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WORKING CAPITAL MANAGEMENT AND TECHNOLOGY INTENSITY
ÇALIŞMA SERMAYESİ YÖNETİMİ VE TEKNOLOJİ YOĞUNLUĞU

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Abstract

Several studies in literature presented that technology intensity firms, which are also assumed as R&D intensive ones, are holding more liquid assets, especially cash, compared to other firms. This study investigates possible differences, which are born by tendency of holding more liquid assets in technology intensive firms, in working capital management policies in emerging markets. 437 firms from 15 emerging countries have been analyzed by the use of Kuruskal Wallis and Mann Whitney U tests. The results revealed that technology intensive firms have been following different and more aggressive working capital management policies compared to less technology intensive ones.

Keywords: Technology intensity, R&D intensity, Working capital management

Özet

Literatürdeki bir çok çalışma teknoloji yoğun şirketlerin, ki bu şirketler AR&GE yoğun olarak da kabul edilirler, diğer şirketlere kıyasla daha fazla likit varlık, özellikle de nakit, tuttuklarını göstermiştir. Bu çalışmada, yüksek likit varlık tutma eğiliminde olan teknoloji yoğun şirketlerin çalışma sermayesi yönetimi politikalarındaki olası farklılıklar gelişmekte olan ülkeler kapsamında araştırılmıştır. 15 gelişmekte olan ülkeden 437 şirket Kuruskal Wallis and Mann Whitney U testleri kullanılarak analiz edilmiştir. Sonuçlar, teknoloji yoğun şirketlerin, diğer şirketlere kıyasla, daha farklı ve agresif çalışma sermayesi yönetim politikaları izlediklerini göstermiştir.

Anahtar Kelimeler: Teknolojik yoğunluk, AR&GE yoğunluğu, Çalışma sermayesi yönetimi

1. INTRODUCTION

One of the important contributors of economic growth and development at macro level, also firms' competitive advantage at micro level, is the magnitude of research and development (R&D) activities or investments (Alam, Uddin, and Yazdifar 2019; Chen et al. 2019; Tirelli and Spinesi 2021). Such that the R&D activities can be defined as processes that transform the knowledge into economic and social benefits (Wang et al. 2016).

Although, there is a general consensus about the value created by R&D activities, several problems surrounding R&D. One of the problems is the financing of the R&D activities, in another saying access to financial resources to fund the R&D investments. As stated by several researchers, R&D investments have some unique characteristics, which differs from other investment activities, and such unique characteristics make it difficult to finance R&D activities. The uncertainty about the returns associated with the results of R&D activities,

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longer periods needed for commercialization of R&D output, high employee costs and adjusting costs, having no liquidation value, collateralization problem associated with knowledge based assets are the most depicted ones in the literature (Bougheas 2004; J. R. Brown, Fazzari, and Petersen 2009; J. R. Brown, Martinsson, and Petersen 2012; J. R. Brown and Petersen 2011; Hall 2002a; Hall and Lerner 2010; Lee 2012; Tirelli and Spinesi 2021).

Surrounded by those problems, the studies about the financial sources of R&D investments are inconclusive but it is found that R&D investments are generally financed by internal sources or equity issuance, while debt is not a favorable means of finance for R&D investments (Baldi and Bodmer 2018; J. R. Brown, Fazzari, and Petersen 2009; R. Brown 2012; Hall 2002b; Shin and Kim 2011). Moreover, some studies also presented that high-tech firms, which assumed have high R&D investments (intensity) and innovation intensity, hold more cash compared to non-high-tech firms (Adler, Ahn, and Dao 2018; Booth and Zhou 2013; Dao and Maggi 2018; Dupuy et al. 2020) and those firms are utilizing their liquid assets, especially cash holdings, to smooth their R&D investments (J. R. Brown, Fazzari, and Petersen 2009; J. R. Brown and Petersen 2011; Sasidharan, Lukose, and Komera 2015; Shin and Kim 2011). Additionally, in a recent study, Alkhataybey (2021) reveals the role of working capital in smoothing R&D investments in the presence of financial constraints.

In sum, the findings in the literature present the importance of liquid assets and even short-term debt (for some markets), combined with accumulation of liquid assets (especially cash) which in turn highlights the importance of working capital management for high-tech and R&D intensive firms. Moreover, those findings arise possibility of different working capital management practices in technology intensive companies or sectors. Several studies have already presented the existence of disparity working capital practices across sectors. While, those studies focused on classical sectoral grouping, to the best of our knowledge, no study has been concentrated on the effect of technology intensity on working capital management.

Motivated by previous literature, this study intends to explore the differences in working capital management practices in the sectors with different levels of technology intensity in 15 emerging economies. The finding of the study presented that firm with different technology intensity levels follow different working capital policies, where the high technology intensive firm are more aggressive in working capital management.

Section 2 presents the related literature and theoretical background. Section 3 defines the variables and tests used. Section 4 displays the finding of the research and Section 5 concludes.

2. RELATED LITERATURE and THEORETICAL BACKGROUND

While the working capital (WC) is the amount of investment on the current assets, the net working capital (NWC) is defined as current assets minus current liabilities. Such definition of working capital or net working capital indicates that the working capital management (WCM) deals with short term financial decisions basically comprising cash management, account receivables management, inventory management, account payables management and short-term debts.

