

A DETAILED INVESTIGATION OF THE EFFECTS OF HUMAN CAPITAL ON FIRM VALUE: AN APPLICATION ON BIST

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ABSTRACT

In the literature, there are studies on intellectual capital and firm market value, but investigations on human capital (HC) and firm market value relationship are scarce. We investigate in detail the effects of HC on firm value, i.e. the direct, interaction, and lagged effects of HC sub-dimensions (capacity and productivity) on firm market value. Full sample consists of 1,257 observations in 149 industrial firms traded in Borsa Istanbul over 2005 to 2017. Panel data is estimated using the fixed effect regression method. We demonstrate that HC capacity and productivity are value-relevant because they affect the decisions of accounting information users. Specifically, our findings show that Turkish industrial companies that invest in more HC capacity and have higher HC productivity have higher market value. It is also documented that HC productivity moderates the relation between HC capacity and firm value. Lastly, we find that HC sub-dimensions have also lagged effects as well as contemporaneous effects. This research contributes to the knowledge of HC, which is a source of sustained competitive advantage for today's knowledge-based companies in line with the theory of resource-based view.

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ÖZ

İNSAN SERMAYESİNİN FİRMA DEĞERİ ÜZERİNDEKİ ETKİLERİNİN DETAYLI BİR İNCELEMESİ: BIST ÜZERİNE BİR UYGULAMA

Literatürde entelektüel sermaye ve firma piyasa değeri ile ilgili çalışmalar bulunmakta olmasına rağmen insan sermayesi (HC) - firma piyasa değeri ilişkisine yönelik araştırmalar azdır. Bu çalışma, HC alt boyutlarının (kapasite ve verimlilik) firma piyasa değeri üzerindeki direkt, etkileşimli ve gecikmeli etkilerini analiz etmektedir. Örnekleme, 2005-2017 yılları arasında Borsa İstanbul'da işlem gören 149 sanayi firmasına ait 1.257 gözlemden oluşmaktadır. Çalışma, panel veri seti, sabit etkiler regresyon yöntemi kullanılarak analiz edilmiştir. Çalışmada muhasebe bilgisi kullanıcılarının kararlarını etkilediği için HC kapasitesinin ve verimliliğinin firma değeriyle ilgili olduğu bulgusuna ulaşılmıştır. Özellikle, daha fazla HC kapasitesine yatırım yapan ve daha yüksek HC verimliliğine sahip olan firmaların daha yüksek piyasa değerine sahip olduğu görülmüştür. Ayrıca, insan sermayesi verimliliğinin, insan sermayesi kapasitesi ile firma değeri arasındaki ilişkide ilmlaştırıcı etkiye sahip olduğu bulgusu da ortaya koyulmuştur. Son olarak, HC alt boyutlarının eşzamanlı etkilerinin yanı sıra gecikmeli etkilerinin de olduğunu ortaya koyulmuştur. Bu araştırma, günümüzün bilgi yoğun işletmeleri için kaynak temelli yaklaşım teorisi doğrultusunda sürekli bir rekabet avantajı kaynağı olarak görülen insan sermayesinin anlaşılmasına katkıda bulunmaktadır.

Anahtar Kelimeler: *İnsan Sermayesi, Ohlson Modeli, Firma Değeri, Etkileşim Etkisi, Borsa İstanbul*

1. Giriş

Resource-based view theory highlights the links between the firm's internal resources, strategy, and performance (Barney, 1991). According to this theory, in order for a resource to be regarded as a source of sustained competitive advantage, the resource must contribute to company value: it must be inimitable, it must be rare, and there must be no adequate substitutes for it. Human resources are thought to fulfill all these characteristics (Wright, McMahan and McWilliams, 1994). Moreover, within the new economic landscape, it can also be claimed that human resources have a higher potential than tangible resources to gain a

competitive advantage (Hitt, Biermant, Shimizu and Kochhar, 2001). Hurwitz, Lines, Montgomery and Schmidt (2002) similarly agree that investments in human capital (HC) rather than in tangibles are necessary to realize more value. Moreover, it is also asserted that many capital market players are ready to put much higher value on corporations that improve their HC (Lim, Chan and Dallimore, 2010).

As today's complex knowledge-based companies are becoming more and more dependent on intangible resources, considering these factors in firm valuation models will be a more accurate approach in determining the intrinsic value of firms. In this regard, many scholars in the literature highlighted the importance of HC for firm valuation (e.g. Samudhram, Stewart, Wickramanayake and Sinnakkannu, 2014; Gavius and Russ, 2009; Liu, Tseng and Yen, 2009; Lajili and Zeghal, 2006; Hurwitz et al., 2002). Moreover, there are studies and recommendations that draw attention to the interaction between HC sub-dimensions and emphasize the time-lag nature of HC. For example, Samudhram et al. (2014) consider that HC input and output indicators can simultaneously serve as a better proxy for HC quality in firm valuation. Joia (2000) and Tseng and Goo (2005) point out that there is a time-lag feature of HC. Hence, HC was studied extensively to incorporate it into firm valuation and performance assessment models (see for recent paper, Daloğlu, 2020; İşseveroğlu and Ercan, 2019; Kuzey et al., 2021; Lajili et al., 2020; Rahman and Akhter, 2021; Samad, 2020; Shamsuzzoha and Tanaka, 2021; Sisodia et al., 2021; Tran and Vo, 2020; Tunçer and Atan, 2020; Yılmaz and Özer, 2019). However, none of them have jointly analyzed the direct, interaction, and lagged effects of HC sub-dimensions on firm value.

Motivated by the recommendations made by scholars, this study aims to examine whether direct, interaction, and lagged effects of HC input (named HC capacity) and HC output (named HC productivity) are necessary factors to be considered in firm valuations. The existing literature has not yet explored these links in detail, neither theoretically nor empirically. This study attempts to fill these research gaps.

