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Absorptive capacity and firm's innovation and performance: Meta-analysis

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ABSTRACT

This meta-analysis investigates the relationship between absorptive capacity and firm performance and innovation. It also tests the moderating effects of AC type, performance type, firm size, industry, and time on this relationship. Using 82 studies, the results show that the relationship between AC and firm performance and innovation is positive and significant. While the effect of type of performance on the relationship is positive and significant, the effect of type of AC on the relationship is not significant. The moderating effect of the firm size and industry is dependent on the type of the firm (large/SME) and type of industry. Time is also found to have a positive significant effect on the relationship. Finally, the results show that there are still other moderators that need to be identified.

INTRODUCTION

Cohen and Levinthal (1990) defined absorptive capacity as “the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends” (p.128). Since Cohen and Levinthal introduced it in 1990, absorptive capacity has caught the attention of researchers. These researchers have used absorptive capacity to analyze how firms utilize external knowledge to improve their performance and innovation (Lane & Lubatkin, 1998; Tsai, 2001; George, Zahra, Wheatley, & Khan, 2001, Zahra & George, 2002; Lau & Lo, 2015). For a firm to have a competitive advantage, it needs to acquire an asset of unique internal and external knowledge, which make it necessary for the firms to have a search strategy for obtaining external knowledge. This need has grown sharper with the increasing importance of knowledge in competition (Grimpe & Sofka, 2009; Volberda, Foss & Lyles, 2010).

Due to this importance, research has examined the relationship between absorptive capacity and the firm's performance and innovation (Chen Lin & Chang, 2009; Fosfuri & Tribó, 2008; Zahra & Hayton, 2008; Kostopoulos, Papalexandris, Papachroni & Ioannou, 2011). Based on empirical findings regarding the relationship between absorptive capacity and the innovation and performance, there are inconsistencies that need addressing. Some empirical studies found a positive, high or low relationship (Liao, Tu & Marsillac, E. 2010; Chang et al. 2012; Song, 2015), while other studies found a negative relationship (Park & Rhee, 2012; Larrañeta, González & Aguilar, 2016). So, to what extent does absorptive capacity really affect both innovation and performance? Answering these questions is what this meta-analysis all about.

The inconsistency in the results is what justifies conducting this meta-analysis to explain the extent to which absorptive capacity really influence innovation and performance. This analytical technique is a helpful approach especially when similar studies arrive at different conclusions. It allows combining data from different studies to provide an evaluative summary of the findings that explains how much an input affects the output (Israel & Richter, 2011). It helps reduce the uncertainty resulting from different conclusions and provides a more reliable and clearer account of the nature of the effect absorptive capacity has on innovation and performance at the organizational level. Therefore, the first goal of this study is to conduct a meta-analysis on the relationship between absorptive capacity and firm's performance and innovation for the first time (to my knowledge) through combining 82 studies that link absorptive capacity to innovation and performance. The second goal is to determine to what extent absorptive capacity affects firm's performance and innovation. Thus, this analysis seeks to provide a better understanding of the nature of the relationship absorptive capacity and firm's performance and innovation. Finally, this meta-analysis also tries to identify other constructs that influence this relationship. Therefore, this meta-analysis will contribute to the existing literature on the relationship between absorptive capacity and innovation and performance at the organizational level in two ways. The first contribution is combining a considerable number of studies that link absorptive capacity to both organization performance and organization innovation to determine the average effect of the absorptive capacity on firm's performance and the innovation for the first time. The second contribution is identifying the nature of other variables that may moderate the relationship between the dependent and independent variables. Thus, the study provides an explanation of how these variables affect the interactions the dependent and independent variables based on this comprehensive analysis of 82 empirical studies.