Above definitions of NWC and WCM point out the importance of short term financial decisions at a glance, however, WCM is also a part of strategic decisions that should be

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considered in line with the long term strategic objectives. Hence, in an alternative definition, NWC is defined as the amount of capital tied up to current assets, and the amount capital devoted to finance operating activities (Preve and Sarria-Allende 2010). As stated by Nunn (1981) some portion of the investment in working capital is permanent, which is not subject to short-term volatility, and long-term or strategic decisions should be made on such investments. From such perspective, aggressive, conservative or moderate WCM preferences become a strategic decision.

Large body of related literature examined the factors effecting the WCM practices. Among these, Nunn (1981) states that product line characteristics (standard production, capacity usage), export or import orientation of industry, some expenses like advertising, market structure shapes the need for working capital and such factors explain the differences within and between the industries. In the same vein, Hawawini, et. al. (1986) asserts that technology (the process of production and nature of the product manufactured), operating cycle management efficiency and level of sales affects the need for WC.

Several studies presented that sectoral or industrial characteristics are one of the significant factors for WCM preferences even for developed and developing markets (Baños-Caballero, et. al. 2010; Bhutto et al. 2015; Koralun-Bereźnicka 2014; Nazir and Afza 2009; Onaolapo and Kajola 2015). While the earlier studies found a persistent industry effect or differences on WCM (Weinraub and Visscher, 1998; Filbeck and Krueger 2005; Hawawini, et.al. 1986) recent evidences revealed that WCM practices are subject to change over time and the rate of change is different across industries. Boisjoly, et.al. (2019) states that the TQM, Six-Sigma, Lean production and other recent developments increase the efficiency of firms' in managing WC. Thus, there is a shift in the mean of WC ratios. Accompanied with technological and software related improvements, firms are able to finance their operations with less capital. Their study presented that WC measures change overtime and some industries are more efficient than others. While, Koralun-Bereźnicka (2014) states that country specific effects dominates the industry and size specific effects in determining the need for WC; increasing globalization may lead decline in the significance of country specific factors and increase industry specific factors and some other factors.

Technological intensity and R&D intensity can be one of the industry specific factors that affect the WCM practices. Booth and Zhou (2013) stated that high-tech companies generally rely on high levels of R&D investments, which are not easy to finance given the unique characteristics of R&D investments. Hall (2002a) states that high employee costs accompanied with importance of human capital and uncertainty about the returns related with R&D investment, differs R&D investments from other investments. Moreover, Brown, et.al. (2009) stressed on limited use of R&D investment as a collateral. Brown and Petersen (2011) also point out the problems related with human capital and state the high adjustment costs for R&D. Moreover, Brown, et.al. (2012) states that young and small firms engaging R&D activities are subject to adverse selection and moral hazard problems, which makes the risk assessment a complicated process (Tirelli and Spinesi 2021). Bougheas (2004) states that R&D investments are too risky and have no value in the case of liquidaiton.

As a result of the such characteristics of R&D investments stated above, the financing decisions by the R&D intensive companies differ from companies with or minimum R&D

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intensity (Blass and Yosha 2010). Several studies assert that there is a financial hierarchy for R&D financing in US and European firms, especially for young and small firms, and such hierarchy starts with internal finance, goes to external equity and debt is not an option for R&D financing (Baldi and Bodmer 2018; J. R. Brown, Fazzari, and Petersen 2009; J. R. Brown, Martinsson, and Petersen 2012; Hall 2002b).

Contrary findings are also reported in the literature. For example, Blass and Yosha (2010) compared the financial sources of Israeli firms, domestic firms versus US stock market traded firms, and find that domestic firms mostly rely on debt. They also differ in terms of uses of funds, while US traded Israeli firms increase their cash and security holdings, while domestic firms invest in fixed capital. Lee (2012) revealed that debt financing is more important than equity financing for Korean companies. Examining the emerging markets Alam, et.al. (2019) state that financing hierarchy is subject to change according to the market orientation, where the firms operating in market based (bank based) markets prefers internal (external) funding.

The findings about the financial sources of R&D investments are inconclusive in the literature, however, there is almost a consensus about the uses of liquid assets or cash holdings for the financially constraint firms, especially if they are young and small. In order to eliminate or manage the R&D adjustment costs, R&D intensive firms tend to keep liquid assets, which are indeed used to smooth the R&D investments and most of the young firms use cash holding for this purpose (J. R. Brown and Petersen 2011). Similar tendency is also observed for SMEs (Shin and Kim 2011) and European countries (Baldi and Bodmer 2018; Brown, et.al. 2012). Borisova and Brown (2013) state that working capital is also used for R&D smoothing. In the same vein, Alkhataybey (2021) stated that internal funds and debt are not used for R&D financing but stock issues are preferred for the firms listed in Tel Aviv Stock Exchange. Moreover, financially constraint firms utilize working capital as financial source in the short-run. Liu, et al. (2021) find that Chinese A-Share listed companies tend to sell their operating and financial assets for R&D investments.