To achieve this purpose, Ohlson (1995) and Feltham and Ohlson (1995) valuation model (OM) is used as a base model. This is because OM provides a direct connection between a firm's market value and its fundamental accounting

numbers (Eloff and de Villiers, 2015). Then OM is extended by hypothesizing the use of HC sub-dimensions, which are proxied by financial variables in exchange for “other information,” one of the OM factor mostly left ignored in previous studies due to the difficulties in measurement (Al-Hares, AbuGhazaleh and Haddad, 2011).

In this study, publicly traded Turkish manufacturing companies were selected as a research sample. Turkey's economy expanded rapidly, especially after the millennium. According to a World Bank report^{††}, it exhibited rapid increases in human capital and total factor productivity growth among the main drivers of this growth together with strong macroeconomic management, supportive global liquidity conditions, and structural reforms in the post-2000 period. Moreover, during this period, the highest contribution to overall productivity growth came from the manufacturing and financial sectors (Atiyas and Bakis, 2015).

The findings show that the direct effects of the HC capacity and productivity significantly affect firm's market value. Therefore, they may be regarded as value-relevant to market players because of their significant effect on the firms' market values. HC productivity moderates the relation between HC capacity and firm market value, where higher levels of HC productivity led to a greater effect of HC capacity on the market value. Lastly, firms' market values are affected by the lagged HC capacity and productivity. These findings conform with the resource-based theory, the dynamic structure of human resources and the suggestions of previous studies. Since Turkey shares many fundamentals with other emerging markets, the findings of this study can be generalized to other emerging countries.

The article is organized as follows: Section 2 provides a review of the conceptual framework of the study and research hypotheses. Section 3 discusses the sample, data, and research methodology. Section 4 conducts empirical analyses. Finally, section 5 concludes the paper.

^{††} World Bank (2016)'s full report is accessible here:
<http://documents.worldbank.org/curated/en/359731468184482131/pdf/103073-BRI-Box394849B-Focus-Note-ENG-Jan2016-PUBLIC.pdf>

2. Previous Studies and Theoretical Framework

Firms have four different resources which are used to create value. These are financial, physical, organizational, and human capital resources. The varied characteristics of these resources contribute to the achievement of sustained competitive advantages. Barney (1991:105) argues that “*to have the potential of sustained competitive advantages, a firm resource must have four attributes: (a) it must be valuable, in the sense that it exploit opportunities and/or neutralizes threats in a firm’s environment, (b) it must be rare among a firm’s current and potential competition, (c) it must be imperfectly imitable, and (d) there cannot be strategically equivalent substitutes for this resource that are valuable but neither rare or imperfectly imitable*”. Wright et al. (1994) states that human capital resources fulfill all these characteristics. Thus, according to the resource-based theory, which highlights the links between the firm's internal resources, strategy and performance, human capital resources can be considered as a source of sustained competitive advantage. More specifically, both theoretical and empirical studies conclude that human capital resources: ensure *value* to firms; high-quality human resources stemming from cognitive abilities are *rare*; the unique history of firms, causal ambiguity between firms' resources and competitive advantage, and social complexity lead to human capital resources being *inimitable*; and continuously training individuals with high levels of cognitive abilities on cutting-edge technological know-how ensure human capital resources are *non-substitutable* (Wright et al., 1994).

Within the new economic landscape, human resource management and investments in human capital are necessary to realize more value (Hitt et al., 2001; Hurwitz et al., 2002). Human capital theory emphasizes that investments in people and human development systems provide economic benefits to individuals, firms, and societies (Lepak and Snell, 1999; Sweetland, 1996). Firms with the best human resource management systems, i.e. selection, appraisal, training, reward and compensation systems that identify, attract, and retain high quality employees will have a higher sustained competitive advantage over than those that do not (Barney and Wright, 1998; Wright et al., 1994). De Saá-Pérez and García-Falcón (2002) investigate the effect of human resource management on the firm’s performance from the resource-based view. They report that human resource decisions affect the firms’ performances and the development of organizational

capabilities, implying that a properly developed human resource systems that create and preserve the human capital can lead to a sustainable competitive advantage. Similarly, Jamal and Saif (2011) show that human capital management has a positive effect on organizational performance, implying that investment in human capital increases the probabilities of competitive advantage of firms. In a meta-analysis on human capital and firm performance studies, Crook et al. (2011) report that human capital is strongly related to firm performance.

In the literature on human capital, studies have conducted firm-level analysis to understand the human capital and firm value/performance relationship. Some recent studies can be listed as follows: Kuzey et al. (2021) examines the impact of human capital investment on firm financial performance in an international context noting a significant positive association with ROA. In a similar manner, Rahman and Akhter (2021) examine the aspects of investment in human capital on bank performance. The data gathered via questionnaire, shows that investment in human capital is positively associated with bank performance. Shamsuzzoha and Tanaka (2021) investigate the role of top managers' human capital on the efficiency of manufacturing firms in Bangladesh. They find that general and specific human capital have an impact on firm performance. Sisodia et al. (2021) for Indian firms, Daloğlu (2020) for holding company publicly traded in BIST, Lajili et al. (2020) for firms that listed in 50 most attractive employers ranking conducted by Universum Global, Samad (2020) for automotive companies in Malaysia, Tran and Vo (2020) for Vietnamese firms, Tunçer and Atan (2020) for Turkish firms listed in 1000 large enterprises registered in the Istanbul Chamber of Industry, İşseveroğlu and Ercan (2019) for BIST technology firms, and Yılmaz and Özer (2019) for 1050 companies across Turkey – all found a positive relationship between human capital and firm value/performance. However, none of them have jointly analyzed the direct, interaction, and lagged effects of HC sub-dimensions on firm value.

2.1. Definition of Human Capital

The notion of human capital (HC) originated with Adam Smith's explanation of the four kinds of capital in the 18th century. In modern economic literature, the use of the concept dates back to a pioneering article written by Jacob Mincer in 1958 "*Investment in Human Capital and Personal Income*

Distribution" (Weber and Reynolds, 2011). The operational definition of HC was first made by Economics Professor Gary Becker who defined HC as a collective knowledge, values, skills, talents, capabilities, and attitudes that the company's employees operationally contribute to its performance and productivity (Weber and Reynolds, 2011).

