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ACCOUNTING

DIRECT AND INDIRECT VALUE RELEVANCE OF R&D CAPITALIZATION

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MELIK ERTUĞRUL[1] ORCID ID: 0000-0003-2068-2080

ABSTRACT

The accounting treatment of R&D investments has been an open and contentious discussion as certain accounting regimes eliminate capitalizing and require immediate expensing while capitalization of R&D investments satisfying all necessary criteria is mandatory in IAS 38. By analysing a sample of listed firms on Borsa Istanbul over 2009-2018, we shed light on the impact of capitalized R&D investments on i) market values, and ii) the value relevance of book value of equity and earnings. We define the former (latter) as the direct (indirect) value relevance. By revealing a significantly positive association between capitalized R&D investments and market values, we conclude that capitalized R&D investments are directly value relevant. Furthermore, the value relevance of earnings (book value of equity) increases (remains unchanged) as capitalized R&D investments increase. These outcomes are consistent with our expectations and the outcome for earnings provides evidence for the indirect value relevance of capitalized R&D investments.

Keywords: Value relevance, Capitalization, Capitalized R&D, Research and development

MUHASEBE

AKTİFLEŞTİRİLEN ARGE'NİN DOĞRUDAN VE DOLAYLI DEĞER İLİŞKİSİ

ÖZ

ARGE yatırımlarının muhasebeleştirilmesi, bazı muhasebe standartlarınca aktifleştirmenin elimine edilmesi ve IAS 38'de gerekli koşulların sağlanması durumunda aktifleştirmenin zorunlu tutulmasından ötürü tartışılagelen bir konudur. Bu çalışmada, Borsa İstanbul'a 2009-2018 yılları arasında kote olan firmalara ilişkin bir veri seti analiz edilerek aktifleştirilen ARGE yatırımlarının hem piyasa değeri üzerindeki hem de kazançlar ile defter değerinin değer ilişkileri üzerindeki etkileri incelenmektedir. Bahsi geçen ilk etki ve ikinci etki dolaylı ve doğrudan değer ilişkisi olarak adlandırılmaktadır. İstatistiki olarak anlamlı bir şekilde pozitif olarak raporlanan aktifleştirilen ARGE yatırımları ile piyasa değeri arasındaki ilişki, bu yatırımların doğrudan değer ilişkisinin bulunduğunu göstermektedir. Ayrıca, aktifleştirilen ARGE yatırımları arttıkça kazançların değer ilişkisinin arttığı, fakat defter değerinin değer ilişkisinin değişmediği de bu çalşmada ortaya konulmaktadır. Bu sonuçlar beklentilerimizle örtüşmektedir ve kazançlar için raporlanan bulgular aktifleştirilen ARGE harcamalarının dolaylı değer ilişkisine kanıt teşkil etmektedir.

Anahtar Kelimeler: Değer ilişkisi; Aktifleştirme, Aktifleştirilen ARGE, Araştırma-Geliştirme

[1] *Asst. Prof. Dr., Istinye University, Faculty of Economics, Administrative and Social Sciences, Department of Economics, melik.ertugrul@istinye.edu.tr*

1. INTRODUCTION

Most literature points out that this century is shaped by knowledge, information, as well as innovation (Hana, 2013; Ilhan, 2019). Increased innovation and competition are major drivers of business changes (Lev & Zarowin, 1999). Therefore, firms have to invest more in intangible fields including new patents, technologies, and research and development (R&D) activities to enhance continuous product innovation and competitive advantage (Wang, 2013) which are expected to result in improved sustainable core competencies.

The literature documenting evidence for the US agrees that investments have shifted from being tangible to intangible (Ciftci, Darrough, & Mashruwala, 2014) due to the aforementioned distinctive characteristics of this century. In the introduction section of his famous book, Lev (2000) underscores this fact by starting the chapter with the following statement: *"Wealth and growth in today's economy are driven primarily by intangible (intellectual) assets*."(Lev, 2000, p. 1). Lev (2000) further claims that tangible (or classical) assets are new versions of commodities anymore. Statistics presented by OECD (2006) confirm this fact: investments in knowledge exceed investments in machinery and equipment in Finland and the US even in 2002.

As underlined by Seow et al. (2006), intangible investments can be divided into two categories: R&D investments (RDI) and non-R&D investments. New product creation requires a significant amount of RDI especially during the earlier stages while non-R&D expenditures are extensively needed afterward (Piekkola, 2016). Although the shift to an intangible-based economic system had already taken place, accounting for intangible assets has still been discussed (Ertuğrul, 2020) not only by the academia but also by regulators together with standard setters majorly due to the following two reasons. First, reliable measurement is not very easy for intangible items. In other words, as stated by Glova and Marz (2018), intangible assets do not have physical substances that make their valuation difficult. Second, uncertain future economic benefits of intangible investments provide a very solid logic to the traditional conservatism principle of accounting which hinders recording such investments in the assets side of the balance sheet (Wang, 2013). Lev and Zarowin (1999) clearly illustrate that financial reporting information becomes less useful (and relevant) since accounting practices are not sufficient to record certain innovative activities such as RDI as parts of intangible assets. As a result, a true presentation of a firm's financial position and performance, which is the fundamental objective of financial reporting (Chandrapala, 2013), may not be possible. In other words, the (decision) usefulness of financial information may be reduced.