The tendency of R&D intensive firms to hold more liquid assets is also supported by evidences can found in the studies dealing with the increasing corporate cash holding for the last a few decades. Among those, Booth and Zhou (2013) find that increasing corporate cash holding especially related with high-tech sector. Moreover, Adler, et.al. (2018) and Dupuy et al. (2020) show that firms with high R&D intensity tend to hold high levels of cash, because of liquidity risks born by high innovation intensity. In the similar vein, Dao and Maggi (2018) find that increase in corporate cash holdings and lending for the last a few decade attributed to the size, tax effects and R&D spending.

Contrary to above, Sasidharan, et.al. (2015) documented that internal financing is important in R&D investments but no R&D smoothing can be found. Moreover, Guney, et.al. (2017) find that not bank debt or term loans but credit lines are also used for R&D smoothing.

3. RESEARCH DESIGN

In the light of above discussions, it is obvious that high-tech firms, which assumed to have high R&D intensity, relay more liquid assets and cash holdings or even bank credit lines, either to smooth their R&D investments or insure the risks born by uncertain R&D activities. Such tendency of R&D and technology intensive firms may lead to different WCM policies.

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Motivated by the above discussion, this study aimed at exploring the WCM differences in emerging markets for the firms with different technology intensity. By following Palazzi et al. (2020), 437 firms, which are traded in stock markets, from 15 emerging countries are classified under 4 groups according to their technology intensity. Following the Weinraub and Visscher (1998) a base line analyses has been conducted to figure out the potential differences in WCM policies.

3.1. Data Set and Variables

In order to explore the difference between technology intensity and WCM practices in emerging markets, Morgan Stanley Capital International (MSCI) Emerging Market classification has been used. By the use of such emerging market classification firms from 15 emerging markets are analyzed. After eliminating companies with missing information, the final dataset comprise 437 non-financial firms listed in 15 countries for the period between 2004 and 2019.

Following data preparation process, data set is divided into 4 groups according to their technology intensity. Table 1 presents the number of firms from each group and industry.

Table 1: Number of firms in each group with respective countries

Country	Group 1	Group 2	Group 3	Group 4	Total
Argentina				4	4
Colombia			3	3	6
Greece		2	4	1	7
Indonesia	7	6	7	15	35
Malaysia	9	13	16	40	78
Mexico			3	4	7
Peru				1	1
Philippines		1	3	1	5
Poland	3	3	5	7	18
Russia	2		1		3
South Africa	2	2	3	2	9
South Korea	17	26	15	21	79
Taiwan	43	18	17	21	99
Thailand	10	14	15	28	67
Turkey	1	7	3	8	19
Total number of firms	94	92	95	156	437

By following Palazzi et al. (2020), who used a Nace Rev. 2 classification of manufacturing industries by technological intensity, Thomsen Reuters Business Classification based on R&D Intensity has been modified to present the technological intensity. The industrial classification used by in this study is given in Table 2.

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Table 2: Technological intensity based on Industry Classification

Group	Technological Intensity	Thomsen Reuters Code	Industry Name	Number of Companies
1	High Technology	52101010	Aerospace & Defense	94
		52102040	Heavy Electrical Equipment	
		56101020	Medical Equipment, Supplies & Distribution	
		56201040	Pharmaceuticals	
		57102010	Communications & Networking	
		57104010	Electronic Equipment & Parts	
		57106030	Household Electronics	
2	Medium-high Technology	51101020	Agricultural Chemicals	92
		52102010	Industrial Machinery & Equipment	
		52102020	Heavy Machinery & Vehicles	
		52102030	Electrical Components & Equipment	
		53101010	Auto & Truck Manufacturers	
		53101020	Auto, Truck & Motorcycle Parts	
3	Medium-low Technology	50102030	Oil & Gas Refining and Marketing	95
		51101010	Commodity Chemicals	
		51201020	Iron & Steel	
		51202010	Construction Materials	
		53101030	Tires & Rubber Products	
		53203020	Construction Supplies & Fixtures	
		53204030	Appliances, Tools & Housewares	
4	Low Technology	51301010	Forest & Wood Products	156
		51301020	Paper Products	
		51302010	Non-Paper Containers & Packaging	
		51302020	Paper Packaging	
		52203020	Commercial Printing Services	
		53202010	Textiles & Leather Goods	
		53202020	Apparel & Accessories	
		53204040	Home Furnishings	
		53403040	Apparel & Accessories Retailers	
		54101010	Brewers	
		54101030	Non-Alcoholic Beverages	
		54102010	Fishing & Farming	
		54102020	Food Processing	

3.2 Variables

The WCM policies are generally classified as conservative or aggressive. While the conservative policies rely more on long-term financing of current assets and higher levels of capital devoted to finance operating activities; the aggressive WC policies rely on short-term financing of current assets and lower levels of capital for operating activities. The firm management should decide which policy to follow by considering the risk-return trade-off for both policies (Avci, 2017).

Following Afza and Nazir (2007) and Weinraub and Visscher (1998) nature of the WCM policies has been identified by the ratio of current assets to total assets and the ratio of current liabilities to total assets.

