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The capacity to innovate: A meta analysis of absorptive capacity

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The capacity to innovate: a meta-analysis of absorptive capacity

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ABSTRACT

For nearly 30 years, ACAP has been the bedrock of theories of innovation. A meta-analysis is timely to glean insights from the rich empirical evidence to date and guide future work on the topic. Our meta-analysis of 241 studies reveals that ACAP is a strong predictor of innovation and knowledge transfer, and that its effects on financial performance are fully mediated by these two outcomes. As different from most theoretical discourse, we also find that the firm size-ACAP relationship is positive for small firms but negative for larger firms and that the firm age-ACAP relationship is negative for mature firms and not significant for young firms. Our findings present a clearer picture of the performance implications of ACAP and also suggest the need to revisit traditional theoretical arguments on innovation, especially regarding the causal arguments underlying age and size. These results provoke scholars to revisit traditional assumptions of organizations and their patterns of innovation. Finally, we also take this opportunity to investigate factors that have been commonly considered to be relevant for the ACAP-innovation relationship, as we detail in our additional analysis.

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Introduction

Absorptive capacity, ACAP for brevity, is defined as 'the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends' (Cohen & Levinthal, 1990, p. 128). Since the construct's introduction (Cohen & Levinthal, 1989), studies have considered its applicability not only to innovation (Cohen & Levinthal, 1990), but also to areas such as inter-organizational collaboration and learning (Lane & Lubatkin, 1998), marketing (Xiong & Bharadwaj, 2011), entrepreneurship (Liao, Welsch, & Stoica, 2003), supply chain management (Azadegan, 2011), and international business (Lyles & Salk, 1996). For 30 years ACAP has played, and continues to play, a major role in the innovation literature. The seminal work by Cohen and Levinthal (1990) has been referred to nearly

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9,000 times by articles that have appeared in more than 900 different journals, based on citation data from Web of Science.

In the innovation literature, researchers have debated the role of age and size on the firm's capacity to innovate (e.g., Acs, Audretsch, & Feldman, 1994; Ahuja & Morris Lampert, 2001; Kotha, Zheng, & George, 2011). The arguments offered in these debates stem primarily from more traditional views of organizations, that larger firms have more resources to invest, but that such benefits may be negated by the rigidity of routines in mature firms. Whereas younger firms are flexible to innovate, they often lack resources to invest in ACAP due to their smaller size. There are broad underlying assumptions that smaller firms lack resources, while larger firms have slack resources to invest. Similarly, arguments assume that younger firms are often more purposeful in their direction due to cohesive teams, whereas mature firms are enmeshed in political coalitions or saddled by rigid routines that prevent innovation. Though these are intuitive theoretical arguments, the underlying empirical evidence may differ across studies. We revisit the age and size relationship with a firm's ability to innovate, particularly by viewing the firm's ACAP as the fundamental driver of innovation. Given the nature of the question and nearly 30 years of empirical evidence of these relationships, we use meta-analysis techniques to examine the patterns of relationship between these constructs.

Our traditional views on innovation stem from Schumpeterian arguments, where he asserts that large firms are generally more innovative than their smaller counterparts (Schumpeter, 1934). Subsequent studies suggest that large firms invest more in R&D expenditure (Fisher & Temin, 1973; Shefer & Frenkel, 2005), thereby having a higher capacity than small firms (Cohen & Levinthal, 1990) and are able to navigate the knowledge landscape more effectively (Ahuja & Morris Lampert, 2001). However, others posit that small firms are more adept at acquiring and exploiting knowledge (Acs et al., 1994; Kotha et al., 2011), because they are more proactive in scanning and utilizing external knowledge (Kickul & Gundry, 2002), better integrated with local partners to access useful knowledge (Freel, 2003), and because small firms have less bureaucracy, making them more effective in the coordination of R&D (Damanpour, 1992). Thus, theoretical arguments do not provide any conclusive insight into the relationship between size and ACAP.

Similarly, there is no consensus regarding how firm age relates to ACAP. Some studies indicate that young firms have higher ACAP than mature firms because they are less affected by organizational inertia (Hannan & Freeman, 1984; Huergo & Jaumandreu, 2004), whereas other studies suggest that ACAP is path-dependent and accumulative so that mature firms would have more experience to identify and exploit external knowledge (Cohen & Levinthal, 1990). Even though they are often used as control variables in empirical studies, the implications of organizational age and size for the firm's ability to absorb and exploit knowledge remains unclear.

In addition, prior studies have examined the relationship between ACAP and performance outcomes including innovation, knowledge transfer, and financial performance. Even as it might be expected that ACAP enhances innovation, knowledge transfer, and financial performance, the strength of these relationships, and therefore the conclusion of researchers, might vary by the methods used. More importantly, how these outcomes are interrelated is not clear. What are the first-order performance outcomes of ACAP and which outcomes are more distant? We use meta-analytic structural equation modeling (MASEM) to also provide clarity regarding these relationships.

Our findings reveal insights into fundamental organizational questions of knowledge absorption and exploitation. Whereas we observe no significant association on average between firm size and ACAP, we uncover meaningful differences. Specifically, within small firms there is a positive relationship between firm size and ACAP, but for large firms this relationship is negative. For firm age, we find that the average effect, which is negative, is due primarily to mature firms, whereas we find no association for young firms. Moving on to the performance implications of ACAP, we find that innovation and knowledge transfer mediate the relationship between ACAP and financial performance. The evidence implies that ACAP does not contribute to firm financial performance directly but that the relationship is indirect, as mediated through innovation and knowledge transfer. In addition, we also present findings on often-examined antecedents of organizational innovation and their relationship with ACAP, in the interest of providing a summary of the evidence and recommendations for future research.

The contributions of our study are threefold. First, using meta-analytic correlations and meta-analytic regression analysis (MARA), we clarify the relationship between firm size, firm age, and ACAP. Our findings reveal that ACAP does not necessarily increase as firms accumulate more resources (become larger) or experience (become older), in contrast to what was expected (Cohen & Levinthal, 1990). On examining related factors, we find, instead, that to enhance a firm's ACAP, managers need to consider organizational mechanisms such as those associated with coordination capabilities and socialization capabilities (Jansen, Van Den Bosch, & Volberda, 2005; Volberda, Foss, & Lyles, 2010).

Second, we use structural equation modeling (MASEM) to clarify how ACAP relates to innovation, knowledge transfer, and financial performance, finding that ACAP contributes directly to innovation and knowledge transfer, whereas its impact on financial performance occurs indirectly, as mediated through innovation and knowledge transfer. Our findings imply that, in order to achieve superior financial performance firms firstly need to renew their knowledge base though knowledge transfer and produce more innovative outcomes (Zahra & George, 2002). These results provide support for a capabilities-based argument for strengthening and leveraging ACAP.

Finally, our meta-analytic approach also allows us to summarize research on ACAP and see how the relationships we investigate vary by the methods used. In this regard, among other things, we look into whether: (1) the relationship found between ACAP and innovation, knowledge transfer, or financial performance differs between survey and archival measures of ACAP; and (2) the relationship between ACAP and innovation is different for radical innovation and other kinds of innovation.

Taken together, our study brings together a rich compendium of studies on ACAP to distill fundamental lessons on how age and size influence an organization's capacity to innovate, and its performance implications. By also providing supplemental analyses of related constructs, the study effectively derives empirical insight from over 25 years of research on this important organizational construct.