Discussions on accounting for intangible assets are especially placed on the treatment of RDI whether they should be capitalized (or recorded in the balance sheet) or expensed (or recorded in the income statement) (Napoli, 2015). While certain domestic generally accepted accounting standards (GAAP) including US GAAP do not allow recording such investments as an asset, International Financial Reporting Standards (IFRS) requires capitalizing RDI under certain circumstances. On the grounds for this discussion, the literature provides ample evidence for the

valuation usefulness of differently treated (expensed or capitalized) RDI by considering the value relevance (VR). A rich body of research analyses this phenomenon in two streams either by considering VR of differently treated RDI or by considering VR of financial reporting information in R&D-intensive industries. The former aims to reveal the direct VR of capitalized and/or expensed RDI by observing their valuation impact while the latter aims to show VR of two traditional accounting measures available in the Price Model of Ohlson (1995): book value of equity (BVE) and earnings. The latter examines VR i) as a whole by considering the explanatory power of a regression as an indicator of VR, and ii) by considering the statistical significance level of each variable of interest. Note that the capitalization of RDI is a relatively new practice since the corresponding standard (IAS 38) of IFRS has been mandatory in most jurisdictions including the European Union (EU), Turkey, Australia, New Zealand, Hong Kong, and South Africa since 2005.

In this study, we contribute to the literature by combining the aforementioned two streams. First, we reveal VR of capitalized RDI by analysing the impact of capitalized RDI on market values. Second, we show the impact of capitalized RDI on VR of BVE and earnings by examining how VR of these accounting items changes as capitalized RDI increases. We define the former as the direct VR while we define the latter as the indirect direct VR. The literature (see, among others, Amir & Lev, 1996; Lev & Zarowin, 1999; Han & Manry, 2004) documents much evidence for VR of accounting items in R&D or intangible intensive industries. However, to our knowledge, the literature does not show how VR of accounting items changes with capitalized RDI. In this study, instead of focussing only on R&D or intangible intensive industries like the extant literature, we document evidence for the whole sample without making any industry selection to mitigate the sampling bias and generate more generalizable outcomes. This study is the first one shedding light on both direct and indirect VR of capitalized RDI to our knowledge and filling this gap in the extant literature is our major motivation. Additionally, this is the first study documenting evidence for VR of capitalized RDI for an emerging economy, Turkey. This is another contribution of this study to the literature.

In this study, we employ a sample of Turkish listed firms due to three significant reasons. First, the Turkish financial reporting environment is distinctively different than other jurisdictions. IFRS-based financial reporting is the mandatory practice for all Turkish listed firms since 2005. Each new standard or amendments of the IASB are directly implemented without any local regulatory intervention (Gür, 2016) which may induce noise in accounting quality (Ertuğrul & Demir, 2018). The non-existence of local regulatory interventions makes the Turkish financial reporting environment very convenient for our research which aims to shed light on one of the most contentious accounting treatments: capitalized RDI. Second, the analysed period of 2009-2018 does include neither local nor global financial crises which makes the data very convenient for our analyses because i) the literature (see, among others, Bepari et al., 2013; Kane et al., 2015) provides ample evidence for the adverse effects of global financial crises on VR of accounting items, and ii) local economic turbulences have detrimental impacts on VR in Turkey as shown by

Kaytmaz Balsarı and Özkan (2009), Dinçergök (2013), and Bilgic et al. (2018). Third, capitalized RDI data are manually collected from the footnotes of annual reports which are generally available in the local language which significantly restricts research on the capitalized RDI to a single country. Therefore, each study discussed in the literature review documents evidence by employing a dataset belonging to a single country. That is our last reason for choosing as sample of Turkish listed firms.

By analyzing listed firms on Borsa Istanbul between 2009 and 2018, we report three significant outcomes. First, in line with the literature, the significantly positive impact of capitalized RDI on market values is the evidence for the direct VR of capitalized RDI. Second, the impact of capitalized RDI on VR of earnings is reported as significantly positive. In other words, the impact of earnings on market values significantly increases as RDI increases. Third, the impact of capitalized RDI on VR of BVE is not reported as significant at conventional levels. In other words, capitalized RDI do not significantly alter the impact of BVE on market values. Since capitalized RDI are a proxy for future profitability, it signifies how a firm utilizes this resource. According to Barth et al. (1996) and Burgstahler and Dichev (1997), earnings serve this utilization while BVE does not. Hence, the last two outcomes are consistent with the argument of Barth et al. (1996) and Burgstahler and Dichev (1997). In line with our hypotheses, the second (third) outcome reveals the indirect value (ir)relevance of capitalized RDI. We perform a battery of robustness checks which provide these outcomes.

The remainder of this study is organized as follows. The second section presents Theoretical Background which discusses the main outcomes of the selected literature and develops hypotheses. The following section focusses on Methodology and Sample Selection. This section further explains the models employed and variables used in analyses. The fourth section includes Results by presenting descriptive statistics and correlation matrix, multivariate analyses, and robustness checks. The last section, Conclusion, concludes this study by generating additional issues for future research and providing certain insights for practitioners.

2. THEORETICAL BACKGROUND

As underlined by most literature, VR research is led by pioneering studies of Miller and Modigliani (1966), Ball and Brown (1968) and Beaver (1968). Although the root of this literature goes down almost half a century ago, the term VR is first used by Amir et al. (1993) according to Barth et al. (2001). In this root, this term is defined and interpreted from different perspectives. Among all perspectives, the last interpretation of Francis and Schipper (1999), which terms VR as the statistically significant effect of a financial statement item on stock market figures including market values or stock returns, is the commonly accepted one by the extant literature (Ertuğrul, 2019a).