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The first ratio presented in Equation 1, called as *Aggressive Investment Ratio (AIR)*, represents the amount of current asset investment as a percentage of total assets. It is accepted that lower levels of AIR is an indication of aggressive WCM, while higher levels indicate conservative WCM policies (Afza and Nazir, 2007; Weinraub and Visscher, 1998).

$$Aggressive\ Investment\ Ratio\ (AIR) = \frac{Current\ Assets}{Total\ Assets} \quad \text{Eq.1}$$

The second ratio presented in Equation 2, called as *Aggressive Financing Ratio (AFR)*, represents the amount of current liabilities as a percentage of total assets. It is accepted that higher levels of AFR is an indication of aggressive WCM, while lower levels indicate conservative WCM policies (Afza and Nazir, 2007; Weinraub and Visscher, 1998).

$$Aggressive\ Financing\ Ratio\ (AFR) = \frac{Current\ Liabilities}{Total\ Assets} \quad \text{Eq.2}$$

In order to explore the potential differences in WCM practices, Accounts Receivable Days (ARD) and Inventory Days Held (IDH) ratios are also included in the analyses. These ratios are calculated as shown in equations 3 and 4.

$$Account\ Receivable\ Days\ (ARD) = \frac{Average\ Account\ Receivables}{Net\ Sales} \times 365 \quad \text{Eq.3}$$

$$Inventory\ Days\ Held\ (IDH) = \frac{Average\ Inventories}{Cost\ of\ Goods\ Sold} \times 365 \quad \text{Eq.4}$$

3.3 Test Statistics

To explore the existence of WCM policy differences among the firms with different technology intensity, Kuruskal Wallis and Mann Whitney U tests are performed. Kuruskal Wallis and Mann Whitney U tests are used for the parametric equivalent of ANOVA and independent sample t test, respectively. Both Kuruskal Wallis and Mann Whitney U test used rank order of the raw data set and that is why they are not affected by the outlier in the data.

Kuruskal Wallis test statistics is calculated as Equation 5:

$$H = (N-1)\frac{\sum_{i=1}^{g} n_i(\bar{r_{i.}} - \bar{r})^2}{\sum_{i=1}^{g}\sum_{j=1}^{n_i}(r_{ij} - \bar{r})^2} \quad \text{Eq.5}$$

where N is the total number of observation; g is the number of groups; n_i. is the number of observations in group i; r_{ij} is the rank (among all observations) of observation j from group i; $\bar{r_{i.}} = \frac{\sum_{j=1}^{n_i} r_{ij}}{n_i}$ is the average rank of all observations in group i and $\bar{r} = \frac{1}{2}(N+1)$ is the average of all the r_{ij} .

The Mann-Whitney U statistics is calculated as as Equation 6:

$$U = n_1 * n_2 + \frac{n_1 * (n_1 + 1)}{2} - R_1 \quad \text{Eq.6}$$

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Where n_1 and n_2 are the number of observations from the first and second population, respectively and R_1 is the sum of the ranks of the observations from the first population.

Assuming that the central locations of the two population distribution are the same, the mean and variance of the Mann-Whitney U statistic is shown in Equation 7:

$$E(U) = \mu_U = \frac{n_1 * n_2}{2}$$
$$Var(U) = \sigma_U^2 = \frac{n_1 * n_2 * (n_1 + n_2 + 1)}{12} \quad \text{Eq.7}$$

By using the Central Limit Theorem standardized score for the Mann-Whitney U test statistics can be written as Equation 8:

$$Z = \frac{U - \mu_U}{\sigma_U} \quad \text{Eq.8}$$

Two populations data mixed first and then ordered smallest to the biggest value and rank order is assigned to the observation. Two groups are separated again and this time instead of observation value rank orders are used to calculate R_1 and R_2 values which are the sum of the ranks of the observation. Smaller values in the raw data will generate smaller rank orders. That means when you calculate z score if it is smaller than zero that mean first group ranks sum is smaller than second group ranks sum (First group raw data values is smaller than second group raw data values).

4. EMPIRICAL FINDINGS

The findings of the study has been presented through Table 3 to Table 7. Table 3 shows the Kuruskal Wallis test, which compares the median of the groups under examination. All the years from 2004 to 2019 median of *Aggressive Investment Ratio* (AIR) is different among the groups with 1% significance. Such finding indicates that the group of firms with different technology intensity have different WCM policies for current asset investments, that is such groups are following different WCM policies in terms of aggressiveness.