Theory and hypotheses

In this section, we first briefly review the research on antecedents of ACAP. Then we contrast the arguments and inconsistent findings regarding the relationship between firm size, age, and ACAP. Following this, we move on to discuss the performance implications of ACAP,

by looking into the relationship between ACAP, knowledge transfer, and innovation. Then, we consider the relationship between ACAP and financial performance, where we propose that the relationship between ACAP and financial performance is not direct, but is instead is mediated through the ACAP–innovation and ACAP–knowledge transfer links.

Antecedents of absorptive capacity: the problem of firm size and firm age

Given the key role of ACAP in sustaining firms' innovative performance, researchers have proposed and tested a number of antecedents that can contribute to a firm's ACAP. The antecedents of ACAP can be categorized into three groups: managerial, intra-organizational, and inter-organizational (Volberda et al., 2010). First, managerial antecedents matter to ACAP because managers can assume boundary-spanning roles to monitor the external environment and translate technical information into a form understandable to other members (Cohen & Levinthal, 1990). A firm's capability to synthesize and apply acquired knowledge is impacted by managers' cognitions and dominant logics (Augier & Teece, 2009). Therefore, managerial antecedents include managers' combinative capabilities and managers' cognitive processes and dominant logics (Volberda et al., 2010). Second, at the organizational level, Cohen and Levinthal (1990) suggest that ACAP is largely a function of a firm's prior related knowledge. In addition, organizational mechanisms associated with coordination capabilities (i.e., cross-functional interfaces, participation, and job-rotation) primarily enhance potential ACAP (acquisition and assimilation) whereas organizational mechanisms associated with socialization capabilities (connectedness and socialization tactics) primarily strengthen realized ACAP (transformation and exploitation) (Jansen et al., 2005). Research also shows that firms' performance appraisal systems and training are positively related to their ACAP. Performance appraisal systems provide employees with feedback and guidance to enhance their competencies. Training helps employees to learn desired skills, thereby enhancing the firm's human capital. Third, the diversity and complementarity of external knowledge sources are an important part of inter-organizational antecedents (Zahra & George, 2002). A firm's ability to learn from another is dependent on the similarity of their knowledge bases, organizational structures, compensation policies, and dominant logics (Lane & Lubatkin, 1998).

Even as research on the antecedents of ACAP has proposed consistent and overlapping arguments and findings about most of these antecedents, there is far less agreement on how firm size and firm age, as two fundamental factors that figure widely in research on innovation, are related to a firm's ACAP. Studies have adopted different theoretical lenses such as political coalitions and investment allocation, organizational routines and inertia, resource fungibility, and organizational search processes to bring about contrasting views of how young and mature firms, or small and large firms, differ in their ability to innovate. Central to these discussions is how ACAP varies and is affected by the age and size of the firm. Even though age and size are often used as proxies for adaptiveness or resourcefulness, their ultimate relationship with ACAP remains theoretically and empirically unclear.

*Firm size***.** Volberda et al. (2010, p. 941) note that firm size is a key source of heterogeneity of ACAP and the lack of research on it is surprising. Findings about how firm size can impact ACAP have been mixed. One fundamental tenet of the Schumpeterian hypothesis is that innovation activity is primarily promoted by large firms (Schumpeter, 1934). Subsequent studies endorse this view and suggest that large firms invest more in R&D expenditure

(Fisher & Temin, 1973; Shefer & Frenkel, 2005), thereby making them likely to have higher ACAP than do small firms (Cohen & Levinthal, 1990). However, some researchers do not find any relationship between firm size and ACAP. For example, Cohen, Levin, and Mowery (1987) find that firm size has no statistically detectable effect on a firm's R&D intensity (proxy of ACAP)[1].

In contrast, some scholars even suggest that there would be a negative relationship between firm size and ACAP (Acs et al., 1994), because small firms are more proactive in scanning for and utilizing useful external knowledge (Kickul & Gundry, 2002), better integrated with local partners and can access vital knowledge (Freel, 2003), and also because small firms have less political bureaucracy, making them more effective in the coordination of R&D (Damanpour, 1992). In short, whereas the arguments and findings about other antecedents of ACAP have been much more consistent and mutually reinforcing, this has not been the case for the relationship between firm size and ACAP.

Firm age. As with firm size, there is no consensus either regarding how firm age is related to its ACAP. Some researchers argue that mature firms would have higher ACAP compared to younger firms, because they accumulate experience and establish formalized routines over time (Cohen & Levinthal, 1990; Zahra & George, 2002). Mature firms are more likely to have had the opportunity to build and establish a reputation and status in the inter-organizational network, making older firms more likely to access diverse knowledge sources, in turn also making them more likely to be early movers to identify and acquire useful external knowledge (Nooteboom, 2000). In addition, the higher reputation and status that are likely to be built with age also enables mature firms to access valuable resources in the inter-organizational network to build their ACAP (Tsai, 2001). Mature firms are also more likely to possess superior human capital and advanced human resource management practices, which are beneficial in the scanning of external knowledge, identifying useful knowledge, and assimilating and utilizing such knowledge (Lund Vinding, 2006; Minbaeva, Pedersen, Björkman, Fey, & Park, 2014; Hayton & Zahra, 2005).

In contrast, there is also evidence that young firms have higher innovation capacity (Huergo & Jaumandreu, 2004). Young firms are less affected by organizational inertia, enabling them to act more quickly and easily in responding to useful new knowledge (Hannan & Freeman, 1984; Hansen, 1992; Huergo & Jaumandreu, 2004). Compared to their mature counterparts that are likely to have gridlocked organizational structures, young firms are more flexible and less formalized. This flexibility enables young firms to efficiently use their existing resources to build up their ACAP (Flatten, Greve, & Brettel, 2011). To summarize, as similar to the case for firm size, the arguments and logic that are posited to apply to firm age and ACAP suggest different and, often, opposite implications for the direction of the relationship between firm age and ACAP.

As our brief summary suggests, even as researchers have reached agreement about how a number of antecedents relate to a firm's ACAP, there has not been a similar level of agreement regarding how firm size and age impact ACAP. The resulting lack of quantitative overview presents an obstacle to a better understanding of the crucial role of firm size and firm age, as fundamental factors of long-standing interest in innovation research generally, in producing heterogeneity in the ACAP of firms. Therefore, in looking into the antecedents of ACAP, we focus on the firm size–ACAP and firm age–ACAP relationships in our meta-analysis, even as we also present a summary of our findings about other broadly studied antecedents as well.

Performance implications of absorptive capacity

Absorptive capacity and innovation. Damanpour (1991, p. 556) defined innovation as 'the adoption of an internally generated or purchased device, system, policy, program, process, product, or service that is new to the adopting organization'. He noted that innovation includes both product and process innovations, where product innovations are new products or services introduced to meet an external user or market need, and process innovations are new elements introduced into an organization's production or service operations that are used to create a product or render a service. Birkinshaw, Hamel, and Mol (2008) argue that most innovation research has focused on various aspects of technological innovation, such as product and process innovation. In their review article, they discuss a relatively under-researched type of innovation, which they term management innovation, and define as the 'invention and implementation of a management practice, process, structure, or technique that is new to the state of art and is intended to further organizational goals' (Birkinshaw et al., 2008, p. 825).