Edvinsson and Malone (1997) defined HC as knowledge, skills, and abilities that employees have in order to meet their duties. Many factors, such as formal training and education, wisdom, innovation capacity, creativity, motivation, internal and external relationships, learning capacity, and previous experience have been recognized as important for HC development (Stanko, Zeller and Melena, 2014; Starovic and Marr, 2003).

Human capital theory views individual members of firms as an important resource, rather than their practices and/or procedures (Wright et al., 1994). The theory divides human capital into "specific" and "general" human capital. General human capital includes qualifications that all employees possess, such as literacy and basic mathematical skills, whereas specific human capital includes characteristics unique to a single employee (Weber and Reynolds, 2011). Barney and Wright (1998) argue that specific human capital cannot be easily duplicated by competitors, and they are not easily marketable by the employees who possess them. Therefore, developing employees throughout the work processes and investing in constant training offers a greater potential for sustainable competitive advantage from specific human capital (Barney and Wright, 1998).

2.2. Sub-dimensions of Human Capital

There is no consensus in the literature on what the sub-dimensions of HC are and how many sub-dimensions need to be used. For example, in a content analysis, a total of 128 different lower-level intellectual capital sub-dimensions were identified and 55 of these were included in HC component (Beattie and Thomson, 2007). Edvinsson and Malone (1997) used 26 different human focus indicators. Roos and Roos, (1997) have divided HC into four different sub-capitals: knowledge, skill capital, motivation, and task capital. However, previous studies show that determining the sub-components of HC depends on research purposes. In accordance with the objectives of this paper, a quantitative perspective has been adopted where the HC input (named HC capacity) and HC

output (named HC productivity) sub-dimensions have been constructed in order to keep the analysis simple in understanding the nature of HC.

Human Capital Capacity: Weber and Reynolds (2011) state that analysis of human capabilities in an organization can be carried out quantitatively and / or qualitatively, and it can be called human capacity when the analysis is done quantitatively. What is expressed as HC capacity in this study is known as the amount of HC (Kucharčíková, Tokarčíková and Blašková, 2015), accumulated HC (Wakelin, 1998), HC investments (Onkelinx, Manolova and Edelman, 2016), level of HC (Lajili and Zeghal, 2005), and HC quality (Samudhram et al., 2014) in other studies. Even though, this sub-dimension of HC is expressed under different names in all of the abovementioned studies, almost similar considerations are incorporated, i.e. employee competence, education, experience, and quality perceived by firms. Degree of HC capacity reflects how qualified employees are seen from the company's point of view. In order to expand HC capacity, firms try to attract and retain talented, well-educated, experienced employees by paying higher salaries and more benefits (Lim et al., 2010). They also need to invest in training programs to improve firm-specific employee skills and abilities (Onkelinx et al., 2016).

Human Capital Productivity: HC productivity represents how much employees contribute to the financial performance of a company by harmonizing their characteristics, such as competence, education, experience, and quality together with firm-specific characteristics. Productivity indicators measure the efficiency and effectiveness of a given input in the generating process (SPRING Singapore, 2011). In that sense, HC productivity is a measure of the extent to which companies use their employees' strengths effectively. The concept that is expressed as HC productivity in this study refers to the HC effectiveness (Bontis and Fitz-Enz, 2002), employee profitability (Huang, Luther and Tayles, 2007), and HC output level (Samudhram et al., 2014) in other studies.

2.2.1. Measuring Sub-dimensions of Human Capital

Organizations, especially large ones, usually assess and measure their HC accumulation for various internal purposes, such as maximizing employee productivity, staff development, determining training needs, refining recruitment and many other objectives (Weber and Reynolds, 2011). There are several

alternative methods to measure and then to value HC, but a single methodology is yet to be adopted. Because every organization is unique and the highest company objectives are achieved in different ways, it is difficult to create a single universal methodology for the measurement of HC (Kucharčíková et al., 2015).

Considering the problem information gap related to HC in the financial statements, we decided to use one proxy for each sub-dimensions of HC. We chose personnel expenses per employee and sales per employee as proxy variables for HC capacity and HC productivity, respectively.

The underlying logic of using personnel expenses per employee proxy variable can be explained as follows: Most studies in the related literature prove strong relationship between employee-related expenses and other hard-to-measure features of HC (Lajili and Zeghal, 2006). For example, according to the findings of Turcotte and Rennison's (2004) study in Canada, factors such as education, training, and experience influence average wages. Similarly, in a study on Belgian firms, Dumont (2008) found a positive relationship between the level of wages and the level of education. In Taiwan, Yeh and Kung (2013) report significant and high correlation between employee-related expenses and various non-financial indicators of HC, such as employee education level, employee tenure, the proportion of professional employees, and employee turnover ratio. Finally, this proxy variable is commonly used for sub-dimensions that may correspond to HC capacity in the previous studies (i.e. Kucharčíková, et al., 2015; Wakelin, 1998; Onkelinx et al., 2016; Lajili and Zeghal, 2005; Samudhram et al., 2014). These considerations lead us to use personnel cost as a proxy for HC capacity.

The underlying logic of using sales per employee proxy variable can be explained as follows: According to HR Metrics Service (2014), business leaders most commonly use sales per employee as a measure of productivity and they rely on this metric in assessing whether an organization is successful or not. Bontis and Fitz-enz (2002) suggest that the effectiveness of an organization's HC capability can be measured using sales per employee. In a study on Taiwanese companies, Yeh and Kung (2013) report significant and high correlation between sales per employee and various non-financial indicators of HC, such as employee education level and proportion of professional employees. Finally, this proxy variable is commonly used for sub-dimensions that may correspond to HC productivity in the previous studies (i.e. Bontis and Fitz-Enz, 2002; Huang et al.,

2007; Samudhram et al., 2014). These considerations lead us to use sales per employee as a proxy for HC productivity.