LITERATURE REVIEW

Absorptive capacity as a Dynamic capability

Dynamic capabilities view has caught the attention of researchers in management for many years (Barreto, 2010). As an extension of the resource-based view, Teece and Pisano (1994) introduced the concept to stress two key factors. They used the term "dynamic" to refer to the rapid changes in the environment surrounding the firm and the ability of the firm to strategically respond to those changes. Second, they used the word "capabilities" to refer to the ability of the firm to adapt, assimilate, configure internal and external organizational skills, resources, and functional competences to respond effectively to a changing environment. Teece, Pisano and Shuen (1997) defined dynamic capabilities as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (p.516).

Furthermore, Lawson and Samson (2001) identified two types of dynamic capabilities depending on how knowledge is acquired and developed. The first type is functional capabilities which refer to the firm's ability to develop knowledge internally. The second type is integrative capabilities which refer to the firm's ability to acquire knowledge from external sources and incorporate the new knowledge in its operations. Therefore, Zahra and George (2002) considered absorptive capacity as a dynamic capability that provides the firm with the competence to develop and maintain its competitive advantage. They emphasized the role of potential

absorptive capacity as a source of capabilities that allow the firm to be strategically successful in its ability to adapt and develop in a changing environment. In their argument, they highlighted the importance of acquisition and assimilation capabilities as the two factors that provide the firm with the capability to recognize external knowledge and internalize it. Wang and Ahmed (2007) suggested that dynamic capabilities, in some industries, depends on obtaining new external knowledge, integrating it with existing internal knowledge to build new knowledge. This flexibility allows the firm to constantly build and improve its knowledge and competencies necessary to compete in a changing environment (Zahra & George, 2002).

Absorptive capacity

Firms need to acquire new knowledge that allows them to introduce new products and processes to their markets. However, many firms cannot depend solely on their own capabilities to develop such knowledge internally because of the lack of certain resources and expertise. Thus, the only way for these companies to acquire new knowledge or technology is to obtain it from external sources. Both the acquisition process and intergrading new knowledge from an external source are critical for the firm operations (Stock & Tatikonda, 2004). The firm's ability to identify external sources to acquire, incorporate and exploit new knowledge is described in the literature as absorptive capacity (Grimpe & Sofka, 2009). This notion was introduced defined by Cohen and Levinthal in 1990 as "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" (p.128). Absorptive capacity consists of two different but complementary components: potential absorptive capacity and realized absorptive capacity. Potential absorptive capacity refers to the firm's ability to acquire and assimilate new knowledge, and it includes knowledge acquisition and assimilation. Realized absorptive capacity, on the other hand, refers to the firm's ability to transform and exploit the newly acquired knowledge, and it includes knowledge transformation and exploitation (Zahra & George, 2002).

Acquisition refers to the firms' ability to recognize and obtain new external knowledge that is beneficial for its activities. Assimilation refers to the firm's ability to decode and understand the newly obtained knowledge. On the other hand, transformation refers to the firm's ability to synthesize the existing knowledge and the newly obtained knowledge to produce new knowledge. Exploitation refers to the firm's ability to apply the obtained and transformed knowledge in its activities to gain new competencies (Zahra & George, 2002). However, to effectively develop absorptive capacity, a firm needs to engage a process of accumulating knowledge where new knowledge adds to the prior similar knowledge (Tsai, 2001).

Absorptive capacity and performance and innovation

Researchers have looked at the relationship between absorptive capacity and firm's performance and innovation in many different ways (Ali, Kan & Sarstedt, 2016; Rangus & Slavec, 2017). Some have examined the direct relationship between these variables and used absorptive capacity as the independent variable and performance as the dependent variable (Wales, Parida & Patel, 2013; Flatten, Greve & Brettel, 2011) or innovation as the dependent variable (Belderbos, Gilting &

Suzuki, 2016). Other studies focused on the indirect relationship between these variables and examined how absorptive capacity influence the relationship between other variables and performance and innovation. Therefore, some researchers studied the mediating role of absorptive capacity (Liu, Ke, Wei & Hua, 2013; Ferreras-Méndez, Newell, Fernández-Mesa & Alegre, 2015), and other examined its moderating effect (Zahra & Hayton, 2008; Patel, Kohtamäki, Parida & Wincent, 2015). In this meta-analysis, absorptive capacity is used as the independent variable and innovation and performance are therefore used as the dependent variables.