ACAP can contribute to a firm's innovative outcomes and performance in innovation in at least two ways. First, ACAP enables a firm to assess the value of external knowledge, acquire external knowledge that is useful, and then to combine such knowledge with its existing knowledge to generate innovation outcomes (Cohen & Levinthal, 1990, p. 141). In this case, ACAP can contribute to a firm's innovation performance by operating as a tool to process useful external knowledge. Second, because knowledge is imperfectly spread across groups and units in an organization (Hargadon & Sutton, 1997), ideas or information from one unit can provide input to another, which can yield innovative outcomes if effective exchanges are made between these units (Cohen & Levinthal, 1990, pp. 131–132). Here, ACAP may contribute to a firm's innovative performance by operating as a pathway for transferring knowledge for cross-organizational innovation activities (Kostopoulos, Papalexandris, Papachroni, & Ioannou, 2011).

By more adeptly processing useful external knowledge and better integrating internally distributed knowledge, a firm can be in a better position to launch new products, refine its processes, or initiate management practices, all of which we expect will improve its innovative outcomes and innovation-related performance. Therefore, we propose that:

> Hypothesis 1: A firm's absorptive capacity is positively related to its innovation (by which we mean both innovation, generally, and also product innovation, process innovation, and management innovation specifically).

Absorptive capacity and knowledge transfer. Knowledge transfer refers to the process through which organizational actors receive and are influenced by the experience and knowledge of others (Argote & Ingram, 2000). Knowledge transfer includes not only the level of external knowledge acquisition, but also the utilization of new knowledge that is acquired (Minbaeva et al., 2014). Knowledge transfer manifests itself through changes in the knowledge base of the receiving firm. A firm's knowledge base plays a dual role in inter-organizational knowledge transfer (Argote & Ingram, 2000). Whereas changes in a firm's knowledge base reflect the outcomes of knowledge transfer, the state of a firm's knowledge base also affects the processes and outcomes of knowledge transfer. The state of the knowledge base represents the firm's level of accumulated prior related knowledge, which influences the firm's capability to assimilate new knowledge from other firms (Cohen & Levinthal, 1990).

According to McGrath and Argote (2001), knowledge is embedded in three basic elements of organizations: members, tools, and tasks. Members are human components of organizations. Tools, including both hardware and software, are the technological component. Tasks reflect the organizations' goal, intentions, and purposes. With these basic elements in mind, knowledge transfer can occur in two ways (Argote & Ingram, 2000). First, knowledge transfer can occur explicitly when members of a receiving firm communicate with members in the other firm. Second, knowledge transfer can occur implicitly when members of a receiving firm understand and imitate the tools and tasks in the other firm. Either of these paths will benefit from the members of the receiving firm's ability to recognize the usefulness of the knowledge, to assimilate it, and to then apply it in the receiving firm. Because both the receiving firm's knowledge base and the skills of members in the receiving firm reflect the receiving firm's ACAP, and will be higher in firms that have higher ACAP, we propose that:

> Hypothesis 2: A firm's absorptive capacity is positively related to its transfer of knowledge [i.e., to its receipt of knowledge as a receiving firm] from other firms.

Absorptive capacity and financial performance. In their seminal work, Cohen and Levinthal (1990) define ACAP as a firm's ability to generate innovation and facilitate learning (as reflected in the title of their study 'Absorptive capacity: A new perspective on learning and innovation'). Consistent with this definition by Cohen and Levinthal (1990), and the arguments we have summarized above in the respective sections, we hypothesized that ACAP is positively related to innovation and knowledge transfer (understood as receiving knowledge from other firms) in Hypotheses 1 and 2. Cohen and Levinthal also note that 'absorptive capacity is intangible and its benefits are indirect' (Cohen & Levinthal, 1990, p. 149). This does suggest that ACAP might not be directly related to tangible financial returns, with its direct benefits being related rather to the generally more intangible outcomes of innovation and knowledge transfer. Zahra and George (2002) draw from the resource-based view and dynamic capabilities to define ACAP as a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability. They suggest that ACAP can 'influence firm performance through product and process innovation' (Zahra & George, 2002, p. 195) and 'play an important role in renewing a firm's knowledge base and the skills necessary in changing markets' (Zahra & George, 2002, p. 196).

Our brief summary above suggests that the two most influential theoretical frameworks about ACAP both indicate that ACAP would be directly related to innovation and knowledge transfer. Returning now to financial performance, we note two broad ways in which a firm can gain tangible financial returns from ACAP. First, the transferred knowledge is embedded in organizational routines, which can help enhance the firm's operation, market reaction, customer service, and product quality, resulting in cost reduction and value creation (Argote & Ingram, 2000; Dhanaraj, Lyles, Steensma, & Tihanyi, 2004; van Wijk, Jansen, & Lyles, 2008). Second, a firm can also gain tangible financial performance by commercializing and marketing innovative products (Narver & Slater, 1990). In this way, by creating additional benefits for buyers or reductions in the buyer's total acquisition and use cost, the firm can convert innovative products to financial return. Since ACAP relates not only to a firm's capability to innovate, but also to its capability to market, and more generally commercialize, products, we hypothesize that:

Hypothesis 3: A firm's absorptive capacity has an indirect positive effect on its financial performance, as mediated through innovation and knowledge transfer.

Data and methods

Literature search and inclusion criteria. We gathered ACAP studies from a variety of sources. First, we conducted an electronic search in the following databases: EBSCO, JSTOR, ScienceDirect, and ProQuest, using the search term 'absorptive capacity'. We did not limit this search to title, abstract, or keywords, casting instead a wide net where the search area was 'anywhere/full text/all text' of the study. We searched for articles that were published between 1989 (Cohen & Levinthal, 1989) and 2017. Second, we also examined the references from the articles identified in the first step to locate additional studies. Third, we searched the PROQUEST Dissertation database and the programs of the annual meetings of the Academy of Management for unpublished work. Fourth, we used Google Scholar to search the articles that are published in top management and innovation journals.

To be included in the meta-analysis, a study needs to report the relationship between firm size and ACAP, between firm age and ACAP, or between ACAP and its performance implications (innovation, knowledge transfer, and financial performance), and also to report a sample size and an effect size (e.g., Pearson's correlation coefficient), or otherwise provide information (e.g., mean, standard deviation, sample size, *t*-test value) that can be used to calculate the effect size. Our final sample includes 241 studies (see Appendix 3).

Coding and variables. The data were coded by two research assistants who were trained for this coding exercise. The two assistants worked separately to complete the coding. Following the suggestion by Schmidt and Hunter (2014), they then compared the completed coding, discussed inconsistencies, and re-examined the affected studies until they reached agreement.

We coded information from studies that used archival-measured (e.g., R&D intensity) ACAP as well as from those that used survey-measured ACAP. Following the meta-analysis by Damanpour (1991), we considered innovation constructs that refer to (a) those that measure technical (product innovation and process innovation) and management innovations together, and (b) those that measure specific types of innovation, including product innovation, process innovation, management innovation, and patents.

The construct of radical innovation is coded as one if a study explicitly mentioned and measured the radical innovation performance or explorative innovation performance of the organizations in its sample, and as zero otherwise.

The financial performance construct includes both perceptual (survey) measures and accounting-based measures (including ROA, ROI, ROS, ROE, Tobin's Q, sales growth, and profitability).

We follow the meta-analysis by van Wijk et al. (2008) to include knowledge transfer, knowledge flows, and knowledge acquisition in our knowledge transfer construct.