2.3. Research Hypotheses

Education is one the significant ways to capture the value of an employee (Stanko et al., 2014), and personnel costs may reflect HC embedded in the employees, such as education and experience (Onkelinx et al., 2016). Accordingly, a high personnel expenses level may indicate a large level of accumulated HC in a firm (Wakelin, 1998). These relationships are rational because more educated and skilled people will demand higher salaries by gaining more experience and seniority in their working life (Kallunki et al, 2005), thereby expected to increase their productivity and the company's long-term competitive edge. Investors also view labor costs as a proxy for HC investments and they incorporate that information into their firm valuation processes (Lajili and Ze'ghal, 2005). As a result, a higher level of personnel expenses per employee indicates higher HC capacity, which would likely lead to better performance, and thus investors will see the company more valuable. In light of this reasoning, we formulate the following research hypothesis:

H₁: As Turkish industrial companies' personnel expenses per employee increase (decrease), their stock prices also increase (decrease).

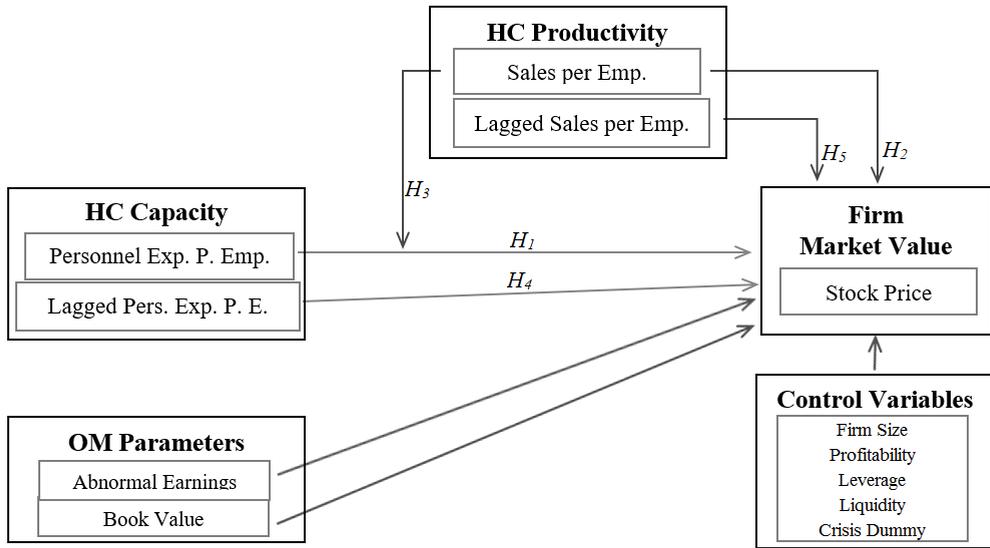
HC theory regards schooling as a way of increasing employee productivity (Wolff, 2000). Employees also improve their productivity by acquiring new abilities in the workplace when applying skills acquired in school or through experience in the previous job(s) (Onkelinx et al., 2016). This increased labor productivity can be measured by sales per employee shown among the most important human resource indicators (Parham and Heling, 2015). Lajili and Zeghal (2005) view this labor productivity indicator as a signal to capital markets illustrating whether a firm is effective in activating its labor force in order to accomplish its corporate goals. In the same way, Samudhram et al. (2014) argue that higher sales per employee can be viewed positively by investors. For this reason, it can be expected that a higher level of sales per employee that indicates higher HC productivity has a positive effect on the market value.

H₂: As Turkish industrial companies' sales per employee increase (decrease), their stock prices also increase (decrease).

Samudhram et al. (2014) argue that personnel expenses in firms with relatively higher labor productivity are probably seen positively by investors, and they may be associated with the higher market valuation. Accordingly, it can be expected that higher employee expenditures may potentially be associated with higher firm value only when higher employee expenditures provide higher employee productivity (i.e. higher sales per employee). Companies often try to attract and retain talented and experienced employees by paying higher salaries and more benefits. In addition, they may increase their level of salaries and benefits in order to reward and motivate their current employees. However, higher salaries may not always lead to a better performance. This HC input (i.e. higher salaries) should somehow turn into an increase in productivity. This increase is only possible if companies can use their employees' strengths effectively. This reasoning allows us to infer something about the way in which these two sub-dimensions work together in their contribution to market value:

H₃: The greater sales per employee in organizations, the stronger the influence of personnel expenses per employee on firms' stock prices in the case of Turkish industrial companies.

Figure 1. Conceptual Model and Hypotheses



Lajili and Zeghal (2006) state that investors seem underestimate the values that arise from the disclosures of quantitative HC-related information. Samudhram et al. (2014) attribute this failure to the possible noise and moderating effects that cause investors to miss signaling indications of disclosed human-related information. In addition, it is also possible that, besides the moderating effect, the lagged effects of the HC indicators may cause investors to miss the signal of indicators. There are scholars who draw attention to this feature of HC. For example, Joia (2000) argues that the hidden time-lag effects must be taken into consideration to eliminate a poor relationship between the degree of intellectual capital and market values. Similarly, Tseng and Goo (2005) point out that one of the characteristics of HC is the effect of time delays, and it takes time to feel the effects of HC investments. Accordingly, it can be assumed that the impact of investments that increase HC capacity on firm performance, and thus the market value, may continue after the investments were made. Additionally, we also wonder if HC productivity could have a lagged effect on the market value. In fact, firms try to increase their HC productivity levels, but visibility of this effect can take time. Therefore, in practice it could be possible that companies can benefit

from the efforts to increase HC productivity in latter times. Lastly, in light of these arguments, we formulate the following research hypotheses:

H₄: It can take time to see the effect of HC capacity on market value; so that Turkish industrial companies' lagged personnel expenses per employee positively affect their current stock prices.

H₅: There may also be lagged effect of HC productivity on market value; so that Turkish industrial companies' lagged sales per employee positively affect their current stock prices

The conceptual model and hypotheses are shown in Figure I.