Table 3: Kuruskal Wallis Test Statistics

	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Aggressive Investment Ratio	**36.9*****	**50.4*****	**41.5*****	**41.4*****	**40.5*****	**34.9*****	**29.7*****	**43.2*****
Aggressive Financing Ratio	1.0	4.1	3.0	5.1	5.6	5.4	2.3	1.1
Account Receivable Days	**25.4*****	**30.4*****	**26.6*****	**28.0*****	**34.1*****	**29.0*****	**18.2*****	**34.8*****
Inventory Days Held	**8.3****	6.2	2.6	2.7	3.2	4.0	**7.5***	**6.4***
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Aggressive Investment Ratio	**49.4*****	**44.6*****	**48.4*****	**42.4*****	**46.8*****	**39.9*****	**38.2*****	**34.2*****
Aggressive Financing Ratio	1.9	0.1	1.9	**8.2****	**10.7****	5.2	**7.7***	2.4
Account Receivable Days	**47.1*****	**46.9*****	**58.1*****	**69.7*****	**54.2*****	**36.9*****	**33.5*****	**29.9*****
Inventory Days Held	4.4	2.5	3.3	4.1	3.8	5.2	**7.8***	6.0

*%10, **%5 , ***%1; AIR= Aggressive Investment Ratio; AFR= Aggressive Financing Ratio; ARD= Account Receivable Days; IHD= Inventory Days Held

In terms of *Aggressive Financing Ratio* (AFR), only 2015 (5% significance), 2016 (5% significance), and 2018 (10% significance), results found to be significantly different. Based on such findings, it is not possible to assert the differences in financing of working capital for

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the firms with different technology intensity. However, it should also be noted that the significant differences in AFRs have been observed in 3 of the 5 last observation years. It is also possible to explain such finding as a changing trend in recent year in the financing of WC, moreover Covid virus related issues can also be effective for the last year of the observation. Such interpretation needs further analysis.

In line with the AIR findings, difference among the groups in terms of *Account Receivable Days* (ARD) is also significant at 1% for all the years in the analysis. Such finding is an evidence that the group of firms with different technology intensity have different credit sales policies. Normally, sales on credit and credit terms regarded as classical industrial difference among the firms, however it is documented that technological intensity is also important in ARDs.

The findings for Inventory Days Held (IDH) presents that the difference among the groups is significant for 2004 (5% significance), 2010, 2011 and 2018 (10% significance). Based on such findings, it is not possible to assert existence of the differences in inventory management for the firms with different technology intensity.

The Table 3 presented that there are differences among groups especially in terms of AIR and ARD but there is weak evidence about the AFR and IHD though 2004 to 2019. Although, such finding is important in documenting the effect of technology intensity on different WCM policies, it is not possible to figure out the differences in between each group and persistence of such differences. In order to point out those differences among each group and possible persistence of differences through time Mann Whitney U tests has been conducted.

Table 4 to Table 7 presents the Mann Whitney U test statistics for group differences for each year of the data. Accourding to Table 4, the group of companies with highest technological intensity (G1 or Group 1) have been following different WC investment policy at 1% significance level for all the years under analysis. Another important finding is the differences between groups are subject to increase when the differences in technology intensity increasing. That is the difference between Group 1 - Group 4 has the highest value among the differences in other groups. Similar findings are also valid for the differences between Group 2, Group 3 and Group 4. The differences between Group 2 - Group 3 is statistically significant for 11 years, and moreover the difference between Group 2 - Group 4 is significant for 15 years. No significant difference can be found for Group3-Group 4.

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Table 4: Mann Whitney U Test Statistics Aggressive Investment Ratio

Groups	G 1 – G2		G 1 – G 3		G 1 – G 4		G 2 – G 3		G 2 – G 4		G 3 – G 4	
Statistics	*U*	*z*	*U*	*z*	*U*	*z*	*U*	*z*	*U*	*z*	*U*	*z*
2004	**1432*****	**-3.51**	**1650*****	**-4.81**	**1822*****	**-5.58**	**2455****	**-2.09**	**2964****	**-2.27**	5017	-0.08
2005	**1496*****	**-3.66**	**1674*****	**-5.27**	**1745*****	**-6.51**	**2506****	**-2.34**	**2801*****	**-3.42**	5072	-1.07
2006	**1445*****	**-4.09**	**1892*****	**-4.80**	**2027*****	**-6.00**	2898	-1.37	**3208*****	**-2.65**	5393	-0.90
2007	**1476*****	**-4.36**	**2143*****	**-4.32**	**2168*****	**-6.21**	3182	-0.58	**3467****	**-2.48**	5425	-1.31
2008	**1710*****	**-4.13**	**2253*****	**-4.59**	**2516*****	**-6.08**	3202	-0.92	**3852****	**-2.08**	5730	-1.17
2009	**1793*****	**-4.31**	**2360*****	**-4.90**	**3205*****	**-5.21**	3315	-1.28	4555	-1.21	6905	-0.03
2010	**2219*****	**-3.43**	**2660*****	**-4.53**	**3671*****	**-4.83**	3397	-1.64	**4717***	**-1.68**	7283	-0.05
2011	**2154*****	**-3.96**	**2403*****	**-5.47**	**3272*****	**-5.88**	**3414****	**-2.05**	**4768****	**-2.00**	7543	-0.03
2012	**2428*****	**-3.87**	**2502*****	**-5.73**	**3424*****	**-6.28**	**3414****	**-2.52**	**4857****	**-2.51**	7802	-0.07
2013	**2605*****	**-3.63**	**4155*****	**-5.38**	**3626*****	**-5.99**	**5080*****	**-2.80**	**4928*****	**-2.62**	11187	-0.37
2014	**2592*****	**-4.07**	**3938*****	**-5.88**	**3693*****	**-6.01**	**5248*****	**-2.86**	**5340****	**-2.26**	11089	-0.60
2015	**2932*****	**-3.40**	**4223*****	**-5.31**	**3850*****	**-5.61**	**5418*****	**-3.10**	**5431****	**-2.58**	10979	-0.84
2016	**2685*****	**-4.10**	**4117*****	**-5.56**	**3633*****	**-6.24**	**5782****	**-2.50**	**5721****	**-2.33**	11442	-0.72
2017	**3222*****	**-3.00**	**4603*****	**-4.93**	**4081*****	**-5.76**	**5681*****	**-2.74**	**5516*****	**-2.90**	11760	-0.32
2018	**3272*****	**-2.76**	**4573*****	**-4.98**	**4290*****	**-5.44**	**5557*****	**-2.85**	**5517*****	**-2.85**	11611	-0.60
2019	**3511*****	**-2.21**	**4616*****	**-4.79**	**4509*****	**-4.86**	**5390*****	**-3.14**	**5500*****	**-2.79**	11118	-0.76
Total Significant Pairs	16		16		16		11		15		--	