Because our sample of studies includes studies that use a panel design as well as those that work with a cross-sectional design, we created a dummy variable to indicate whether the study used a panel design (coded as 1) or a cross-sectional design (coded as 0).

We also coded whether the country that the data of the study come from was a developed country. We use a dummy variable, labeled developed country, for this coding, which is coded as 1 for developed countries and as 0 otherwise.

We coded whether the firms included in the sample are publicly listed firms or not. This dummy variable was coded as 1 if the firms in the sample are public firms, and coded as 0 if they are private firms.

We coded firm size as one if the average number of employees of the sample of a study was more than 50, or if the average annual sales for organizations in the sample of the study was greater than US$50 million. As we also return to later, because some studies use neither employees nor sales, but instead use assets to measure firm size, for these studies we also coded firm size as one if assets were greater than US$50 million (because the cut-off regarding sales is not as common as cut-offs regarding number of employees or sales, we also use US$200 million as an alternative cut-off, with our essential point and findings remaining consistent with either cut-off). Otherwise, we coded firm size as zero.

Since the studies in our sample are from different industries, we use dummy variables to indicate whether the firms in each sample are from low technology industry, high technology, or mixed industry.

The journal impact factor is coded from Journal Citation Reports, which matches the year of the study in which the study in question was published.

We coded firm age as the (average) number of years since the founding of the firms in the sample of the study in question.

To use in our additional analysis, as we will detail later in a separate sub-section, we also coded information about the breadth of external search, social integration mechanisms, knowledge infrastructure, management support, environmental dynamism, competitive intensity, and relational capability. Information on these constructs comes only from those studies where ACAP is measured by surveys, so the value of a construct for each sample was calculated as the average value in that study, normalized by the maximum score on the scale used in the study.

External search breadth is defined as the number of external sources or search channels that firms rely upon in their innovative activities (Laursen & Salter, 2006). Social integration mechanism is measured as the creation of shared identity, the establishment of trusting relationships, and the absence of divisive conflicts between the members within the organization (Zahra & George, 2002). Knowledge infrastructure refers to the technical systems within an organization that influence how knowledge travels throughout the organization and how knowledge is accessed (Gold, Malhotra, & Segars, 2001). Management support is the degree to which top management understands the importance of innovation activities and the extent to which top management takes risks and provides adequate financial resources and other resources to support these activities (Premkumar & Ramamurthy, 1995). Environmental dynamism is the rate of change and instability of the external environment (Dess & Beard, 1984). Dynamic environments are characterized by changes in technologies, variations in customer preferences, and fluctuations in product demand. Competitive intensity captures the degree to which competition is high due to the number of competitors in the market and the lack of potential opportunities for further growth (Barnett, 1997). Finally, relational capability refers to a firm's ability to build close relationships with other firms and utilize resources in its network (Lorenzoni & Lipparini, 1999).

We provide a list and brief description of the variables in Appendix 1 for reference.

Meta-analytic procedures. We employed the procedures suggested by Schmidt and Hunter (2014) for our meta-analysis. To correct for measurement unreliability, we used Cronbach's alpha coefficients reported in the studies. For original studies in which Cronbach's alpha

coefficients were unavailable, we imputed an average Cronbach's alpha coefficient from all the other studies that involve the same construct (as suggested by Schmidt & Hunter, 2014). We used the *metafor* package in R to conduct the meta-analysis (Viechtbauer, 2010). The *metafor* package provides functions to implement all procedures in Schmidt and Hunter's (2014) psychometric meta-analysis (by indicating method = 'HS' in the function). This package also provides functions to check publication bias, perform trim and fill, and generate funnel plots, as we will return to later.

Meta-analytic structural equation modeling (MASEM). To test whether innovation and knowledge transfer mediate the ACAP–financial performance relationship, as we propose in Hypothesis 3, we first calculated the meta-analytic correlations among absorptive capacity, innovation, knowledge transfer, and financial performance. Because our sample does not have enough studies to calculate the meta-analytic correlation for knowledge transfer–innovation relationship and also the knowledge transfer–financial performance relationship, we follow one recent meta-analytic practice (Jeong & Harrison, 2017) and use the meta-analytic correlations from another meta-analytic study. Specifically, we drew the meta-analytic correlations for these two relationships from the meta-analysis by van Wijk et al. (2008). Second, we used the created correlation matrix in AMOS to estimate the structural equation models (SEM). Because the sample sizes for different correlations are not identical, we imputed the sample size for the SEM analysis by calculating the harmonic mean of the correlation sample sizes (Jiang, Lepak, Hu, & Baer, 2012; Karna, Richter, & Riesenkampff, 2015). Compared with the arithmetic mean, the harmonic mean assigns a lower weight to information that comes from studies with large sample sizes, and thus results in more conservative parameter estimates.

Meta-analytic regression analysis (MARA). To investigate factors that can weaken or strengthen the relationships between ACAP and firm size, firm age, innovation, knowledge transfer, and financial performance, we conducted random effect meta-analytic regression analysis, which is a type of weighted least squares regression investigating the relationship between key independent variables and the effect size as the outcome variable (Lipsey & Wilson, 2001). In random-effects meta-regression, effect sizes are weighted by the differences in precision (inverse variance weights).[2] The inverse variance of an effect size is the inverse of its squared standard error and the random effects variance component. We used a STATA macro developed by Lipsey and Wilson (2001) to conduct this analysis.

Results

In this section, we first briefly discuss the meta-analytic correlations between firm size and ACAP and between firm age and ACAP. Then we present the results between ACAP and its performance implications: innovation (Hypothesis 1), knowledge transfer (Hypothesis 2), and financial performance. Following this, we present our meta-analytic structural equation modeling (MASEM) results (Hypothesis 3). Finally, we discuss the meta-analytic regression analysis (MARA) results.

Meta-analytic correlation results

Table 1 summarizes the meta-analytic correlations between firm size and ACAP. Whereas the overall relationship between firm size and ACAP is not significant ($r_c = -0.004$, $p = .809$), subgroup analysis suggests that this relationship is positive and significant ($r_c = 0.081$, $p = .067$)

Table 1. Meta-analytic results for relationship between firm size and ACAP.

Subgroups	*k*	*N*	r_c	*p*-value	−95% CI	+95% CI
all firms	146	91,551	−0.004	0.809	−0.039	0.031
non-small firms (assets cut-off = 50*)	102	73,086	−0.040	0.057	−0.080	0.001
small firms (assets cut-off = 50)	42	18,105	0.081	0.067	−0.006	0.168
non-small firms (assets cut-off = 200)	101	72,871	−0.041	0.049	−0.082	0.000
small firms (assets cut-off = 200)	43	18,320	0.082	0.060	−0.003	0.168
public firms	23	7356	−0.122	0.003	−0.204	−0.041
private firms	123	84,195	0.018	0.319	−0.018	0.055
high-tech firms	46	10,970	−0.014	0.706	−0.084	0.057
low-tech firms	59	41,012	0.029	0.203	−0.016	0.075
mixed industry firms	41	39,569	−0.042	0.343	−0.128	0.045

Notes: k = number of correlations; *N* = total sample size; r_c = sample size weighted mean effect size corrected for unreliability; 95% CI = 95% confidence intervals around the mean correlation.
*the unit is $US million.

for small firms and negative and significant for non-small firms (r_c = −0.040, p = .057). Because our data include studies that use firm assets to measure firm size, we used multiple cut-off points between $US50 and 200 million to distinguish between small and non-small firms, using these two end points in presenting our results to demonstrate consistency. The results for small firms and non-small firms, in terms of the direction and significance of the relationship between firm size and ACAP, do not change with other cut-offs for firm size between US$50 million and US$200 million for firm assets. In addition, we note that the correlation for private firms is not significant (r_c = 0.018, p = .319), whereas for public firms it is negative and significant (r_c = -0.122, p = .003). We return to this difference later, in our discussion section. Our sub-group analysis does not reveal differences between industries, when they are considered in terms of the broad categories of low-tech, high-tech, or mixed.