Absorptive capacity and performance

The observed difference in firms' performances is a core interest of dynamic capabilities view. Thus, how the firm develops and sustains competitive advantage has received a great attention in several studies (Wang and Ahmed, 2007). In fact, many studies provide support for the positive impact of dynamic capabilities on the long-term performance which is measured by market indicators (i.e. market share, absolute sales volume and increase in market share and sales) and financial indicators (i.e. return on equity, profit margin and net profits relative to competition) emphasizing the role of absorptive capacity in determining both the nature and sustainability of a firm's competitive advantage (Wang & Ahmed, 2007). In this regard, knowledge is considered to be a pre-requisite for the firm to develop its competitive advantage. However, not all firms, especially the young ones, have enough to resources and expertise required for developing new knowledge capabilities internally which leads these firms to search for knowledge in external sources through networking and engaging in alliances with other firms that possess such knowledge. Therefore, networking and alliances allow the firm to develop its absorptive capacity which is an important factor in improving its performance (George et al., 2001). So, the ability of the firm to identify new external knowledge is a critical step of having the absorptive capacity. This capability is known as potential absorptive capacity, and it allows the firm to focus on the exploring new external knowledge (Lichtenthaler & Lichtenthaler, 2009). However, for the absorptive capacity to effective and contribute to the firm's performance, it is not enough to acquire and assimilate new knowledge. It requires the firm to acquire, assimilate, transform and apply new knowledge by translating it into new products and processes (Flatten, et al. 2011). Adding realized absorptive capacity to the potential absorptive capacity allows the firm to enhance its ability to sell its new products, increase its business operations efficiency and make it more profitable (Tsai, 2001). Firms that have the required capabilities to recognize and exploit new external knowledge are more likely to achieve higher innovation and performance (George et al., 2001).

Research findings show a positive significant relationship between absorptive capacity and firm's performance. For example, Wales, Parida and Patel (2013) examined the nature of the relationship between absorptive capacity and financial performance. Their findings showed that correlation absorptive capacity and performance was positive and significant. Similarly, Ferreras-Méndez, Newell, Fernández-Mesa, and Alegre (2015) found that the relationship between absorptive capacity and firm's performance was positive and significant. In their study of the relationship between absorptive capacity and performance, Tzokas, Kim, Akbar, and

Al-Dajani (2015) also found that absorptive capacity would lead to better firm' performance with the presence of firm's technological capabilities and customer relationship. Therefore, the following hypothesis is suggested:

- *H1: Absorptive capacity has a positive significant effect on firm's performance.*

Absorptive capacity and innovation

Searching and obtaining external knowledge is becoming one of the major parts of the innovation process (Grimpe & Sofka, 2009). The innovation capability of firms has become an important factor in determining their financial performance and survival probabilities and more firms have increased their focus on obtaining new knowledge from external sources to sustain their innovation (Volberda, Foss & Lyles, 2010). Therefore, many businesses have adapted an open innovation strategy to obtain and exploit external knowledge to maintain their abilities to introduce new products and increase their market shares (Grimpe & Sofka, 2009).

Cohen and Levinthal (1990) described two ways for absorptive capacity to effectively influence firm's innovation performance. The first way is knowledge accumulation. Absorptive capacity accumulation in one period helps the firm accumulate additional knowledge in future. The process increases the firm's ability and readiness to exploit any new external knowledge. Second, the accumulation process endows the firm with the related expertise needed for understanding current knowledge and foreseeing future technological development. Thus, firms with knowledge base related to the new external knowledge are in a better position to absorb new technology that allows them to create new products and find out new solutions. Having high absorptive capacity facilitates the firms' goals to acquire new knowledge and technologies from other firms and exploit it to enhance their innovative capabilities (Tsai, 2001). Therefore, absorptive capacity is a core part of the organization's innovative capabilities (Cohen & Levinthal, 1990).