*%10, **%5 , ***%1; G1 = Group 1 composed of High-Technology firms; G2 = Group 2 composed of Medium High-Technology firms; G3 = Group 3 composed of Medium Low-Technology firms; G4 = Group 4 composed of Low-Technology firms

These findings clearly reveals a persistant WC investment policy differences between technology intensive firms and the others. Another finding related with Table 4 is presented by sign of the *z* scores. The *z* scores have negative sign in all years and among all groups. As the difference in technology intensity is increasing, the *z* score is getting more negative. Such finding indicates that the technology intensive firms invest less in currenst assets as a percentage of total assest and they are following more aggresive WC investment policies compared to lower technology intensive companies.

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Table 5: Mann Whitney U Test Statistics Aggressive Financing Ratio

Groups	G 1 – G2		G 1 – G 3		G 1 – G 4		G 2 – G 3		G 2 – G 4		G 3 – G 4	
Statistics	*U*	*z*	*U*	*z*	*U*	*z*	*U*	*z*	*U*	*z*	*U*	*z*
2004	1982	-0.75	2681	-0.66	3261	-0.97	2788	-0.43	3501	-0.39	4767	-0.18
2005	2025	-1.25	**2541****	**-2.03**	3460	-1.48	2967	-0.56	3925	-0.15	5106	-0.64
2006	2071	-1.32	2802	-1.48	3588	-1.53	3237	-0.02	4111	-0.08	5606	-0.08
2007	**2029****	**-2.00**	**2814***	**-1.96**	**3850***	**-1.77**	3308	-0.06	4287	-0.32	5871	-0.24
2008	**2228****	**-2.18**	**3090****	**-1.98**	4469	-1.43	3367	-0.29	4365	-0.79	5869	-0.76
2009	2624	-1.34	**3297****	**-2.15**	5292	-0.57	3525	-0.53	4672	-0.94	**5962***	**-1.70**
2010	2893	-1.15	3772	-1.40	5538	-0.81	3857	-0.21	5205	-0.50	6777	-0.77
2011	3070	-0.95	4251	-0.56	6024	-0.11	4015	-0.37	5257	-0.85	7236	-0.49
2012	3513	-0.54	4249	-1.32	6372	-0.47	4080	-0.72	5956	-0.15	7199	-1.03
2013	3729	-0.14	6973	-0.15	6446	-0.30	6395	-0.07	6008	-0.02	11064	-0.23
2014	3702	-0.87	7029	-0.19	6369	-0.92	6330	-0.79	6455	-0.05	10657	-1.16
2015	3517	-1.64	6702	-0.43	**5435****	**-2.45**	6360	-1.21	6565	-0.41	**9723****	**-2.30**
2016	3822	-0.65	6568	-0.76	**5578****	**-2.25**	6299	-1.27	6041	-1.36	**9247*****	**-3.09**
2017	3752	-1.21	6598	-0.82	**5818****	**-2.20**	6756	-0.39	6505	-0.78	10418	-1.57
2018	3595	-1.53	**5700*****	**-2.62**	**5905****	**-2.31**	6278	-1.01	6587	-0.50	11498	-0.36
2019	4110	-0.34	6419	-1.36	6487	-1.00	6397	-1.14	6632	-0.45	11194	-0.56
Total Significant Pairs	2		5		5		--		--		3	

*%10, **%5 , ***%1; G1 = Group 1 composed of High-Technology firms; G2 = Group 2 composed of Medium High-Technology firms; G3 = Group 3 composed of Medium Low-Technology firms; G4 = Group 4 composed of Low-Technology firms

The test results about the possible difference in terms of financing, which is measured as the ratio of current liabilities to total assets, is presented by Table 5. Although, some findings present significant differences among the financing policies of firms with different technology intensity, it is not possible to arriave a general conclusion. The most significant difference has been found between Group 1 - Group 3; Group 1 - Group 4. No significant differences can be dedected for Group 2 - Group 3, Group 2 - Group 4.

Table 4 and Table 5 reveals the firms with different technology intensity follow different the working capital investment policy, but not financing policy. The technology intensive firms have more aggressive working capital investment policy compared to firms with lower intensity, as their current asset to total assets ratio is significantly different.