3. Methodology

3.1. Sample and Variables

The research sample comprises 149 industrial companies traded in the Borsa Istanbul (XUSIN) from 2005 to 2017. We start the sample period from 2005 in Turkey, because inflation accounting started in 2003 and 2004. In addition, 11 different data on related companies were obtained from the Finnet databases (<https://www.finnet.com.tr>) and the companies' financial statement footnotes (from <https://borsaistanbul.com/tr> and <https://www.kap.org.tr/tr>). After subtracting the missing data observations, a total of 1,257 observations remained. The variables are explained in Table 1.

3.2. Empirical Models

For value-relevance studies, Ohlson (1995) and Feltham and Ohlson (1995) model (OM) has become the leading model as OM provides a direct connection between a firm's market value and its fundamental accounting numbers. OM models a firm's market value as a linear function of the book value, the present value of future abnormal earnings, and the other information affecting future abnormal earnings. There are many studies that prove the validity of the OM in various developed and emerging markets (Penman and Sougiannis, 1998; Dechow, Hutton and Sloan 1999; Ota, 2000). To test the value relevance of any accounting variables with control variables, it may be modified as follows:

$$Stock Price_{it} = \beta_0 + \beta_1 Book Value (PS)_{it} + \beta_2 Abnormal Earning (PS)_{it} + \beta_3 Controls_{it} + \varepsilon_{it} \quad (1)$$

As can be seen in equation 1, researchers generally simplify the original OM to make the model appropriate for econometric panel data analysis. They assume that the effects of other information on market value are entirely absorbed by the constant term. But some scholars dispute that ignoring other information due to the difficulties experienced in measurement may deteriorate the fit of OM (Al-Hares et al., 2011; Ota, 2000). Therefore, studies that add diverse fundamental information instead of other information are common in OM literature (Barth et al., 1999; Dechow et al., 1999). In this paper, HC sub-dimensions and their interaction are lagged and added to OM as ‘other information’ to examine whether or not these sub-dimensions have meaningful impact on the firm market value, as follows:

$$Stock Price_{it} = \beta_0 + \beta_1 Book Value (PS)_{it} + \beta_2 Abnormal Earning (PS)_{it} + \beta_3 Human Capital_{it} + \beta_4 Controls_{it} + \varepsilon_{it} \quad (2)$$

Table 1. Research Variables

Variables		Explanation of the Variables
Dependent Variable	Stock Price	It is the closing price of firms' share at the last official release of the annual reports at time $t+1$ (since financial statements at time t do not become publicly available until the release date at time $t+1$)
	Book Value (Per Share)	Shareholder's equity value at time t is divided by ordinary shares outstanding at time t .
Ohlson Model Parameters	Abnormal Earning (Per Share)	Abnormal earning is calculated as follows: $X_t - r_f \cdot bv_{t-1}$ Where X_t is net income at time t ; r_f is cost of equity capital (= risk-free interest rate given risk neutrality); and bv_{t-1} is book value at time $t-1$. Then, abnormal earning in year t is divided by ordinary shares outstanding at time t .
HC Capacity	Personnel	Personnel expenses at time t are divided by the number of

	Expenses Per Employee	employees at time t. These expenses contain all types of related expenses, such as salaries, wages, employee insurance, bonuses, education and training expenses and other employee benefits.
HC Productivity	Sales Per Employee	Net sales at time t are divided by the number of employees at time t.
Control Variables	Firm Size	It is natural logarithm of the total assets at time t of the firm.
	Profitability	Net incomes at time t are divided by net sales at time t.
	Leverage	Total liabilities at time t are divided by shareholder's equity at time t.
	Liquidity	Ratio of current assets to current liabilities.
	Crisis Dummy	It denotes a dummy variable which equals to one for 2008 and to zero otherwise to control the effect of the global financial crisis on the firms' financial performances.

4. Analysis and Results

4.1. Descriptive statistics

Table 2 reports descriptive statistics and correlations of model variables. The table reports that the mean stock price is about 1.5 times of mean book value. On the other hand, the market-to-book value ratio of the American (USA) and European firms is approximately between 3 and 8 (Yu and Zhang, 2008). This means that the difference between market and book values of these companies is more than those in Turkey. Mean abnormal earnings are close to zero. However, in some previous studies this value was negative (e.g., Barth et al., 1999; Gavious and Russ, 2009). Mean personnel expenses per employee (5.142) shows that on average, our sample companies pay their employees about 51,420 TRY per employee. Mean sales per employee is 5.911, which shows that companies gain on average 591,100 TRY per employee.

Table 2. Descriptive statistics and correlations

Variables	Mean	St. Deviation	1	2	3	4	5	6	7	8
1. Stock Price	9.276	14.19	1.00							
2. Book Value	6.071	7.757	0.62*	1.00						

3. Abnormal Earning	0.075	0.867	0.27*	0.20*	1.00					
4. Personnel Exp. P.E.	5.142	2.393	0.27*	0.24*	0.18*	1.00				
5. Sales per Emp.	5.911	4.332	0.21*	0.22*	0.26*	0.60*	1.00			
6. Firm Size	19.75	1.364	0.13*	0.12*	0.20*	0.31*	0.44*	1.00		
7. Profitability	0.057	0.103	0.13*	0.17*	0.56*	0.17*	0.20*	0.18*	1.00	
8. Leverage	0.452	0.212	-0.03	-	-	-0.05	0.04*	0.14*	-	1.00
				0.22*	0.12*				0.53*	
9. Liquidity	2.196	1.542	0.06*	0.14*	0.19*	-0.00	-	-	0.48*	-
						0.09*	0.20*			0.74*

The asterisks indicate statistical significance at the 5% level. Variables are winsorized at the 5th and 95th. Personnel Exp. P.E. and Sales per Emp. are decreased by a factor 10.000 and 1.000.000, respectively, for reporting issues.