Most research suggests a high positive correlation between absorptive capacity and firm's innovation. In this regard, Huang, Lin, Wu, and Yu (2015) investigated the effects of both absorptive capacity and autonomous R&D climate on firm's innovation. Their results showed a high positive significant relationship between absorptive capacity and firm's innovation. Ferreras-Méndez et al. (2015) also found that the relationship between absorptive capacity and firm's innovation was positive and significant. Furthermore, Expósito-Langa, Molina-Morales and Tomás-Miquel (2015) found that absorptive capacity had a positive significant effect on firm's innovation. Based on these findings, the following hypothesis is suggested:

- *H2: Absorptive capacity has a positive significant effect on firm's innovation.*

According to Zahra and George (2002), the four dimensions of absorptive capacity interact with each other in a complementary way to create unique dynamic capabilities. However, firms differ in the way they develop and use these four dimensions. This variation affects firms' capabilities to transform and apply new knowledge which leads to different types of competitive advantage. Thus, both types of absorptive capacity are important. Potential absorptive capacity is the means through which firms acquire the external knowledge they need. However, this knowledge cannot be translated into innovation or competitive advantage without

having realized absorptive capacity or the ability to transfer and exploit it (Fousfuri & Tribo, 2008). Thus,

- *H3: Type of absorptive capacity moderates the relationship between absorptive capacity and firm's performance.*
- *H4: Type of absorptive capacity moderates the relationship between absorptive capacity and firm's innovation.*

Since absorptive capacity have positive influence on both innovation and performance (Cohen & Leviathan, 1990; Tsai, 2001), the new levels of innovation and performance will enhance the firm's ability to invest in acquiring new knowledge from external sources and through collaboration with other firms (Wales, Parida & Patel, 2013). The increasing profitability has also a positive impact on the firm's ability to search for new external knowledge.

- *H5: Type performance (financial, innovation, etc.) moderates the relationship between absorptive capacity and firm's innovation.*
- *H6: Type performance (financial, innovation, etc.) moderates the relationship between absorptive capacity and firm's performance.*

Firms with high absorptive capacity, such as large firms, tend to allocate resources to obtain more advanced and complex external knowledge. As a result, when firms become larger, they limit their external knowledge sources to the sources that can provide a high novel and complex knowledge (Guo & Wang, 2014). Large companies have also the ability to possess their own research centers and R&D departments (Massa & Testa, 2008) and thus focus their capabilities on developing new knowledge internally instead of allocating resources for new external knowledge. On the other hand, Massa and Testa (2008), pointed out that small and medium size companies do not have strong external networks and they lack enough resources that allow them to conduct in-house R&D activities. Based on this point of view, the ability of these firms to absorb new external knowledge is limited which reduces these firms' ability to develop a strong effective base of absorptive capacity. However, SMEs are capable of developing networks through aligning with other firms which help them access external knowledge and overcome problems resulting from resource limitations. Thus, SMEs depend more on external sources to develop their innovation capabilities than R&D (Muscio, 2007).

- *H7: The company size moderates the relationship between absorptive capacity and firm's performance.*
- *H8: The company size moderates the relationship between absorptive capacity and firm's innovation.*

The search for external knowledge differs in high-tech firms technological the search patterns in low-tech firms. High-tech firms focus on obtaining technological knowledge from sources such as universities, while low-tech firms focus on acquiring market knowledge from sources such as competitors and customers. This difference in the search for external knowledge affects the absorptive capacity direction and impacts innovation [and performance] in both types of industries (Grimpe & Sofka, 2009). For example, non-R&D intensive firms depend on external sources to obtain their needs of equipment and intermediate goods more than R&D intensive firms. This phenomenon implies that the absorptive capacity has a greater role in low and medium-low tech industries compared to high-tech industries (Som et al., 2013), which affects the firm's innovation and performance. Therefore, the type of industry

effects relationships between absorptive capacity and both innovation and performance.