The theoretical background of capitalizing RDI backs to the contentious decision of the Financial Accounting Standards Board (FASB), the regulatory authority in the

US, in 1974. By publishing SFAS 2 in 1974, the FASB eliminated capitalizing RDI as a treatment method and required immediate expensing all RDI with no exception. Eliminating this treatment method which was in practice before SFAS 2 triggered significant discussions. Dukes (as cited in (Dukes, Dyckman, & Elliott, 1980)) reports that investors adjust net income figures for expensed RDI. Therefore, the proper treatment of RDI most likely yields useful and meaningful balance sheet and income statement figures from the perspective of financial statement users. In other words, the improper treatment of RDI hinders the usefulness of financial statement information. This effect is expected to be more apparent for firms operating in R&D intensive industries as they are more engaged in RDI. For instance, in their seminal study, Amir and Lev (1996) do conclude that none of the analyzed financial statement information (BVE, earnings, and operating cash flows) of US cellular firms has a significant impact on either stock prices or returns. Outcomes of Amir and Lev (1996) should be read as the value irrelevance of accounting information in R&D intensive industries. Similarly, Lev and Zarowin (1999) report a decline in VR of accounting information over the past two decades due to the inadequacy of the existing financial reporting regime in reflecting an entity's existing economic condition which is driven by large investments including R&D costs.

In this paragraph, the major outcomes of the selected literature on VR of capitalized RDI are briefly discussed. By employing a dataset belonging to R&D intensive US companies between 1975-1991, Lev and Sougiannis (1996) analyze the impact of capitalized RDI on stock returns and prices by using as if (or calculated, not reported) capitalized RDI. They show that capitalized RDI significantly and positively affect both stock returns and prices. By employing a dataset belonging to Korean firms with R&D activities between 1988-1998, Han and Manry (2004) document that: i) impacts of both capitalized RDI and expensed RDI on stock prices are positive at conventional significance levels, ii) expensed RDI spent by firms reporting capitalized RDI do not have any significant effect on stock prices, and iii) the impact of capitalized RDI on stock prices is significantly greater than the impact of expensed RDI on stock prices. The last two outcomes of Han and Manry (2004) reveal VR superiority of capitalized RDI over expensed RDI. By employing a dataset belonging to R&D intensive Australian companies between 1998-2001, Ke et al. (2004) reveal that the impact of R&D capitalization on market values is significantly positive. By employing a dataset belonging to French companies with R&D activities between 1993-2002, Cazavan-Jeny and Jeanjean (2006) find that capitalized RDI has a statistically significant and negative impact on stock prices. They also report that the change in capitalized RDI negatively affects stock returns at conventional significance levels. By employing a dataset consisting of UK firms with R&D Scoreboard values between 2006-2008, Tsoligkas and Tsalavoutas (2011) conclude that capitalized RDI has a significantly positive impact on market values. By dividing their sample into two based on market capitalization, Tsoligkas and Tsalavoutas (2011) reveal the validity of this outcome for both sub-samples. They further reveal that the impacts reported for both sub-samples are not statistically different than each other. By employing a dataset belonging to Australian health-care companies between 2006-2009, Mitrione et al. (2014) document that capitalized

RDI has no statistically significant impact on stock prices and returns.[2] They further extend their analyses by dividing their sample into two major industries and by dividing their analysed time interval into two based on the global financial crisis (before the crisis and during the crisis). They report that this impact becomes statistically significant only for the sub-sample comprising biotechnology science and pharmaceutical firms during the Crisis period. For other combinations, they conclude again no significant association. By employing a dataset belonging to R&D intensive Italian companies between 2005-2013, Napoli (2015) shows that capitalized RDI has a significantly positive impact on stock prices.

In the US, the FASB issued an exception to SFAS 2 in 1985. As per this exception, after the establishment of technological feasibility, all investments in software development are required to be capitalized. Therefore, research documenting evidence for the US by using reported data (contrary to Lev and Sougiannis (1996) who use as if or calculated data) generally focuses on this exception. For instance, in this industry, Aboody and Lev (1998) conclude that capitalized RDI has a statistically significant association with stock prices by employing a dataset between 1987-1995 while Eccher (as cited in (Aboody & Lev, 1998)) finds no statistically significant association by employing a dataset between 1988-1992. Although Eccher (1998) criticizes the outcomes of Aboody and Lev (1998) from different perspectives including potential survivorship bias, regression specification related problems, and available information substitutes, she underlines that the technological feasibility definition of the FASB leads to capitalization of a smaller percentage of total investments.

After the decision of the European Commission on the IFRS implementation, IFRS implementation has gained a significant momentum (Eng, Lin, & Neiva De Figueiredo, 2019; Ertuğrul, 2019a). Especially after 2005, IFRS has become the existing financial reporting regime in most jurisdictions although it is not still the mandatory reporting regime in the largest three economies (Nobes & Zeff, 2016). As a part of IFRS, the International Accounting Standards Board (IASB) developed a standard, IAS 38, for reporting intangible assets including RDI in 1998. Since this initial publishing date, IAS 38 has still been in practice (with some amendments) and provides a convenient framework to capitalize development costs if the six criteria clearly stated in Paragraph 57 are all met.

As discussed above, the immediate expensing of RDI, which may be a proxy for accounting conservatism (Ahmed & Falk, 2006), is not mandatory in the IFRS-based financial reporting. Instead, IAS 38 makes two treatment methods (expensing and capitalizing) for RDI available depending on the nature of the transaction: if development costs satisfy all the aforementioned six criteria, they are required to be

[2] Although Mitrione et al. (2014) use a dataset covering 2004-2009, this outcome is deduced from their analyses belonging to 2006-2009.

capitalized and reported as a part of intangible assets.[3] This two-treatment approach mitigates the criticisms of Lev and Zarowin (1999) to the prevalent accounting practice in the US which is insufficient in reporting innovative activities including RDI as parts of intangible assets. In other words, by allowing capitalizing as a treatment method of RDI, IAS 38 aims to contribute to the fundamental objective of IFRS which is serving players in capital markets (Zahid & Simga-Mugan, 2019) by presenting relevant and faithfully recorded financial information in financial statements.