As aggressive invesment ratio related with current assets has been documented in Table 4, further analyses has been conducted for *Account Receiable Days* (ARD) and *Inventory Days Held* (IDH), to explore the possible differences in receivables and inventories management. These two indicators, ARD and IDH, has been selected as they are two of the main components of working capital measure, which is *Cash Conversion Cycle* (CCC). Although, CCC has 3 components as ARD, IDH and payables days, payables days is ignored as aggressive financing ratio findings are inconclusive as presented in Table 5.

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Table 6: Mann Whitney U Test Statistics Account Receivable Days

Groups	G 1 – G2		G 1 – G 3		G 1 – G 4		G 2 – G 3		G 2 – G 4		G 3 – G 4	
Statistics	*U*	*z*	*U*	*z*	*U*	*z*	*U*	*z*	*U*	*z*	*U*	*z*
2004	1639	-1.6	**1960*****	**-2.88**	**1950*****	**-4.65**	2428	-0.93	**2423*****	**-2.99**	**3666****	**-2.52**
2005	1901	-1.4	**2234****	**-2.55**	**1996*****	**-4.99**	2731	-0.90	**2471*****	**-3.67**	**3642*****	**-3.10**
2006	2126	-0.7	**2455****	**-2.42**	**2419*****	**-4.51**	2678	-1.51	**2637*****	**-3.76**	**4342*****	**-2.60**
2007	2270	-0.6	**2498*****	**-2.64**	**2572*****	**-4.52**	**2627****	**-2.07**	**2754*****	**-3.90**	**4607****	**-2.39**
2008	2162	-1.5	**2521*****	**-3.03**	**2476*****	**-5.37**	2806	-1.57	**2898*****	**-3.78**	**4675*****	**-2.70**
2009	2804	0.0	**3144****	**-1.92**	**3156*****	**-4.42**	**2830****	**-2.11**	**2927*****	**-4.28**	**4842*****	**-2.83**
2010	2900	-0.1	3545	-0.90	**3897*****	**-3.46**	3149	-0.88	**3438*****	**-3.40**	**5013*****	**-2.74**
2011	2546	-1.1	3581	-1.21	**3056*****	**-4.95**	3502	-0.15	**2956*****	**-4.15**	**4318*****	**-4.29**
2012	2937	-1.0	3766	-1.39	**3234*****	**-5.70**	3931	-0.25	**3353*****	**-4.90**	**4650*****	**-4.93**
2013	3315	-1.0	**4055***	**-1.69**	**3550*****	**-5.83**	4215	-0.36	**3610*****	**-4.97**	**5084*****	**-4.65**
2014	3285	-1.6	5069	-1.08	**3324*****	**-6.47**	4823	-0.72	**3601*****	**-5.21**	**5289*****	**-5.73**
2015	**3119****	**-2.4**	**4811***	**-1.76**	**2923*****	**-7.39**	4963	-0.89	**3754*****	**-5.39**	**5339*****	**-5.92**
2016	**3420***	**-1.9**	5091	-1.10	**3407*****	**-6.37**	5297	-0.77	**4129*****	**-5.08**	**5782*****	**-5.32**
2017	3803	-0.9	5477	-0.37	**4370*****	**-4.86**	5314	-0.73	**4584*****	**-4.46**	**6382*****	**-4.68**
2018	3729	-1.5	**4660****	**-2.54**	**4343*****	**-5.28**	5247	-0.88	**4893*****	**-3.94**	**7439*****	**-3.17**
2019	3803	-1.3	**4669****	**-2.34**	**4412*****	**-5.04**	5206	-0.78	**4937*****	**-3.73**	**7326*****	**-2.99**
Total Significant Pairs	2		10		16		2		16		16	

*%10, **%5 , ***%1; G1 = Group 1 composed of High-Technology firms; G2 = Group 2 composed of Medium High-Technology firms; G3 = Group 3 composed of Medium Low-Technology firms; G4 = Group 4 composed of Low-Technology firms

Table 6 presents the Mann Whitney U test statistics for *Account Receivable Days* (ARD). The findings clearly revealed that ARD is significantly different for the firms with high technology intensity, where those firms have shorter ARD. ARD differences between firms is subject to increase as technology intensity diffference is increasing. According to z score the difference between Group 1 - Group 4 firms is highest compared to difference between other groups.

Another important finding presented in Table 6 is the persistance of the observed differences through 2004 to 2019. The difference in ARD between Group 1 - Group 4 is significant at 1% and such difference is increasing. The same pattern is observed for the difference for Group 2 - Group 4, and also Group 3 - Group 4. On the other hand, differences between Group 1- Group 2 and Group 2- Group 3 are weak that only 2 years of observation is significant.

The findings about receivables presented in Table 6 also reveals the differences in WCM policies between the firms with different technology intensity. The firms with higher technology intensity consistantly following different credit terms compared to lower technology intensive firms, which also indicates that firms with higher technology intensity follow more aggressive WCM policies.