Table 2 also presents the correlation matrix results amongst the variables. The table reveals that the stock price is positively and significantly correlated with all variables, except for leverage. As desired, correlation results among variables, excluding the dependent variable, are not too high. Only a slightly higher correlation coefficient between leverage and liquidity (-0.74) is reported. Hence, we utilized variance inflation factors (VIF) to detect if there are any multicollinearity problems among the independent variables. The VIF results (untabulated) are between 1.16 and 2.66, which indicates that there is no collinearity among the variables.

4.2. Multiple Regression Results

To test our research hypotheses, we estimate five models (Model 1 to 5) on a sample of XUSIN companies from 2005 to 2017. Before estimating models, to determine which estimation technique is more appropriate for our data set, we run panel data model specification tests (such as Breusch-Pagan Lagrange Multiplier test, F (Chow) test, and Hausman test). According to unreported results, it would be more appropriate to use the fixed effects estimator (Hereafter FE). Moreover, the FE will allow us to minimize the omitted variable bias by considering unobserved firm-specific effects. Panel data analysis results are presented in Table 3.

Initially, according to the values of F , P , and R^2 , all models in Table 3 are statistically valid, meaning that all models have a statistically significant predictive capability on *stock price*. The coefficients of *book value* and *abnormal earning* are significantly positive in all models. Hence, we confirmed OM’s suitability for stock prices of Turkish industrial companies.

Firstly, the coefficient of *personnel expenses per employee* is positive and statistically significant in almost all models (except Model 4). *Secondly*, the coefficients of *sales per employee* are statistically significant in all models. As a result, according to the findings, Hypothesis 1, which proposes that firms’ personnel expenses per employee positively affect stock prices in Turkish industrial companies and Hypothesis 2, which proposes that firms’ sales per employee positively affect stock prices in Turkish industrial companies, are supported.

Thirdly, in order to test the interaction effect of HC sub-dimensions, we add an interaction term, which is obtained by multiplying HC sub-dimensions by each other, in Model 3. Following Aiken and West (1991), personnel expenses per employee and sales per employee are centered (mean=0) to decrease any multicollinearity. The table report that the coefficient of the interaction term is positive and statistically significant. Tables 3 and 4 also report second F -values (ΔF -value) which test whether adding any variables to a particular model (i.e., change) is statistically significant, or not. ΔF -values of Model 3 in Table 3 (3.27; $P<.10$) and Table 4 (7.88; $P<.01$) indicate that *change R-squares* are statistically significant. As a result, these findings support Hypothesis 3, which suggests that interaction between HC sub-dimensions has a positive effect on stock price in Turkish industrial companies.

Table 3. Panel Data Analysis Results

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Book Value	0.297*** (7.57)	0.261*** (6.11)	0.271*** (6.29)	0.261*** (6.06)	0.285*** (6.56)
Abnormal Earning	2.641*** (10.29)	1.934*** (7.11)	1.931*** (7.11)	1.900*** (6.80)	2.133*** (7.65)
Firm Size	3.706***	0.933*	1.148**	1.203**	1.323**

	(10.03)	(1.79)	(2.14)	(2.22)	(2.50)
Profitability	-	-	-	-7.252**	-
	11.457***	7.994***	8.033***		7.666***
Leverage	(-4.53)	(-2.92)	(-2.94)	(-2.56)	(-2.75)
	3.758*	7.411***	7.326***	5.794***	7.241***
Liquidity	(1.93)	(3.45)	(3.41)	(2.59)	(3.27)
	0.247	0.771***	0.779***	0.682***	0.642***
Crisis Dummy	(1.24)	(3.41)	(3.45)	(2.91)	(2.73)
	-2.844***	-	-	-	-
Personnel Exp. Per Employee		2.970***	3.043***	3.330***	3.006***
	(-5.08)	(-5.01)	(-5.13)	(-5.30)	(-4.80)
Sales per Employee		0.450***	0.453***	-0.136	
		(3.26)	(3.29)	(-0.72)	
Interaction Term		0.476***	0.391***	0.307**	
		(4.07)	(3.11)	(2.14)	
Personnel Exp. Per Emp. _{t-1}			0.044*		
			(1.81)		
Sales per Employee _{t-1}				0.638***	0.600***
				(3.02)	(3.91)
Adjusted R ²				0.137	0.342***
F - value				(0.86)	(2.60)
Observations	0.840	0.876	0.876	0.890	0.883
ΔF-value	53.11***	60.13***	59.87***	62.50***	60.67***
	1,540	1,257	1,257	1,161	1,185
			3.27*		

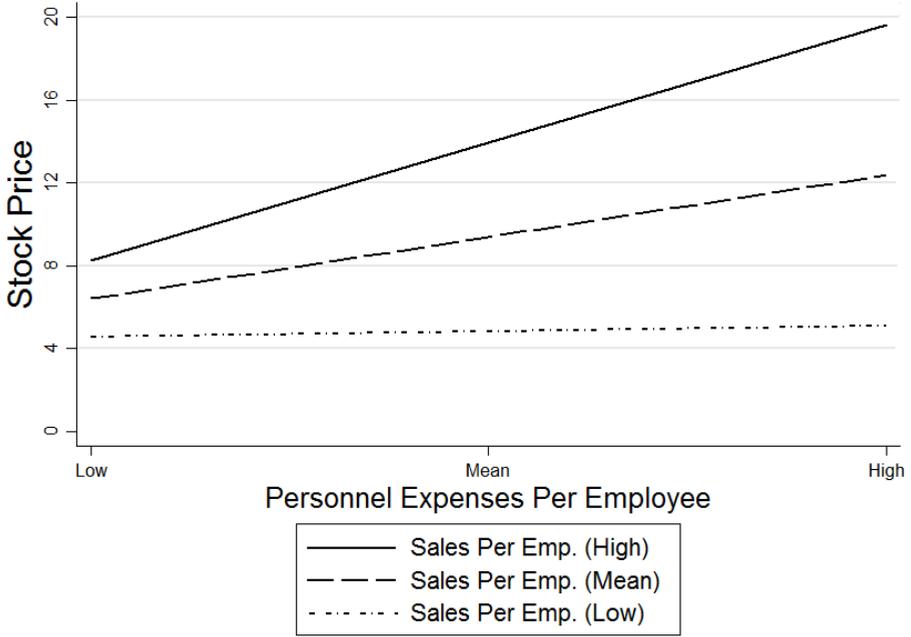
t-statistics are presented in parentheses. Asterisks *, ** and *** indicate two-tailed statistical significance at the 10, 5 and 1 per cent levels, respectively. Constant term is included in the models, but it is not reported in the table. Variables are winsorized at the 5th and 95th percentiles. Personnel Exp. P.E. and Sales P.E. are decreased by a factor 10.000 and 1.000.000, respectively, for reporting issues.