- *H9: Industry moderates the relationship between absorptive capacity and firm's performance.*
- *H10: Industry moderates the relationship between absorptive capacity and firm's innovation.*

Developing absorptive capacity is a process that occurs over time through knowledge accumulation. "Accumulating absorptive capacity in one period will permit its more efficient accumulation in the next. By having already developed some absorptive capacity in a particular area, a firm may more readily accumulate what additional knowledge it needs in the subsequent periods in order to exploit any critical external knowledge that may become available. Second, the possession of related expertise will permit the firm to better understand and therefore evaluate the import of intermediate technological advances that provide signals as to the eventual merit of a new technological development. These revised expectations, in turn, condition the incentive to invest in absorptive capacity subsequently [...]. These two features of absorptive capacity--cumulativeness and its effect on expectation formation--imply that its development is domain-specific and is a path- or history-dependent" (Cohen & Levinthal, 1990, p. 136). Therefore, time is important in affecting the relationship between absorptive capacity and firm's performance and innovation.

- *H11: Time moderates the relationship between absorptive capacity and firm's performance.*
- *H12: Time moderates the relationship between absorptive capacity and firm's innovation.*

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METHODS

Meta-analysis is an analytic approach that provides more objective and reliable conclusions than individual studies and reduces uncertainty especially when the individual studies' results are not consistent (Egger & Smith, 1997). Thus, this meta-analysis combines and analyzes a number of quantitative studies on the relationship between absorptive capacity and organization performance and organization innovation to help explain the inconsistency in the individual studies results and conclusions. It includes 82 individual quantitative studies that link absorptive capacity to either organization performance or organization innovation or both. To obtain this number of required, various techniques were utilized to find out the relevant studies and extract data in a systematic way. The process required to start with determining the research question, the scope of the search, and identifying the key words that would be used in the search for the relevant studies in different databases.

The preliminary search in EBSCOhost using the key words such as (absorptive capacity and firm performance, absorptive capacity and organization performance, absorptive capacity and firm innovation, and absorptive capacity and firm innovation).the search yielded 49 studies including 31 studies and 18 dissertations. The ABI/INFORM and Google Scholar were used mainly for the forward and backward search. These two techniques led to the detection of a new number of articles. The search in ABI/INFORM yielded a number of articles including some of

the article that had been already retrieved from the EBSCOhost database. Google scholar also was a valuable place to do the back ward and forward search. The total new articles obtained from these two sources was 44 studies.

The coding process was accomplished in two phases. In the first phase, the focus was more on recording data from the obtained articles without applying the inclusion and exclusion criteria. This phase results in 93 articles. In the second phase, the focus was on determining inclusion and exclusion criteria. Thus, in order to include an article, it has to draw a relationship between absorptive capacity and innovation or performance. Second, because this meta-analysis is based on correlation, the article has to report a correlation between the independent variable (absorptive capacity) and the dependent variables (performance or innovation).

All articles that met the two defined criteria were included and those did not meet the same criteria were excluded. This process resulted in the inclusion of 71 articles and the exclusion of 22 articles. The vast majority of the excluded articles did not report the correlation between the analyzed variables. The other articles were not relevant to the topic. However, nine extra relevant articles were included after finding them in Google scholar, which results in a final sample of 82 dependent studies.

Because some studies used types of the absorptive capacity (potential absorptive capacity and realized absorptive capacity) or the four dimensions of absorptive capacity to analyze the relationship between absorptive capacity and organization performance and innovation, I had to treat each type or dimension correlation with organization performance or organization innovation as an independent study. This approach resulted in 153 observations. Each observation, then, was coded either with 0 (for the overall absorptive capacity) or 1 (for the type or dimension) to analyze the effect of the absorptive capacity type on the relationship between the independent and dependent variables. Type of performance was also coded with 0 for general performance and 1 for innovation to assess its effect on the relationship between the dependent and the dependent variables. Both absorptive capacity function (independent, moderator, or mediator) and year of publication are also tested for moderating possible effects.