Table 2 summarizes the meta-analytic correlations for the relationship between firm age and ACAP. The overall correlation between firm age and ACAP is negative and significant (r_c = −0.040, p = .006). However, the subgroup analysis also reveals differences here between young firms and non-young firms. We use either 5 years or 10 years as a cut-off point to differentiate young firms from non-young firms (the results are the same, in terms of the direction and significance if we use 7 years). In either case, the correlation is negative and significant for non-young firms (r_c = −0.046, p = .004), whereas the correlation is not significant for young firms (r_c = 0.013, p = .801). In addition, we also see that the correlation is negative and significant for private firms (r_c = −0.032, p = .022), but it is not significant for public firms (r_c = −0.097, p = .248).

Table 3 summarizes the meta-analytic correlations between ACAP and its performance implications. Because these studies measure absorptive capacity by either archival proxies or via surveys, we conducted our meta-analysis separately for each of these sets of studies, as based on their measurement of absorptive capacity.

In Hypothesis 1, we proposed that a firm's absorptive capacity is positively related to its innovative performance. In Table 3, we see that the ACAP–innovation relationship is positive and significant (p < .05), regardless of the measure of absorptive capacity or the type of innovation that is considered. Hypothesis 1 is supported.

In Hypothesis 2, we proposed that a firm's ACAP is positively related to its knowledge transfer performance. We see in Table 3 that the meta-analytic correlation between ACAP and knowledge transfer is positive and significant (r_c = 0.394, p < .001). Hypothesis 2 is supported.

Table 2. Meta-analytic results for relationship between firm age and ACAP.

Subgroups	*k*	*N*	r_c	*p*-value	−95% CI	+95% CI
all firms	82	31,730	−0.040	0.006	−0.069	−0.012
non-young firms (cut off = 5*)	64	28,110	−0.046	0.004	−0.077	−0.015
young firms (cut off = 5)	13	3239	0.013	0.801	−0.088	0.113
non-young firms (cut off = 10)	50	15,333	−0.059	0.040	−0.115	−0.003
young firms (cut off = 10)	27	16,016	0.004	0.851	−0.036	0.044
public firms	7	1697	−0.097	0.248	−0.262	0.068
private firms	59	30,033	−0.032	0.022	−0.060	−0.005

Notes: k = number of correlations; *N* = total sample size; r_c = sample size weighted mean effect size corrected for unreliability; 95% CI = 95% confidence intervals around the mean correlation.
*the unit is year.

Table 3. Consequences of ACAP.

Measure of ACAP	Consequences	Factors	Data	*k*	*N*	r_c	*p*-value	95% CI Lower	95% CI Upper
Archival proxies	Innovative performance	Innovation	all	55	62,019	0.135	0.000	0.094	0.176
			P	19	55,524	0.041	0.015	0.013	0.069
			CS	36	6495	0.200	0.000	0.124	0.276
		Product innovation	all	29	17,788	0.172	0.000	0.123	0.223
			CS	26	10,055	0.158	0.000	0.100	0.218
	Financial performance	Financial performance (Accounting-based*)	all	38	41,139	−0.005	0.935	−0.117	0.108
			P	10	33,240	−0.096	0.408	−0.322	0.131
			CS	28	7899	0.028	0.497	−0.053	0.110
Survey	Innovative performance	Innovation		51	12,163	0.476	0.000	0.410	0.542
		Product innovation		27	24,947	0.529	0.000	0.443	0.615
		Process innovation		7	6472	0.588	0.000	0.416	0.761
		Management innovation		5	5509	0.636	0.000	0.412	0.860
	Knowledge transfer			37	7953	0.394	0.000	0.322	0.466
	Financial performance	Financial performance (Perceptual)		26	7542	0.364	0.000	0.291	0.438
		Financial performance (Accounting-based*)		12	2160	0.171	0.004	0.053	0.288

Notes: all = all data from all samples (i.e., cross sectional and panel); CS = cross-sectional data; P = panel data; k = number of correlations; *N* = total sample size; r_c = sample size weighted mean effect size corrected for unreliability; 95% CI = 95% confidence intervals around the mean correlation.
*Accounting-based financial performance includes ROA, ROI, ROS, ROE, Tobin's Q, sales growth, and profitability. Data from survey-measured ACAP studies are all cross-sectional data.

The relationship between absorptive capacity and accounting-based financial performance is not significant when we consider studies that use archival proxies to measure absorptive capacity (r_c = -0.005, p = .935). However, this same relationship, between absorptive capacity and financial performance (for both perceptual measures (r_c = 0.364, p < .001) and accounting-based measures (r_c = 0.171, p = .004)), is positive and significant when ACAP is measured by surveys. As these results suggest, the support for the ACAP–financial performance relationship is mixed.

Meta-analytic structural equation modeling (MASEM) results

The MASEM results, which we use to investigate the indirect (mediated) relationship we propose in Hypothesis 3, are shown in Tables 4 and 5. We note that this model has a good model fit (GFI = 1, CFI = 1, RMR = 0). The results suggest that the direct relationship

Table 4. Direct relationship between ACAP and financial performance.

Relationship			Estimate	*S.E.*	*p*
ACAP	to	Financial performance	.127	.012	<.001

Table 5. Mediation relationship between ACAP and financial performance.

Relationship			Estimate	*SE*	*p*
ACAP	to	Innovation	.370	.011	<.001
ACAP	to	Knowledge transfer	.394	.011	<.001
Innovation	to	Financial performance	.207	.012	<.001
ACAP	to	Financial performance	.005	.013	.724
Knowledge transfer	to	Financial performance	.133	.012	<.001

Notes: Sobel test for innovation (as a mediator for the link between ACAP and financial performance): $z = 15.34$, $p < .001$. Sobel test for knowledge transfer (as a mediator for the relationship between ACAP and financial performance): $z = 10.58$, $p < .001$.

between ACAP and financial performance, before considering any possible mediation – or indirect effects, is positive and significant ($b = 0.127$, $p < .001$). However, we see that, once we take innovation and knowledge transfer into account, the direct relationship between ACAP and financial performance relationship is no longer significant ($b = 0.005$, $p = .724$), which implies that innovation and knowledge transfer fully mediate the ACAP–financial performance relationship. The Sobel test results also indicate that both innovation and knowledge transfer significantly mediate the ACAP-financial performance relationship ($p < .001$). These results provide evidence to support Hypothesis 3, that the ACAP–financial performance relationship is mediated through innovation and knowledge transfer.

Meta-analytic regression analysis (MARA) results

Table 6 presents the MARA results that predict the correlation between firm size and ACAP. The results suggest that the correlation between firm size and ACAP is weaker for public firms than it is for private firms ($b = -0.237$, $p < .01$). In addition, we also see that the correlation between firm size and ACAP is stronger when ACAP is measured by surveys than when ACAP is measured by archival proxies ($b = 0.105$, $p < .05$).