As a robustness check, we also performed some supplementary analyses in order to further back up this finding. Yu (2000) suggests that partial Gram–Schmidt orthogonalization procedure suggested by Burrill (1997) can also be used

for interaction term in order to eliminate multicollinearity. In this method, firstly, a simple interaction term is formed by multiplying two original uncentered variables, and then a regression model in which the simple interaction term is a dependent variable, and the original variables are independent is estimated. Finally, residual of this regression model is used as an orthogonalized interaction term, which has a mean zero and correlates zero with original variables (Burrill, 1997). According to the untabulated results, this partial Gram–Schmidt orthogonalization procedure produces similar results to our first finding.

To facilitate interpretation of the moderating effect of *sales per employee* on the relation between *personnel expenses per employee* and *stock price*, Figure 2 is plotted. To plot Figure 2, all variables in Model 3, excluding *sales per employee* and *personnel expenses per employee*, were constrained to sample means. However, *sales per employee* and *personnel expenses per employee* took three different values: average value (mean); average value minus one standard deviation (low); and average value plus one standard deviation (high). Figure 2 depicts that the positive effect of *personnel expenses per employee* on *stock price* is stronger when *sales per employee* is higher. Consequently, higher levels of *sales per employee* lead to a greater impact of *personnel expenses per employee* on *stock price*. Thus, Figure 2 re-supports Hypothesis 3.

Figure 2. Moderating Effects of Sales per Employee



Finally, in order to test the temporal dynamics between HC sub-dimensions and firm's value, we predict two different lagged models. Due to possible multicollinearity between lagged and non-lagged variables, Model 4 may be biased.^{‡‡} Therefore, in Model 5, only lagged variables are used while the current level of related variables are not. It is observed that one-year-lagged coefficients of *personnel expenses per employee* are positive and statistically significant in both models, while the coefficient of *sales per employee* is only statistically significant in Model 5. Hence, these results support Hypothesis 4, which proposes that a firm's personnel expenses per employee have a lagged effect on stock prices in Turkish industrial companies and Hypothesis 5, which proposes that a firm's sales per employee have a lagged effect on stock price in Turkish industrial companies.

^{‡‡} The correlation coefficients between current and lagged variables are bigger than 0.94 and VIF values in Model 4 are bigger than 5.

On the other hand, to avoid biased statistical inference it is important to comply with the regression assumptions on residuals (Hoechle, 2007). According to the results of deviation tests of these assumptions (untabulated), heteroscedasticity, autocorrelation, and cross-sectional dependence problems were determined. Therefore, we use a robust estimator for the standard errors, called Driscoll Kraay standard errors. It produces robust and consistent results under heteroscedasticity, autocorrelation, and cross-sectional dependence problems. The results of this regression analysis are reported in Table 4. Our results are similar to those in Table 3 when we use Driscoll Kraay standard errors method.

Overall, our findings indicate that Turkish industrial companies that invest in more HC capacity through wages, salaries, or training and have higher HC productivity are more likely to have higher market value. According to us, this finding is not surprising because of several theoretical and practical reasons: (I) In knowledge-based environments, HC continues to be an important character of organizational competitiveness, economic performance, and innovation (Lim et al., 2010). Increased HC indicates that a firm can effectively utilize its workforce to achieve its corporate goals (Lajili and Zeghal, 2005). Thus, as more educated and skilled people demand higher salaries from firms (Kallunki et al., 2005). Higher HC capacity, such as more talented employees, will probably lead to better performance. (II) This finding is also highly consistent with the findings of previous research, i.e. Lajili and Zeghal (2005) in Canada, Gavius and Russ (2009) in the US. Further, Samudhram et al. (2014) found positive associations between personnel expenses and market values in Malaysian firms that have personnel costs and sales per employee above industry averages. Moreover, Wang and Chang (2005) found a positive impact of sales per employee on firm performance in Taiwan and Yu and Zhang (2008) found a positive impact of sales per employee on firm market value in China. In short, in accordance with the theoretical expectation, it can be considered that HC capacity and productivity are value-relevant because they affect the decisions of related information users.

Table 4. Panel Data Analysis Results with Driscoll-Kraay Standard Errors

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Book Value	0.297***	0.261***	0.271***	0.261***	0.285***

	(4.70)	(4.32)	(4.22)	(4.19)	(5.18)
Abnormal Earning	2.641***	1.934***	1.931***	1.900***	2.133***
	(6.07)	(5.12)	(5.25)	(4.43)	(5.08)
Firm Size	3.706***	0.933	1.148*	1.203*	1.323*
	(7.32)	(1.56)	(1.89)	(1.82)	(1.82)
Profitability	-	-7.994**	-8.033**	-7.252*	-7.666**
	11.457***				
	(-2.90)	(-2.39)	(-2.46)	(-1.90)	(-2.01)
Leverage	3.758**	7.411***	7.326**	5.794**	7.241**
	(2.18)	(2.66)	(2.57)	(2.24)	(2.22)
Liquidity	0.247*	0.771**	0.779**	0.682**	0.642**
	(1.78)	(2.51)	(2.51)	(2.09)	(2.04)
Crisis Dummy	-2.844***	-	-	-	-
		2.970***	3.043***	3.330***	3.006***
	(-4.93)	(-4.92)	(-4.91)	(-5.54)	(-4.63)
Personnel Exp. Per Employee		0.450***	0.453***	-0.136	
		(2.67)	(2.71)	(-0.94)	
Sales per Employee		0.476***	0.391***	0.307***	
		(4.73)	(3.72)	(2.92)	
Interaction Term			0.044***		
			(2.81)		
Personnel Exp. Per Emp. t_{-1}				0.638***	0.600***
				(2.81)	(3.63)
Sales per Employee t_{-1}				0.137	0.342*
				(0.63)	(1.84)
R-squared	0.856	0.891	0.891	0.904	0.898
F - value	3817***	186.6	182.6	418.4	362.7
Observations	1,540	1,257	1,257	1,161	1,185
ΔF -value			7.88***		