RESULTS

The simple model

The results of the main effects of meta-analysis model, before considering the effect of the moderators, show that there is a significant effect of the absorptive capacity on both the organization performance and innovation. The confidence interval of the intercept is positive (0.2789 to 0.3474) and the p-value is less than 0.05 ($p\text{-val} < .0001$). Thus, the relationship between the dependent and independent variables is positive and significant.

The random-effect model test of the heterogeneity shows that the I^2 is very high (96.11%) which means that the degree of the absorptive capacity influence on organization performance and organization innovation very considerably between the sample. Thus, the high value of the I^2 and the low p-val ($p\text{-val} < 0.0001$) indicates a strong presence of moderating effects on the relationship between absorptive capacity and organization performance and innovation.

τ^2 (estimated amount of total heterogeneity): 0.0437(SE = 0.0054)
 τ (square root of estimated τ^2 value): 0.2090

I^2 (total heterogeneity / total variability): 96.11%

H^2 (total variability / sampling variability): 25.70

Test for Heterogeneity:

$Q(df = 157) = 6233.1805$, $p\text{-val} < .0001$

Model Results:

estimate	se	zval	pval	ci.lb	ci.ub	
0.3131	0.0175	17.9113	<.0001	0.2789	0.3474	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

> confint(meta.res01)

	estimate	ci.lb	ci.ub
τ^2	0.0437	0.0343	0.0559
τ	0.2090	0.1852	0.2364
$I^2(\%)$	96.1087	95.0988	96.9315
H^2	25.6985	20.4030	32.5888

The full model

The visual examination of the forest plots of the model (the figure 1) after including the five first moderators suggests that there is a significant relationship between the examined variable as the great majority of the studies' estimate effects lie on the same side (the right side) of the no effect line. In fact, only a very few estimate effects are on the left side of the no effect line. However, this does not provide enough information to conclude that all studies on the right side of the no effect line have a homogeneous effect of absorptive capacity (O'Connor, Sargeant & Wang, 2014). In fact, the plots show a high amount of heterogeneity due to the variations in the positions of the estimate effects of the different studies. In other words, the estimate effects of the studies on the right side of the no effect line do not line up vertically on a straight line which means that the magnitude of the estimate effects varies considerably between the studies (Israel & Richter, 2011). Therefore, the visual assessment of the forest plots of the model indicates a strong relationship between absorptive capacity and both organization performance and organization innovation. However, the studies show signs of a high amount of heterogeneity which appears in the high variation in both the average effects across studies.

The statistical results of heterogeneity test, on the other hand, show that the I^2 is still high (94.83%) and the amount of the heterogeneity that can be associated with the presence of the five moderators is only 16.92%. This low number of the R^2 (less than 75%) is an indication of the presence of a moderator or moderators that have a strong effect on the relationship between absorptive capacity and organization performance and innovation. The statistical significant p-value in the residual heterogeneity and moderators' tests confirms the presence of such moderators:

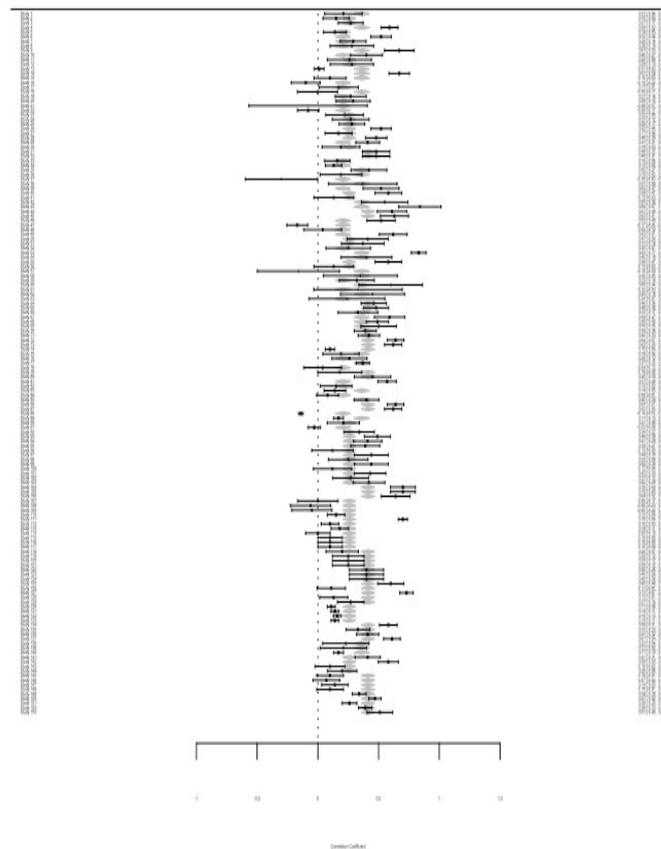
Test for Residual Heterogeneity:

$QE(df = 146) = 3747.2061$, $p\text{-val} < .0001$

Test of Moderators (coefficient(s) 2,3,4,5,6,7,8,9):

$QM(df = 8) = 38.5370$, $p\text{-val} < .0001$

Figure 1



The model results suggest that absorptive capacity has a significant effect on both organization performance and innovation (estimate = 0.3550, z- val = 4.8245, p-val < 0.0001). The range of confidence interval does not include zero (0.2108 to 0.4992), therefore, the influence of absorptive capacity on the organization performance and innovation is positive. Thus, the H1 and H2 are supported.

The results also show that the effect of the factor (mod1), the type of absorptive capacity, on the relationship between absorptive capacity and organization performance is not significant (z-val = 1.2254, p-val > 0.05). The average effect of this factor is 0.0423 and the confidence interval includes zero (-0.0253 to 0.1099). Therefore, the H3 and H4 is not supported. The second moderator, factor (mod2), the type of performance, shows a significant effect on the relationship between absorptive capacity and the two dependent variables (z = 4.8261, p-val < 0.0001). The average effect of the factor (mod2) is positive (0.1651) and the confidence interval is on the right side of the no effect line indicating a positive significant effect (0.0981 to 0.2322). This provides support for the H5 and H6.

The results also show that the organization size has different effects on the relationship between dependent and independent variables depending on the size of the organization. The large size of the organization plays a significant moderating role on the relationship between the dependent and the dependent variables (z = -2.3464, p-val = 0.0190). However, the average effect of this variable is negative (-0.2377). On the other hand, the small and medium sizes show a negative but no

significant effect on the relationship. The average effect is (-0.0921) and the p-val = 0.1808. Thus, the H7 and H8 are partially supported.

In industry, the effect of high-tech industry on the relationship between absorptive capacity and organization performance and innovation is negative but not significant. The average effect is (-0.0575) and the p-val = 0.0919. Thus, the H9 and H10 are not supported.

For time (or date of publication), the effect is positive and significant with the average effect of (0.0341) and p-val = 0.0504 which provides support for H11 and H12.

DISCUSSION

The results of this meta-analysis provide support for the main stream literature that links absorptive capacity with a positive effect on both organization performance and organization innovation. The results also show that type of performance significantly moderates the relationship between the dependent and independent variables. However, type of absorptive capacity does not have any significant influence on the relationship.

One of the important findings reported in this meta-analysis is that large size of firm has a significant negative influence on the relationship between the dependent and independent variables. This finding suggests that as the firm becomes bigger the role of the absorptive capacity in creating better performance and more innovation declines. The main reason for the decline in the importance of external knowledge sources is that large firms focus more on developing new knowledge internally and only target novel external knowledge. This strategy narrows the search scope of these firms. In the long run, the increased costs of acquiring new knowledge negatively affect the firm's performance. As the firm enjoys high levels of absorptive capacity, it increases its search for a higher degree of novelty in the external knowledge which narrows the range of its search. As the novelty in the sources becomes rare, the expenses required for enlarging the search scope increases. The increased absorptive capacity also leads to higher novelty requirements which, in turn, limits the firm's ability to find new knowledge partners who can meet the new novelty requirements. The absorptive capacity, therefore, decreases as the two important factors, investments and alliances, of developing it become less effective (Wales et al. 2013). Moreover, the high costs of assimilation and transformation may lead the firm to connect with knowledge sources that provide knowledge different from what the firm needs. In this case, the firm may not benefit from the advantage of its prior accumulated knowledge especially when the newly acquired knowledge requires capabilities different from what exists in the firm (Wales, Parida & Patel, 2013).