Among all criteria listed in Paragraph 57 of IAS 38, the fourth one indicates the strong association between capitalized RDI and future economic benefits. In line with most discussed studies documenting evidence for the positive VR of capitalized RDI, we expect that capitalized RDI significantly contribute to the available information mix in the market and put forward our first hypothesis:

Hypothesis 1: Capitalized RDI are positively value relevant.

The literature indicates a positive association with RDI and innovation (Dukes et al., 1980), the benefits of which are recorded in future periods (Lev & Zarowin, 1999). In other words, today's RDI are expected to generate higher future performance. Note that this is one of the strict criteria of recording RDI as a part of intangible assets in IAS 38. As total investments comprise majorly RDI and tangible investments (or known as capital expenditures), arguments for the latter should be expected to be valid for the former: Capitalized RDI may be signals about i) lucrative projects with very positive net present values, and ii) the management's communication of their future projections (Kerstein & Kim, 1995). Not surprisingly, as discussed by Markarian et al. (2008), a rich body of research concludes the evidence for the positive relationship between capitalized RDI and future profitability.

As perfectly illustrated by Barth et al. (1996) and Burgstahler and Dichev (1997), earnings and BVE serve different purposes. According to Barth et al. (1996), BVE is the proxy for exit (or liquidation/bankruptcy) value while earnings are the proxy for the value in use. Similarly, Burgstahler and Dichev (1997) conclude that BVE is a proxy for the value of a firm's assets while earnings are a proxy for how those assets (or resources) are used. Capitalized RDI indicate (future) profitability which should be read as the way of utilizing this resource. For that reason, capitalized RDI are expected to increase VR of the proxy for the value in use, earnings, which provides a solid ground to our second hypothesis which argues the impact of earnings on market values increases as capitalized RDI increases. For the same reason, we do not expect to see a significant impact of capitalized RDI on VR of the proxy for exit,

[3] Note that this mandatory reporting eliminates the managerial discretion on capitalizing which may be exerted by optional reporting as in other local accounting standards such as Italian GAAP (Markarian et al., 2008; Napoli, 2015).

BVE, and we put forward our third hypothesis. In other words, we expect to report the indirect VR of capitalized RDI only for earnings.

Hypothesis 2: Earnings have a more positive impact on market values as capitalized RDI increases.
Hypothesis 3: The impact of BVE on market values does not change as capitalized RDI increases.

3. METHODOLOGY AND SAMPLE SELECTION

3.1 Methodology

VR research utilizes either the Return Model or the Price Model to test the association between financial reporting information and stock market figures. Analysing VR of BVE (and its reconciliation items) is not possible in the Return Model (Mestelman, Mohammad, & Shehata, 2015). Since one aim is this study is to shed light on the impact of capitalized RDI on VR of BVE, the use of the Price Model may be more convenient in the light of Mestelman et al. (2015). Therefore, we use a modified linear model which is similar to the Price Model of Ohlson (1995) available in Equations 1 to 2.

Equation 1 is employed to test our first hypothesis which is confirmed by a statistically significant and positive regression coefficient of β_3. To test our second and third hypotheses, Equation 2 is employed. A statistically significant and positive regression coefficient of β_3 confirms our second hypothesis while a statistically insignificant regression coefficient of β_4 confirms our last hypothesis.

$$MV_{i,t+1} = \beta_0 + \beta_1 \text{ x } BVE_{i,t} + \beta_2 \text{ x } E_{i,t} + \beta_3 \text{ x } RDI_{i,t} \quad (1)$$

$$MV_{i,t+1} = \beta_0 + \beta_1 \text{ x } BVE_{i,t} + \beta_2 \text{ x } E_{i,t} + \beta_3 \text{ x } BVE_{i,t} \text{ x } RDI_{i,t} + \beta_4 \text{ x } E_{i,t} \text{ x } RDI_{i,t} \quad (2)$$

In each Equation, subscripts of i and t stand for firm and year while variables of MV, BVE, E, and RDI represent market values, book value of equity, earnings, and capitalized R&D investments, respectively. MV is market value measured at the last trading day after three months from the fiscal year-end. Ertugrul (2019a) shows that the literature tests VR by changing the measurement date of the dependent variable as further robustness checks. As suggested by Ertugrul (2019a), to reveal our outcomes are independent of the measurement date of the dependent variable which should be read as a simultaneous robustness check, we also employ market value measured at the last trading day after four months from the fiscal year-end as our dependent variable. Earnings are net income figures while BVE is calculated by subtracting earnings available to common shareholders and all liabilities from total assets. As a significant portion of the current earnings figure, which is earnings available to common shareholders, is a part of BVE, it has to be considered in the calculation of BVE to mitigate mechanical interdependencies among dependent variables. Capitalized RDI are manually collected from the footnotes of annual reports. During this collection, we realize that there is no unique way of disclosing capitalized RDI. Hence, we obtain capitalized RDI in two ways. First, if a firm

separately reports the capitalized RDI figure in its annual report, we take this figure. If a firm does not separately report the capitalized RDI figure in its annual report, we calculate capitalized RDI as follows: if a firm reports different ending and beginning figures of capitalized RDI available under intangible assets, we take the difference between those ending and beginning figures and consider that difference as capitalized RDI. Note that this calculation may yield in negative capitalized RDI if the beginning figure exceeds the ending figure. If there is no information for either reported capitalized RDI or ending and beginning figures of capitalized RDI, we assume that such observations have no (or zero) capitalized RDI.