*Driscoll Kraay t-statistics (in parentheses). Driscoll Kraay standard error method is used via xtsc command in Stata (Hoechle, 2007). Asterisks *, ** and *** indicate two-tailed statistical significance at the 10, 5 and 1 per cent levels, respectively. Constant term is included in the models, but it is not reported*

in the table. Variables are winsorized at the 5th and 95th percentiles. Personnel Exp. P.E. and Sales P.E. are decreased by a factor 10.000 and 1.000.000, respectively, for reporting issues.

Besides, Lajili and Zeghal (2006) argue that investors fail to take overall advantage of the opportunities, which arise from the disclosures of quantitative HC-based information. In this study, we attributed this failure to the possible interaction and lagged effects, and we reached some important findings. Firstly, we found that interaction between a firm's personnel expenses per employee and sales per employee has a positive effect on stock price of Turkish industrial companies. Therefore, we may conclude that HC sub-dimensions interact with each other and work together in their contribution to market value. This inference seems plausible on the grounds that companies with productive employees may increase their personnel expenses in order to reward and motivate productive ones. Likewise, it is also possible that rewarded employees work more efficiently. Consequently, when the increase in personnel expenditures to reward and motivate current employees and to attract potential ones, is supported by increased productivity, stock value may be further increased.

Lastly, we found that the firm's personnel expenses per employee and sales per employee exhibit lagged effects on stock prices. This finding is rational because one of the intellectual capital characteristics points to the effect of time delays (Tseng and Goo, 2005), and thus, the impact of investments made to increase HC capacity may take time and companies can benefit from the efforts to increase HC productivity in latter times. Therefore, we may conclude that HC capacity and productivity have contemporaneous and lagged effects on the firm value within the context of Turkish industrial companies.

5. Conclusion

Many capital market players are ready to put very high values on corporations that improve their HC (Lim et al., 2010). Therefore, considering HC-related factors in firm valuation models will be a more accurate approach in determining the intrinsic value of today's companies. In this regard, it is necessary to identify and analyze HC internal structure in-depth. In this paper, we examined HC by dividing it into sub-dimensions, and investigated the direct, interaction and lagged connection between HC sub-dimensions and firm's value. Ohlson (1995)

and Feltham and Ohlson (1995) valuation model (OM) is used as a base model on a sample of Borsa Istanbul publicly traded industrial companies from 2005 to 2017. HC sub-dimensions' proxy variables were added to OM as 'other information' to examine whether these sub-dimensions have meaningful information on firm market value. We considered personnel expenses per employee as a proxy for HC capacity and sales per employee as a proxy for HC productivity.

We find that Turkish industrial companies that invest more in HC capacity through wages, salaries or training and have higher HC productivity are more likely to have higher market value. Further, we show that HC sub-dimensions interact with each other and work together in their contribution to market value and they exhibit lagged effects on firm value within the context of Turkish industrial companies. These findings coincide with the arguments of resource-based theory. The theory regards human capital as a source of the sustained competitive advantage because it is valuable, rare, inimitable, and non-substitutable (Barney, 1991; Wright et al., 1994). Thus, a properly developed human resource system and investment in human capital can lead to sustainable competitive advantage and thus higher firm value (De Saá-Pérez and García-Falcón, 2002; Jamal and Saif, 2011). These findings are also in line with the previous research, which reports that human capital has positive effect on firm's value/performance (see for Turkey sample, Daloğlu, 2020; İşseveroğlu and Ercan, 2019; Tunçer and Atan, 2020; Yılmaz and Özer, 2019 and see for other countries sample Lajili et al., 2020; Kuzey et al., 2021; Rahman and Akhter, 2021; Samad, 2020; Shamsuzzoha and Tanaka, 2021; Sisodia et al., 2021; Tran and Vo, 2020).

Based on these findings, it is recommended that firm managers should manage human-related entities more effectively and efficiently to maximize firms' market values and shareholders' wealth in knowledge-based environments. Moreover, companies should not only settle for paying more salaries to their employees but also try to create environments that allow their employees to harmonize their competence, education, experience, and quality features with firm-specific characteristics to increase productivity. We also advise investors and managers to take the temporal and interrelated dynamics of HC sub-dimensions into account.

As a final word, Samudhram et al. (2014) claim that companies gather various HC-related quantitative metrics for internal usage purposes and much of this information is remains undisclosed in external reports. There are also expectations in the capital markets that HC information should appear on the financial statements (Lim et al., 2010). The absence of disclosing detailed information about human capital is the biggest limitation of this study. For example, we have considered average personnel expenses as an indicator of HC capacity since there is not much data shared on education and training expenses, seniority levels and educational status of employees in Turkey. Therefore, firms should disclose more information on human capital, which has been shown to have an impact on market value. All the findings should be assessed by taking the limitations and scope of the study into consideration. For example, a common consensus has not been reached between scholars and practitioners about the conceptual definition, the division into sub-components, and the measurement of HC. This situation has prevented us from creating a general framework. On the other hand, due to selecting only the firms that are traded in the BIST-Industrial Index as a research sample, studying different sectors of different countries with the same method may lead to different results. Therefore, the findings should be evaluated in terms of the firms that are traded in the BIST-Industrial Index during the research period. It must be also noted that other intellectual capital components such as structural / internal / organizational capital and relational / external / customer capital are beyond the scope of this research.

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