On the other hand, results show a non-significant negative effect of the SMEs on the relationship between the dependent and independent variables. Despite that the SMEs have limit resources compared to large firms, SMEs depend more on external knowledge. This dependence necessitates the involvement of these firms in developing networks through alliances with other firms. Findings also suggest that the importance of absorptive capacity increases over time. This phenomenon can be attributed the rapid development in technology which increases the firms' need for absorptive capacity to maintain their innovativeness and competitive advantage.

Limitations and Future Directions

This study has several limitations. The first, limitation is the high amount of heterogeneity (95%) of the absorptive capacity effects across studies. Second, the R^2 (amount of heterogeneity accounted for) is still very low (16.92%) suggesting that there are still more moderators that need to be detected. Therefore, this meta-analysis does not provide a full explanation for the variation among studies regarding the effect of absorptive capacity on both firm's performance and innovation. Third, the study uses the date of publication as a proxy for the development of absorptive capacity importance over time which may not provide a clear information how absorptive capacity importance evolves from time to time.

Therefore, there are great opportunities for future research investigate other moderators that may affect the relationships between AC and firm's performance and innovation. Moderators that are not included in this study such as employees' AC, firm support for its employees to increase their knowledge and experiences, firm environment etc. may provide a better understanding of relationships between AC and performance and innovation. Finally, researchers can also conduct more longitudinal studies to explore how absorptive capacity importance evolve over time. Such investigations would explain the role of technological advancements in the increasing need for absorptive capacity in all types of firms.

CONCLUSIONS

This meta-analysis has investigated the effect of absorptive capacity on both the firm's performance and innovation. The results show that there is a significant effect of Absorptive capacity on both firm's performance and firm's innovation. This meta-analysis also has tested several moderators that affect the relationship between the independent variable and dependent variables. The results show that effect of types of absorptive capacity on the relationship is not significant while the effect of types of performance on the relationship is significant. However, the results also show that there are still more moderators that need to be identified. Finally, the findings suggest that the need for absorptive capacity increases over time.

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Appendix

Summary

Relation	<i>k</i>	Total sample size	<i>r</i>	SEr	z-val	p-val	95% Confidence Interval		of
							Lower Bound	Upper Bound	
Factor(mod)1	155	71901	0.0423	0.0345	1.2254	0.2204	-0.0253	0.1099	
Factor(mod)2	155	71901	0.1651***	0.0342	4.8261	<.0001	0.0981	0.2322	
Size: large firms	18	2466	-0.2377 *	0.1013	-2.3464	0.0190	-0.4362	-0.0391	
Size: SMEs	135	69435	-0.0921	0.0688	-1.3382	0.1808	-0.2269	0.0428	
Industry: high-tach	64	11400	-0.0575 .	0.0341	-1.6854	0.0919	-0.1243	0.0094	
Year	155	71901	0.0341 .	0.0174	1.9566	0.0504	-0.0001	0.0682	
Function(mod)	73	44312	-0.0203	0.0394	-0.5149	0.6066	-0.0974	0.0569	
Function(mod)	33	12320	-0.0989 *	0.0473	-2.0880	0.0368	-0.1916	-0.0061	

Significance Moderation Effects

p<.1;*p<.05;**p<.01;***p<.001
Factor(mod)1= type of AC; Factor(mod)2= type performance; Function(mod) = when AC is used as mediator; Function(mod) = when is used as moderator