Econometrical deficiencies leading to outcomes vulnerable to the scale effect and stale information effect problems make the Price Model to be criticized by several studies including Kothari and Zimmerman (1995), Brown et al. (1999), and Easton and Sommers (2003). The literature mitigates this problem by dividing both dependent and independent variables by a common figure and it uses certain types of deflators as shown by Ertugrul (2019a). Among all deflators, Goncharov and Veenman (2014) illustrate that lagged market value controls not only for the scale effect problem but also for the stale information problem. By following their concrete outcomes, we use previous market value as a deflator and divide all variables in our Equations with this measure.

To mitigate the impact of outliers on our regression outcomes, all variables are winsorized at the top and bottom 1% percentiles. Before regressions, we perform a pooled OLS regression and check the presence of multicollinearity (or mechanical interdependencies among our independent variables) by performing the Variance Inflation Factor (VIF) analysis. During this stage, we do not take year dummies into account as they reduce mean VIF figures. For Equation 1, all individual VIF figures together with the mean VIF figures are reported as very close to 1 which indicates no significant multicollinearity problem. Then, we add interaction terms to Equation 1 and re-perform VIF analyses. Note that the independent variable of capitalized RDI and its interaction terms with BVE and earnings are available in the same formula together in that setting. Afterward, we perform VIF analyses again. The VIF figures belonging to the regression with the dependent variable of market value measured at the last trading day after three months from the fiscal year-end do not exceed the critical VIF figure of 3. However, individual VIF figures belonging to capitalized RDI and its interaction terms exceed the critical VIF figure of 3 for the regression with the dependent variable of market value measured at the last trading day after four months from the fiscal year-end. Hence, by excluding capitalized RDI from that formula and keeping only interaction terms which are enough to test our last two hypotheses, we re-perform VIF analyses. In this setting, all VIF figures indicate the non-presence of multicollinearity at conventional significance levels. Hence, in our analyses, we use this version which is shown in Equation 2.

After controlling for the presence of multicollinearity, we determine the econometrically convenient regression method. This step is very essential to obtain correct inferences from regression outcomes (Ertuğrul & Demir, 2018; Onali,

Ginesti, & Vasilakis, 2017). Therefore, we first perform the Hausman Test for each regression with differently measured dependent variables. All results of the Hausman Test analyses strongly indicate that the convenient method is the fixed-effects regressions. This methodology controls for individual-level (or time-invariant) unobserved heterogeneity. Another source of unobserved heterogeneity is at year-level (or firm-invariant) (Ertuğrul & Demir, 2018). In other words, outcomes may be driven by different years or different trends (Alali & Foote, 2012). As the most prevalent method is to add year dummies into regressions to mitigate firm-invariant unobserved heterogeneity we follow this method by adding year dummies in our Equations; however, we do not present them in our regression outcomes for the sake of brevity. All in all, by controlling for firm-fixed and year-fixed effects, almost unbiased regression coefficients are obtained (Allison, 2006).

The final step of performing convenient analyses is to mitigate correlations in standard errors resulting in potential biases. Standard errors may be correlated both serially and cross-sectionally. Therefore, as illustrated by Gow et al. (2010) and Petersen (2009), these two correlations should be controlled to mitigate the problem induced by biased standard errors. By following suggestions of Gow et al. (2010) and Petersen (2009), standard errors are clustered at both the firm-level and at the year-level to mitigate this problem.[4]

3.2 Sample Selection

The sample of this study comprises listed firms on Borsa Istanbul. We retrieve market values data from the database provided by Borsa Istanbul. Since this database provides market values for each month-end as of 2009, market values over the period 2009-2019 are used in this study. For each month, the following filters are performed to finalize the sample of market values data. First, financial institutions together with holdings and utilities are excluded due to their idiosyncratic transactions and different financial reporting regulations. Second, watchlist observations are excluded since they have a very limited daily trading time which falsifies the liquidity homogeneity of the sample. Third, except for the most liquid one, all multiple listed shares of a firm are excluded if any. After these filters, we manually collect necessary financial reporting information from annual reports provided by the Public Disclosure Platform. Note that as the Price Model of Ohlson (1995) requires one time-lagged financial reporting information (or independent variables), this information is collected for the period over 2009-2018. This manual collection is controlled by two different persons for possible manual collection errors. After this step, all observations without the fiscal-year end of December to keep the reporting homogeneity in our sample, as well as all observations with non-positive BVE figures as per the going concern related issues, are excluded. Last, observations with any missing variable necessary for analyses are further excluded.

[4] By following Petersen (2009), we also obtain outcomes with various cluster options: i) unclustered standard errors, ii) White standard errors, iii) only at the firm-level clustered standard errors (which is the common approach of in the extant VR research, and iv) only at the year-level clustered standard errors. Our outcomes remain unchanged.

All these filters yield 2,226 firm-year observations belonging to 287 firms.

4. RESULTS

4.1 Descriptive Statistics and Correlation Matrix

Panel A of Table 1 reveals detailed descriptive statistics. Each variable except for two ratios of capitalized RDI in this Panel is deflated by the previous market value. The mean and median market values point out annual growth in market capitalization. Furthermore, firms do trade at a premium to BVE as shown by the mean and median BVE figures which should be read as the positive attitude of the market towards the existing value in use of resources of firms in our sample. Although the mean and median earnings figures are positive, P25 statistics belonging to that item is negative which means that more than one-fourth of the sample records losses. Untabulated statistics reveal that almost 30% of total observations suffer from losses.