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Table 7: Mann Whitney U Test Statistics Inventory Days Held

Groups	G 1 – G2		G 1 – G 3		G 1 – G 4		G 2 – G 3		G 2 – G 4		G 3 – G 4	
Statistics	*U*	*z*	*U*	*z*	*U*	*z*	*U*	*z*	*U*	*z*	*U*	*z*
2004	1742	-1.2	2249	-0.1	2904	-1.5	1983	-1.3	**2520*****	**-2.7**	3295	-1.6
2005	2151	-0.3	2109	-1.5	**3030***	**-1.7**	**2097****	**-1.7**	**3008***	**-2.0**	4018	-0.2
2006	2152	-0.6	2353	-1.3	3521	-1.4	2445	-0.8	3659	-0.8	4631	-0.1
2007	2276	-0.6	2570	-0.9	3960	-0.7	2383	-1.4	3676	-1.4	4788	-0.1
2008	2340	-0.7	2701	-0.9	4282	-0.7	2393	-1.5	3748	-1.5	4971	-0.2
2009	2677	-0.5	2769	-1.5	4757	-0.6	**2460***	**-1.8**	4158	-1.1	4800	-1.0
2010	2669	-0.9	2922	-1.1	**4674***	**-1.7**	**2313****	**-2.1**	**3862****	**-2.4**	5263	-0.2
2011	**2284****	**-2.1**	3220	-0.6	5096	-0.2	**2538***	**-1.7**	**3661****	**-2.3**	5230	-0.6
2012	**2667***	**-1.9**	3469	-0.6	5726	-0.4	3029	-1.3	**4762***	**-1.8**	6152	-0.3
2013	3195	-1.4	4032	-0.1	6282	-0.3	3307	-1.3	5340	-1.3	6474	-0.2
2014	**3193***	**-1.8**	4067	-0.3	6265	-0.5	3447	-1.3	5459	-1.3	6644	-0.2
2015	**3357***	**-1.8**	4259	0.0	6564	-0.3	**3492****	**-1.7**	5646	-1.6	6736	-0.4
2016	**3486***	**-1.7**	4208	-0.2	6513	-0.3	3762	-1.5	5928	-1.6	6911	-0.2
2017	**3426****	**-1.9**	4151	-0.3	6700	-0.1	3728	-1.6	**5741****	**-2.1**	7020	-0.2
2018	**3393***	**-2.4**	4064	-1.1	7011	-0.2	3909	-1.1	**5542****	**-2.5**	6605	-1.0
2019	**3549****	**-1.9**	3905	-1.1	6817	-0.2	4043	-0.5	**5672****	**-2.1**	6147	-1.5
Total Significant Pairs	8		--		2		5		8		--	

*%10, **%5 , ***%1; G1 = Group 1 composed of High-Technology firms; G2 = Group 2 composed of Medium High-Technology firms; G3 = Group 3 composed of Medium Low-Technology firms; G4 = Group 4 composed of Low-Technology firms

Table 7 presents the Mann Whitney U test statistics for *Inventory Days Held* (IDH). Although, there is not a clear evidence of inventory management difference between groups, there are significant differences between some groups for a few years. The difference between Group 1 - Group 2 is significant for 8 years especially in the last years of the observation. Such finding could be interpreted as the high technology companies manage their inventories more aggressively compared to lower technology firms, however, such argument is not supported by the findings about Group 1 – Group 3 and Group 1- Group 4, where there is no or a few significant differences can be found. Moreover, the significance levels are either 5% or 10%. Similar findings are also presented for the differences in inventory management between Group 2 – Group 3 and Group 2 - Group 4. Hence, it is not possible arrive a general conclusion from the findings showed in Table 7.

5. CONCLUSION

Intensive R&D investments accombined by advances in technology in the last a few decades re-shape the world economy and also the way firms doing their business from several aspects. From the financial decisions side, the uniques characterstics of R&D investment and the recent tendency of firms for holding liquid assets have some financial consequences for firms especially in high-technology sectors.

This study intends to explore the potential working capital management policy differences among the firms with different technological intensity. The dataset used in the study comprise 437 non-financial firms listed in 15 emerging countries for the period between

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2004 and 2019. To explore the existence of WCM policy differences among the firms with different technology intensity, Kuruskal Wallis and Mann Whitney U tests are performed.

The results of the study presented a persistant difference in working capital investment policies, measured by *Aggressive Investment Ratio*, between high technology firms and other lower technology companies. Such difference is also existing for *Account Receiable Days* (ARD). On the other hand, no persistant difference can be found according to working capital financing policies (measured by *Aggressive Financing Ratio*) and *Inventory Days Held*.

The finding of the study is in line with the previous literature in two ways. First, as documeneted by Hawawini, et. al. (1986), Nunn 1981) and Boisjoly, et.el. (2019) that technology is one of the factors that effects the working capital policy preferences. Second, several studies also presented that high-technology and R&D intensive firms tend to hold more liquid assests especially cash (Alkhataybey 2021; Baldi and Bodmer 2018; Brown, et.al., 2009; Brown and Petersen 2011; Shin and Kim 2011), which can raise the possibility of differences in working capital management policies, especially from the current assets side. The findings about AIR and ARD are also evidence about the different poicies followed in terms of current asstes management.

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