Table 7 displays the MARA results that predict the firm age–ACAP correlation. Similar to the results for the firm size–ACAP correlation, we see that the correlation between firm age and ACAP is weaker for public firms than it is for private firms ($b = -0.126$, $p < .10$). The correlation between firm age and ACAP is stronger when ACAP is measured by surveys than when ACAP is measured by archival proxies ($b = 0.125$, $p < .05$) (Figure 1).

As we have noted, in Tables 6 and 7 we see that the firm size–ACAP and firm age–ACAP correlations are stronger when ACAP is measured by surveys than when ACAP is measured by archival proxies. In Tables 8, 9, and 10, we observe, similarly, that when ACAP is survey-measured the ACAP–innovation, ACAP–knowledge transfer, and ACAP–financial performance relationships are stronger (or positively moderated) ($p < .01$). Finally, in Table 8, we also see that the ACAP–innovation relationship is weaker when innovation is radical than when innovation is non-radical (or incremental) ($b = -0.167$, $p < .01$).

Table 6. Meta-analytic regression results (DV: correlation between firm size and ACAP).

	(1)	(2)	(3)	(4)
ACAP measured by survey	0.105*	0.093*	0.090^{+}	0.090^{+}
	(0.041)	(0.041)	(0.046)	(0.048)
Public firm	−0.237**	−0.233**	−0.347**	−0.346**
	(0.061)	(0.061)	(0.074)	(0.068)
Panel design	0.119*	0.115*	0.133^{+}	0.133^{+}
	(0.055)	(0.055)	(0.075)	(0. 075)
Median year of sample	0.003	0.002	0.008	0.008
	(0.003)	(0.003)	(0.005)	(0.005)
High technology industry	−0.026	−0.037	−0.075	−0.075
	(0.042)	(0.042)	(0.054)	(0.055)
Mixed industry	−0.099*	−0.094*	−0.124**	−0.123**
	(0.043)	(0.041)	(0.048)	(0.048)
Developed country	0.077	0.066	0.190**	0.190**
	(0.049)	(0.050)	(0.059)	(0.056)
Firm size measured by assets	0.131*	0.151*	0.210**	0.211**
	(0.065)	(0.068)	(0.077)	(0.078)
Firm size measured by sales	−0.079	−0.059	0.045	0.045
	(0.056)	(0.058)	(0.078)	(0.079)
Journal impact factor	−0.015	−0.010	−0.022	−0.022
	(0.012)	(0.012)	(0.014)	(0.014)
Firm size		−0.092*		−0.002
		(0.015)		(0.058)
Firm age			−0.003*	−0.003^{+}
			(0.001)	(0.001)
Constant	−5.633	−4.632	−16.185	−16.196
	(6.945)	(6.977)	(9.921)	(10.005)
N	140	138	74	74

Note: Standard errors in parentheses.
$^{+}p < .10$; $*p < .05$; $**p < .01$. All tests are two-tailed.

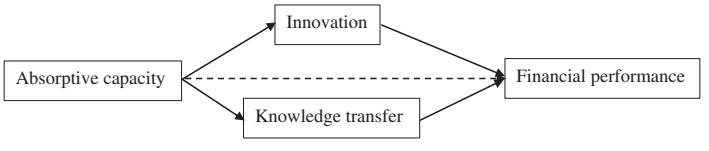

Figure 1. MASEM model to test the interrelationship between ACAP and performance implications.

Additional analysis

To the extent our data allow, we also investigate factors that have been commonly considered to be relevant for ACAP and more specifically to the ACAP–innovation relationship. We present the results of this additional analysis in Table 11. Because the number of studies that present the required data for us to investigate these relationships is generally very

Table 7. Meta-analytic regression results (DV: correlation between firm age and ACAP).

	(1)	(2)	(3)
ACAP measured by survey	0.125*	0.098^{+}	0.134*
	(0.055)	(0.053)	(0.053)
Public firm	−0.126^{+}	−0.144^{+}	−0.150^{+}
	(0.075)	(0.084)	(0.080)
Panel design	0.054	0.067	0.065
	(0.076)	(0.086)	(0.082)
Median year of sample	−0.006	−0.005	−0.008
	(0.005)	(0.005)	(0.005)
Developed country	0.052	0.058	0.059
	(0.062)	(0.066)	(0.064)
High technology industry	−0.025	0.003	−0.014
	(0.055)	(0.059)	(0.058)
Mixed industry	−0.050	−0.038	−0.052
	(0.055)	(0.059)	(0.058)
Journal impact factor	0.010	0.014	0.009
	(0.014)	(0.016)	(0.015)
Firm age	−0.027		−0.036
	(0.062)		(0.074)
Firm size		0.028	0.024
		(0.063)	(0.066)
Constant	12.680	10.608	15.823
	(10.147)	(10.985)	(10.768)
N	74	74	70

Note: Standard errors in parentheses.
$^{+}p < .10$; $^{*}p < .05$; $^{**}p < .01$. All tests are two-tailed.

small, we present – with one exception – models that look into each of these factors on its own. Our intention here is not to test specific predictions but rather present results that might be useful in considering the body of evidence on ACAP, and specifically the ACAP to innovation relationship, and provide relevant information for future studies.

First, we do not find a significant association between the breadth of external search and the relationship between ACAP and innovation (model 1 in Table 11). Breadth of external search might in fact be important for the relationship between ACAP and innovation, but perhaps this relationship is moderated in different ways by other factors. Thus the absence of a significant relationship on average might suggest that future research might benefit from looking into such moderation. The same is true of competitive intensity, for which we do not observe a significant association with ACAP–innovation (model 6 in Table 11). However, we emphasize that the number of observations here are smaller ($n = 9$) as compared to the case for the breadth of external search ($n = 34$).

Second, we observe that social integration mechanisms ($b = 0.897$, $p < .05$, $n = 22$), knowledge infrastructure ($b = 1.565$, $p < .10$, $n = 5$), management support ($b = 0.568$, $p < .01$, $n = 9$), and relational capability ($b = 1.400$, $p < .01$, $n = 3$) all have a positive and significant impact on the relationship between ACAP and innovation (models 2, 3, 4, and 7 in Table 11).