The mean figure of capitalized RDI indicates that this item is very smaller than the other two traditional accounting figures. Moreover, the P75 figure belonging to that item is zero which means that more than three-fourth of the sample records no capitalized RDI. Panel B of Table 1 reveals annual distribution: the highest (lowest) number of observations with capitalized RDI are observed in the last (first) two years. On average, almost 15% of observations have capitalized RDI. These statistics provide a convenient ground to arguments of Bhana (2013) and Hellman (2008). Bhana (2013) claims that capitalization criteria in IAS 38 are very rigid which reduces the use of capitalization as a common practice. Hellman (2008) approaches the subject from a different perspective by considering conservatism-based accounting practices in certain Code-Law countries. Note that conservatism hinders the use of capitalization (Wang, 2013). The last two statistics presented in Panel A of Table 1 belong to capitalized RDI-to-assets and capitalized RDI-to-non-current assets ratios. The latter is more than three times the former.

Panel C of Table 1 reveals the correlation matrix. Since a correlation matrix documents the direct relationship between two variables without considering any other variables, it has a limited ability to give evidence for hypotheses. However, it provides an insight: the significantly positive association with market value and capitalized RDI gives a solid ground for our first hypothesis. All correlation coefficients between market value and accounting information are reported as significantly positive while no correlation coefficient between BVE and other accounting information is statistically significant. Last, there is a significantly positive association between earnings and capitalized RDI. Although all correlation coefficients are small figures which may be an indication of the non-presence of multicollinearity, the VIF analysis should be performed to detect this problem. As discussed earlier, all VIF analyses show that our outcomes are not significantly affected by the multicollinearity problem.

Table 1. Descriptive Statistics and Correlation Matrix

PANEL A										
	N	**MEAN**	**P10**	**P25**	**P50**	**P75**	**P90**	**SD**	**MIN**	**MAX**
MV	2,226	1.2690	0.6580	0.8290	1.0550	1.4710	2.1190	0.7260	0.3480	4.5740
BVE	2,226	0.9560	0.2210	0.4120	0.7250	1.2350	1.9810	0.8210	0.0664	4.6420
E	2,226	0.0306	-0.1800	-0.0221	0.0453	0.1180	0.2100	0.2120	-0.8130	0.7310
RDI	2,226	0.0035	0	0	0	0	0.0052	0.0130	-0.0002	0.0856
RDI_A	2,226	0.0023	0	0	0	0	0.0026	0.0091	-0.0002	0.0622
RDI_NC	2,226	0.0072	0	0	0	0	0.0064	0.0291	-0.0004	0.2070

PANEL B			
Year	**N**	**with RDI**	**without RDI**
2009	188	25	163
2010	192	24	168
2011	206	31	175
2012	221	35	186
2013	232	38	194
2014	233	35	198
2015	235	32	203
2016	244	38	206
2017	237	41	196

2018	238	44	194	
TOTAL	2,226	343	1,883	

PANEL C				
	MV	**BVE**	**E**	**RDI**
MV	1			
BVE	0.2810*	1		
E	0.1747*	-0.0237	1	
RDI	0.1131*	-0.0037	0.0530*	1

Notes: Panel A and Panel B show descriptive statistics and annual distribution of observations with and without capitalized R&D investments. Panel C presents the correlation matrix. MV, BVE, E, and RDI respectively refer to market value measured at the last trading day after three months from the fiscal year-end, book value of equity, earnings, and capitalized R&D investments. All these variables are deflated by the previous market value. RDI_A and RDI_NC show capitalized R&D investments-to-total assets and capitalized R&D investments-to-non-current assets ratios. N, MEAN, P10, P25, P50, P75, P90, SD, MIN, and MAX refer to the total number of observations, mean, 10^{th} percentile, 25^{th} percentile, median, 75^{th} percentile, 90^{th} percentile, standard deviation, minimum, and maximum. * indicates the significance level at 5%.

4.2 Multivariate Analyses

Panel A of Table 2 demonstrates regression outcomes belonging to the dependent variable measured at the last trading day after three months from the fiscal year-end. As a general outcome, market value is significantly and positively affected by both BVE and earnings which reveals that these accounting items are value relevant. This outcome is in line with the extant research (see, among others, Ates, 2020; Bilgic et al., 2018; Ertuğrul, 2019b, 2020; Ertuğrul and Demir, 2018; Kargin, 2013; Suadiye, 2012) analysing VR of Turkish listed firms covering periods after mandatory IFRS adoption.

Capitalized RDI has the significantly positive regression coefficient which means that the market significantly and positively values capitalized RDI and an increase in capitalized RDI leads to an increase in market values. By getting inspired from the interpretation of Kerstein and Kim (1995) for capital expenditures, we argue that this outcome may also be read as follows: the market received the message conveyed in forms of capitalized RDI about the management's future projections and it reflects capitalized RDI in market values. This outcome confirms our first hypothesis by revealing that capitalized RDI are positively value relevant. This outcome is consistent with the most literature (see, among others, Aboody & Lev, 1998; Han & Manry, 2004; Ke et al., 2004; Lev & Sougiannis, 1996; Napoli, 2015; Tsoligkas & Tsalavoutas, 2011) while it does not in line with Cazavan-Jeny and Jeanjean (2006) who -contrary to most literature- report that capitalized RDI are negatively value relevant and Eccher (as cited in (Aboody & Lev, 1998)) and Mitrione et al. (2014) who document evidence for the value irrelevance of capitalized RDI.

