dependent on external finance. These two aspects relate closely to the literature on the rise of corporate net lending (e.g. Dao and Maggi 2018; Gruber and Kamin 2015; Saibene 2018) which highlights that, on average, internal funds of the firms have become sufficient to cover their capital expenditure. The paper explored the relationship between EFD and corporate net lending. It has been maintained that the EFD index (as formulated by Rajan and Zingales) can be considered a proxy of corporate net lending, rather than a measure that

grasps structural and unchangeable features of the industries. Two main arguments have been provided in support of this assertion. To start with, section 3.1 has shown that the analytical formulation of the EFD resembles closely that of corporate net lending. The only relevant difference between the two measures, expressed by equation (1) and (2), lies in the variable of liquidity of the firm, i.e. cash flow vs. corporate savings. It has been demonstrated that the accounting definitions of these variables are very similar, as well as their evolution during the period under scrutiny. Departing from these considerations, a new version of the EFD index, that employs corporate savings (instead of cash flow) as the indicator of liquidity of the firm has been developed (section 3.3). The values of the new version of the index created, following this criterion, resembles very closely those obtained following the original methodology (equation (1)), as testified by the correlation coefficients between the two series. These results support the argument that net lending and the EFD index are equivalent concepts. Considering these findings, it is not surprising that the EFD index varies in time and across countries, as showed in section 3.3.

Overall, it can be concluded that the EFD index is, ultimately, a proxy of corporate net lending. Both indexes grasp the capacity of the firms to finance their capital expenditure via internal funds. Considering the arguments presented in this study it is hard to conceive this index uniquely as a measure determined by embodied and invariable technological features of the industries. Consequently, the determination of the values of this index should be subject to the same forces that determine the evolution of net lending. Irrespective of the discussion about factors that contribute to the evolution of net lending (and therefore the EFD index), what is important to remark here is that the ratio of liquidity of the firms (cash flow or savings) can vary over time. This evidence has potentially important consequences for the literature that employs the EFD index, since industry EFD values largely change in time and across countries. As corporate net lending, this paper has showed that the EFD values can oscillate so it is not possible to claim that values of the EFD index obtained for American firms are universal proxies of EFD.

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Appendix

Figure A1. Cash flow including and omitting changes in Receivables, Payables and Inventories. Average values by firm.