Table 8. Meta-analytic regression results (DV: correlation between ACAP and innovation).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ACAP measured by survey	0.296**		0.287**	0.287**	0.206**	0.274**	0.272**
	(0.029)		(0.028)	(0.034)	(0.035)	(0.045)	(0.046)
Radical innovation		−0.167**	−0.113**	−0.088**	−0.055	−0.070	−0.062
		(0.054)	(0.042)	(0.043)	(0.040)	(0.047)	(0.048)
Panel design				−0.120*	−0.120**	−0.108^{+}	−0.101^{+}
				(0.046)	(0.043)	(0.057)	(0.058)
Median year of sample				−0.004	−0.005	−0.006	−0.007
				(0.003)	(0.003)	(0.005)	(0.005)
Management innovation				0.080	0.008		
				(0.082)	(0.147)		
Process innovation				−0.012	−0.103	−0.143	−0.140
				(0.056)	(0.067)	(0.114)	(0.116)
Product innovation				0.009	0.032	0.021	0.021
				(0.037)	(0.039)	(0.065)	(0.066)
High technology industry				0.005	−0.032	0.014	0.023
				(0.037)	(0.040)	(0.062)	(0.064)
Mixed industry				−0.048	−0.069^{+}	−0.119^{+}	−0.119^{+}
				(0.035)	(0.036)	(0.059)	(0.061)
Journal impact factor				−0.018^{+}	0.002	−0.014	−0.014
				(0.011)	(0.012)	(0.015)	(0.016)
Developed country				−0.022	−0.013	−0.039	−0.046
				(0.041)	(0.047)	(0.056)	(0.058)
Firm size					−0.090*		−0.031
					(0.034)		(0.062)
Firm age						0.000	0.001
						(0.001)	(0.001)
Constant	0.144**	0.327**	0.163**	7.805	10.122^{+}	13.124	13.800
	(0.021)	(0.019)	(0.022)	(5.968)	(6.088)	(10.316)	(10.566)
N	165	165	165	163	112	59	58

Note: Standard errors in parentheses.
$^{+}p < .10$; $*p < .05$; $**p < .01$. All tests are two-tailed.

While these relationships are indicative, coming from estimations with just the one predictor and sometimes from small samples (within the MARA approach, where each observation refers to one study, even as the information provided comes from hundreds of observations), they nevertheless suggest that these might be effective levers to improve the relationship between a firm's level of ACAP and innovative performance. Researchers and practitioners would both benefit from more work to get a clearer representation of the mechanisms, thus enabling organizations to be even more effective in leveraging these factors to strengthen the link between ACAP and innovation.

Third, environmental dynamism ($b = -1.476$, $p < .10$, $n = 7$) has a marginally significant negative association with the ACAP–innovation relationship (model 5 in Table 11), which implies that it might be more difficult for firms to achieve a stronger coupling between a

Table 9. Meta-analytic regression results (DV: correlation between ACAP and knowledge transfer).

	(1)	(2)	(3)	(4)	(5)
ACAP measured by survey	0.298**	0.250**	0.262+	0.433	4.038*
	(0.059)	(0.062)	(0.063)	(0.369)	(1.62)
Median year of sample		0.008+	−0.006	0.011	−0.239*
		(0.005)	(0.012)	(0.031)	(0.113)
High technology industry		−0.029	−0.208*	−0.027	0.615+
		(0.073)	(0.099)	(0.174)	(0.331)
Mixed industry		−0.012	0.046	0.249+	1.302**
		(0.057)	(0.100)	(0.138)	(0.481)
Journal impact factor		0.004	−0.000	−0.042+	−0.334*
		(0.016)	(0.029)	(0.024)	(0.129)
Firm size			−0.021		0.741*
			(0.098)		(0.325)
Firm age				−0.015**	−0.027**
				(0.005)	(0.008)
Constant	0.093	−16.652	12.269	−22.512	476.292
	(0.058)	(9.504)	(13.381)	(62.338)	(227.158)
N	37	37	14	8	8

Note: Standard errors in parentheses.
+$p < .10$; *$p < .05$; ** $p < .01$. All tests are two-tailed.

Table 10. Meta-analytic regression results (DV: correlation between ACAP and financial performance).

	(1)	(2)	(3)	(4)	(5)
ACAP measured by survey	0.269**	0.183**	0.172**	0.278**	0.241**
	(0.048)	(0.066)	(0.065)	(0.087)	(0.062)
Panel design		−0.126+	−0.150*	0.019	−0.006
		(0.073)	(0.066)	(0.208)	(0.147)
Median year of sample		0.007	0.008	0.002	−0.009
		(0.006)	(0.005)	(0.010)	(0.008)
High technology industry		−0.112*	−0.168**	−0.210**	−0.094+
		(0.053)	(0.060)	(0.069)	(0.052)
Mixed industry		0.008	−0.000	−0.077	0.066
		(0.063)	(0.074)	(0.120)	(0.107)
Journal impact factor		−0.021	−0.035*	−0.031+	−0.047*
		(0.014)	(0.015)	(0.019)	(0.013)
Firm size			−0.107*		0.129*
			(0.053)		(0.064)
Firm age				0.000	−0.001
				(0.003)	(0.003)
Constant	−0.007	−14.350	−15.535	−4.165	17.469
	(0.034)	(11.018)	(10.853)	(20.371)	(16.420)
N	76	76	51	26	23

Note: Standard errors in parentheses.
+$p < .10$; *$p < .05$; **$p < .01$. All tests are two-tailed.

Table 11. Meta-analytic (MARA) regression results that predict the bivariate correlation between ACAP and innovation.

Model	Variable	Coefficient	Observations
1	Breadth of external search	0.124 (0.144)	34
	Constant	0.170** (0.063)	
2	Social integration mechanism	0.897* (0.350)	22
	Constant	−0.252 (0.227)	
3	Knowledge infrastructure	1.565^{+} (0.926)	5
	Constant	−0.731 (0.695)	
4	Management support	0.568** (0.198)	9
	Constant	0.039 (0.135)	
5	Environmental dynamism	−1.476^{+} (0.786)	7
	Constant	1.061* (0.475)	
6	Competitive intensity	−0.681 (1.039)	9
	Constant	0.751 (0.683)	
7	Relational capability	1.400* (0.567)	3
	Constant	−0.487 (0.364)	

Notes:Each model includes one predictor and a constant, due to the generally small samples. Each observation represents one study. Values in parentheses are standard errors.
$^{+}p < .10$; $*p < .05$; $**p < .01$. All tests are two-tailed.

given level of ACAP and the innovative outcomes that yields, when the external environment (e.g., technology trends and customer demands) is changing more quickly.

*Publication bias***.** To investigate whether our sample provides a fair representation of the general population of ACAP studies, we looked into publication bias. We used the 'trim and fill' method of publication bias detection (Duval & Tweedie, 2000). This method visually captures distortions due to selective reporting as evidenced by an asymmetric funnel graph. A funnel graph is a scatter plot of each study's effect size (correlation coefficient) against some measure of sampling error, such as standard error (which is what we use here) or overall sample size. In cases of publication bias, a funnel graph will have a skewed and asymmetrical shape. The trim and fill method identifies 'asymmetric' studies, imputes their missing counterparts (so as to make them symmetric, which is what would be expected in cases of no publication bias), and after adding these imputed data to a study's database (thereby adjusting for the putative bias), re-estimates effect sizes.

Using this method, it is possible to detect whether, and to what degree, publication bias may be affecting meta-analytic results (Duval & Tweedie, 2000). We used *metafor* package in R to conduct this publication bias check (Viechtbauer, 2010). Following the suggestion by Egger, Smith, Schneider, and Minder (1997), we conducted a publication bias check only for those relationships where we can draw from at least 10 correlations. We present the results of these publication bias checks and the funnel plots in Appendix 2. While we find no evidence of publication bias for seven relationships, the results indicate the presence of publication bias for three relationships. However, we see that even after the relevant data imputation, the weak or non-significant relationships remain weak or non-significant and correlations that are moderate or strong likewise remain in these ranges after the data imputation to adjust for any detected bias.

Discussion

In the three decades since Cohen and Levinthal (1989) proposed the concept of absorptive capacity, researchers have examined and applied this concept quantitatively and qualitatively

in a large number of studies to investigate in a broad range of different areas. By aggregating the empirical evidence, we investigated two questions: (1) How do firm size and firm age relate to a firm's ACAP? (2) How are the performance implications of ACAP interrelated?