The interaction term between capitalized RDI and earnings is reported as significantly positive. In other words, as capitalized RDI increases, market values are more positively affected by earnings at conventional significance levels or earnings become more positively value relevant. Since capitalized RDI signal about future profitability (Lev & Zarowin, 1999) and improved future operating performance (Chen & Ramaboa, 2017), they lighten the way of utilizing this resource which makes earnings a more significant determinant of valuation from the perspective of of Barth et al. (1996) and Burgstahler and Dichev (1997). This outcome is purely in line with this way of utilizing this source argument of Barth et al. (1996) and Burgstahler and Dichev (1997) and it confirms our second hypothesis by revealing that the impact of earnings on market values becomes more positive as capitalized RDI increases. In other words, this outcome provides evidence for the indirect VR of capitalized RDI.

The interaction term between capitalized RDI and BVE is not reported as significant at conventional levels. In other words, VR of BVE remains statistically unchanged as capitalized RDI increases. It is an expected outcome because capitalized RDI bring the way of utilizing this source argument into the scene instead of the proxy for the exit or liquidation which makes BVE a more significant determinant of valuation from the perspective of Barth et al. (1996) and Burgstahler and Dichev

(1997). This outcome confirms our third hypothesis by showing the impact of BVE on market values is independent of capitalized RDI. In other words, this outcome expectedly provides evidence for the indirect value irrelevance of capitalized RDI.

Table 2. Regression Outcomes

	PANEL A		**PANEL B**	
BVE	0.4228***	0.4144***	0.4094***	0.4047***
	(0.0575)	(0.0612)	(0.0678)	(0.0700)
E	0.8068***	0.7272***	0.7466***	0.6953***
	(0.1286)	(0.1287)	(0.1393)	(0.1406)
RDI	6.8545**		4.2840*	
	(2.6951)		(2.2612)	
BVE x RDI		1.1510		1.4828
		(1.2721)		(1.4251)
E x RDI		17.9093*		18.8669*
		(7.9226)		(9.9225)
Constant	0.8165***	0.8425***	0.8350***	0.8469***
	(0.0536)	(0.0584)	(0.0619)	(0.0645)
Number of Obs.	2,226	2,226	2,226	2,226
R^2	0.479	0.481	0.446	0.448
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Notes: Panel A (B) shows outcomes belonging to the dependent variable of market value measured at the last trading day after three (four) months from the fiscal year-end. BVE, E, and RDI respectively refer to book value of equity, earnings, and capitalized R&D investments. All these variables are deflated by the previous market value. Regression outcomes are obtained by the fixed effects methodology. Year fixed effects are also controlled. Standard errors in parentheses are clustered at both the firm level and the year level. *** p<0.01, ** p<0.05, * p<0.1.

The literature employs several market values as the dependent variable to increase the robustness of outcomes (Ertuğrul, 2019a). Therefore, we employ market value measured at the last trading day after four months from the fiscal year-end as our dependent variable and present outcomes belonging to these analyses in Panel B of Table 2. By revealing i) a significantly positive regression coefficient of capitalized RDI, ii) a significantly positive interaction term between capitalized RDI and earnings, and iii) an insignificant interaction term between capitalized RDI and BVE, Panel B purely confirms all outcomes reported in the Panel A.

4.3 Robustness Checks

To obtain econometrically robust and unbiased outcomes, we control for i) all individual and mean VIF values; as a result, we decide not to include capitalized RDI figures in Equation 2 due to the multicollinearity problem, ii) firm-fixed effects together with year-fixed effects, as suggested by Ertuğrul and Demir (2018) and Onali et al. (2017), iii) cluster standard errors at both the firm-level and the time-level as suggested by Gow et al. (2010) and Petersen (2009). We further report outcomes obtained for two different dependent variables which work as simultaneous robustness mechanisms. In this section, we discuss additional robustness checks.

First, as discussed previously, our untabulated statistics show that approximately 30% of total observations record losses. As losses convey more information than profits (Hayn, 1995), differential valuation of losses should be controlled as stated by Chambers et al. (2007). Therefore, by adding loss dummies in Equations 1 and 2, Equations 3 and 4 are obtained. L stands for the loss dummy which is equal to one if net income (or earnings) is less than zero. All analyses are re-performed by employing Equations 3 and 4, and Panel A of Table 3 presents outcomes belonging to this robustness check. These outcomes are totally consistent with outcomes reported in the previous section which should be read as the insensitivity of our outcomes to the differential valuation of losses.

$$MV_{i,t+1} = \beta_0 + \beta_1 \text{ x } BVE_{i,t} + \beta_2 \text{ x } E_{i,t} + \beta_3 \text{ x } RDI_{i,t} + \beta_4 \text{ x } L_{i,t} \quad (3)$$

$$MV_{i,t+1} = \beta_0 + \beta_1 \text{ x } BVE_{i,t} + \beta_2 \text{ x } E_{i,t} + \beta_3 \text{ x } BVE_{i,t} \text{ x } RDI_{i,t} + \beta_4 \text{ x } E_{i,t} \text{ x } RDI_{i,t} + \beta_5 \text{ x } L_{i,t} \quad (4)$$

Second, the nature of minority interests triggers contentious discussions, the center of which is summarized in one sentence as follows: "*Is it debt or BVE, or perhaps neither?*" (Clark, 1993, p. 10). As per this concern, to mitigate the complex and intricate nature of minority interests, re-calculate BVE by subtracting minority interests from the previously calculated BVE figures. Afterward, all analyses are re-performed by considering this version of BVE, and Panel B of Table 3 presents outcomes belonging to this robustness check. These outcomes are completely in line with outcomes reported in the previous section which should be read as the insensitivity of our outcomes to the complex nature of minority interests.

We perform two more robustness checks, but we do not prefer presenting outcomes belonging to them for the sake of brevity. Results are available from the authors. First, singleton observations may overstate significance levels in fixed-effects regressions and lead to incorrectly generated regression outputs (Correia, 2015). Hence, we exclude all singleton observations and re-perform all analyses. Second, we term BVE net of capitalized RDI as BVE indirectly carries capitalized RDI. Therefore, in addition to subtracting minority interests, we also subtract capitalized RDI from BVE figures, and then we re-perform all analyses. Those untabulated outcomes are also entirely consistent with outcomes reported in the previous section

which means that our outcomes are not sensitive to singleton observations and indirect impact of capitalized RDI on BVE.

Table 3. Robustness Analyses

	PANEL A		**PANEL B**	
BVE	0.4240***	0.4149***	0.4501***	0.4409***
	(0.0573)	(0.0610)	(0.0621)	(0.0658)
E	0.6644***	0.5778***	0.7073***	0.6223***
	(0.1651)	(0.1615)	(0.1634)	(0.1616)
RDI	6.8492**		6.6241**	
	(2.6953)		(2.7390)	
BVE x RDI		1.2809		1.1400
		(1.1747)		(1.2227)
E x RDI		17.9062**		17.5626**
		(7.5172)		(7.3961)
L	-0.1183**	-0.1233**	-0.1096**	-0.1145**
	(0.0488)	(0.0433)	(0.0481)	(0.0427)
Constant	0.8553***	0.8832***	0.8467***	0.8740***
	(0.0497)	(0.0536)	(0.0507)	(0.0557)
Number of Obs.	2,226	2,226	2,225	2,225
R^2	0.481	0.483	0.481	0.483
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Notes: Panel A and B reveal regression outcomes with differently calculated book value of equity figures. In Panel A, book value of equity is calculated by subtracting total liabilities and earnings available to common shareholders from total assets. In Panel B, book value of equity is calculated by subtracting total liabilities, earnings available to common shareholders and minority interests from total assets. The dependent variable of the first (second) column of each Panel is market value measured at the last trading day after three (four) months from the fiscal year-end. BVE, E, RDI, and L respectively refer to book value of equity, earnings, capitalized R&D investments, and loss dummy which is equal to 1 if the earnings figure is less than 0. All these independent variables except loss dummy are deflated by the previous market value. Regression outcomes are obtained by the fixed effects methodology. Year fixed effects are also controlled. Standard errors in parentheses are clustered at both the firm level and the year level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

All presented robustness checks in Table 3, as well as untabulated ones, are robustly in line with all outcomes reported in Table 2 and confirm all our hypotheses. To recap, these robustness analyses reveal that the impact of capitalized RDI on market values is significant at conventional levels. They further show that capitalized RDI make the impact of earnings on market values more significantly positive while capitalized RDI do not alter the impact of BVE on market values.

5. CONCLUSION

In this study, the direct and indirect VR of capitalized RDI is analysed by employing a sample of listed firms on Borsa Istanbul between 2009 and 2018. The direct VR is measured by the impact of capitalized RDI on market values while the indirect VR is measured by the impact of capitalized RDI on VR of earnings and BVE.

By using a modified linear Price Model very similar to Ohlson (1995), we report three significant outcomes. First, consistent with the most literature, we find strong evidence for the positive VR of capitalized RDI which is shown by the significantly positive impact of capitalized RDI on market values. This outcome reveals that the market captures the information conveyed by capitalized RDI and it incorporates capitalized RDI in market values. Second, the impact of earnings on market values becomes more positive as capitalized RDI increases. In other words, VR of earnings significantly increases with capitalized RDI. Last, the impact of BVE on market values does not change with capitalized RDI. The last two outcomes are in line with the argument of Barth et al. (1996) and Burgstahler and Dichev (1997) who illustrates that earnings and BVE figures have different valuation implications: while earnings show how a firm utilizes its resources, BVE serves the purpose of the value of assets. As capitalized RDI indicate the way of utilizing this resource, it is (not) expected to increase VR of earnings (BVE). Our first outcome reveals the direct VR of capitalized RDI and our second and third outcomes respectively show the indirect VR and value irrelevance of capitalized RDI. Our outcomes add to the literature as it has not studied both direct and indirect VR of capitalized RDI. It is our major motivation.

This study may further be interest to equity analysts and investors since i) it provides valuable input, capitalized RDI, for accounting-based valuation models, and ii) it demonstrates how the valuation effectiveness of earnings increases with capitalized RDI. This study provides further insights for regulatory authorities. As argued by Bhana (2013), the rigid R&D capitalization criteria hinder the use of capitalization in practice. Therefore, regulatory authorities may consider amending or relaxing the criteria to increase the practical use of capitalization which are expected to result in more value relevant capitalized RDI and earnings.

Future research may get avenues from this study. First, we report outcomes by employing a sample of a single country which reduces the generalizability of our outcomes. Future research may employ a sample comprising firms from different countries to publish more generalizable outcomes. However, to our knowledge, international data vendors, which are heavily utilized by studies reporting outcomes

by employing multi-country samples, do not provide capitalized RDI data for most countries including Turkey. Hence, all studies discussed in the literature review section document evidence belonging to only one country. Second, future research may present outcomes for capitalized RDI by analysing different perspectives of accounting quality, only one of which is VR. Last, since market values for each month-end are provided beginning from 2009 by the database of Borsa Istanbul, we analyse a 10-year horizon. Future research may employ a longer horizon which may allow for observing trends.

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