Our main findings are that: (a) the firm size–ACAP relationship is positive and significant for small firms and negative and nonsignificant for non-small firms (Table 1); (b) the firm age–ACAP relationship is negative and significant for mature firms, but not significant for young firms (Table 2); and (c) the ACAP–financial performance relationship is indirect, as mediated by innovation and knowledge transfer (Tables 4 and 5). In addition, the relationships between ACAP and its antecedents and performance implications are stronger when ACAP is measured by surveys than when ACAP is measured by archival proxies.

Firm size and absorptive capacity. Firm size is widely used as a control variable in ACAP and innovation studies because of the suggestion that, having more resources than small firms, large firms are in a better position to build their ACAP. As we report in Table 1, our meta-analytic results suggest that the overall relationship between firm size and ACAP is not significant. The subgroup analysis, however, suggests that this relationship is positive and significant for small firms but negative and significant for non-small firms. This finding suggests that firms' ACAP does not necessarily increase with their size. Small firms can efficiently utilize additional resources to build up their ACAP, to the point where they are still considered small firms and therefore have the associated benefits that come with being small. But once firms are already large, the additional factors that come with increasing size impede their ACAP. To explain the heterogeneity in firms' ACAP, Lewin, Massini, and Peeters (2011) proposed the microfoundations of ACAP routines. They suggest that ACAP routines include facilitating variation and selection regimes, sharing knowledge across the firm, and reflecting on, updating, and replacing old practices.

We speculate that for small firms, the positive relationship between firm size and ACAP may be because of the following reasons. First, an increase in employee numbers helps generate more new ideas within the firm. Second, as firm size increases, the firm can allocate more resources to explore different ideas. Third, as the number of employees increases, different employees are likely to have different expertise. When employees with diverse knowledge backgrounds share their knowledge with other members, such knowledge recombination will generate more novel ideas. Finally, since even with the increases in size we consider here the firm still remains small, employees can effectively communicate with each other, and it is easy for employees to search for useful information within the firm.

For non-small firms, even as the number of new ideas might still increase as firm size grows, the negative relationship between firm size and ACAP may arise due to the difficulty of coordination and socialization, which dampens knowledge sharing and knowledge search within the firm. To alleviate this issue, managers can use organizational mechanisms associated with coordination capabilities (e.g. cross-functional interfaces, participation in decision-making, and job rotation) and organizational mechanisms associated with socialization capabilities (Jansen et al., 2005). These two mechanisms can increase employee interaction, promote problem solving, facilitate flow of information, and thereby, improve the conversion of knowledge to innovative outputs.

Our results also challenge the traditional Schumpeterian view that a larger firm's resource endowments yield a net increase in its capacity to innovate. With changes in the underlying nature of how R&D and innovation activities are being carried out over recent decades, the evidence suggests a need to revisit these traditional assumptions of resource endowments

and maturity traps. Emergence of radically different innovation processes such as crowdsourcing and open innovation (e.g., Alexy, George, & Salter, 2013; Laursen & Salter, 2006) may be transforming the advantages or disadvantages of size. Therefore, new empirical studies might want to pay closer attention to how size effects may influence innovation capabilities or outcomes.

Firm age and absorptive capacity. Firm age is another widely-used control variable in ACAP studies because of the suggestion that a firm accumulates more experience as it grows older and ACAP is a path-dependent capability that relies on prior accumulated related knowledge (Cohen & Levinthal, 1990). The fact that ACAP is accumulative implies that mature firms are expected to be more adept at absorbing the external useful knowledge. As we report in Table 2, our meta-analytic finding reveals the firm age–ACAP relationship is actually negative for mature firms. Even though mature firms are likely to have accumulated prior related knowledge, they become less flexible as they age further in their responses to external useful knowledge due to organizational inertia.

Mature firms emphasize predictability, formalized roles, and control systems, making their behaviors predictable, rigid, and inflexible (Kelly & Amburgey, 1991), leading to the idea that organizational inertia increases with firm age (Hannan & Freeman, 1984). Consequently, the probability of change in core features decreases with age. Building ACAP requires firms to be responsive to innovative ideas from the environment. Organizational inertia makes firms less likely to respond to innovative ideas from the environment because such ideas may be too distant from the firm's existing knowledge base to be either appreciated or assessed. Consequently, mature firms are less flexible to respond to external useful knowledge, less likely to recognize the value of external useful knowledge, and therefore less likely to assimilate and exploit external useful knowledge.

Although our collective evidence points to a negative relationship between age and ACAP, changing practices may be making mature firms more attentive to innovation than in previous decades (e.g., Salter, Criscuolo, & Ter Wal, 2014). The negative impact of organizational inertia on ACAP can be mitigated or even overcome (e.g., Ahuja & Morris Lampert, 2001). Managers should actively monitor the external environment to translate the technical information to other members in the firm. When knowledge change is rapid and uncertain, managers can encourage employees with different knowledge backgrounds to monitor the external environment. Senior executives can also help foster an innovative organizational culture that encourages employee participation in innovation, and provide incentives for new ideas. Mature firms can improve their knowledge systems so that employees can efficiently search for knowledge, locate the knowledge, store the knowledge, and share the knowledge with other members in the firm.

How are performance implications of ACAP interrelated? Absorptive capacity was originally proposed as a predictor of a firm's innovation and knowledge transfer (Cohen & Levinthal, 1990). In addition, because of the wide-ranging impact of the concept, researchers have investigated the relationship between absorptive capacity and financial performance. Our MASEM results suggest that, as we report in Tables 4 and 5, innovation and knowledge transfer fully mediate the ACAP–financial performance relationship. This finding suggests that ACAP is better considered as a firm's capability to renew its knowledge base and generate innovative outcomes, but not a capability to directly generate financial returns. It is worthwhile for future research to explore other mediating, and also additionally – moderating factors, that can impact the realization of financial return. Firms invest in ACAP in order

to absorb and exploit external useful knowledge. In this endeavor, not only do the amount of knowledge and the quality of the knowledge matter, but so does the speed in absorbing external knowledge and converting it to products, to realize the financial return because the first mover has more advantage. Future research can examine what kind of external knowledge or information the firm can absorb and exploit to maximize the financial return.

Implications of MARA findings. Our MARA results provide an overview of findings to date, and guide future research on ACAP.

First, all the models in Tables 6–10 suggest that survey-measured ACAP leads to a stronger relationship than archival-measured ACAP. A few survey-measured absorptive capacity studies did control for R&D intensity, which is the most commonly used archival proxy for absorptive capacity, and these studies show an average of 0.185 correlation between survey-measured absorptive capacity and R&D intensity. This leads to a question about which measure can better represent absorptive capacity. The low correlation between the two measures may be because R&D intensity does not fully capture the multidimensionality (acquisition, assimilation, transformation, and exploitation) of absorptive capacity. Future research can further investigate other proxies (e.g., percentage of R&D employees, employee education, and employee training) and see how they might contribute to each dimension of absorptive capacity.

Second, even though there is a positive relationship between a firm's absorptive capacity and its innovation performance, as we report in model 2 in Table 8, our MARA results indicate that this relationship is stronger when innovation is incremental than when it is radical. This may be the case because given that radical innovation takes more time and involves more uncertainty in terms of future returns, firms are more inclined to utilize their absorptive capacity in ways that generate incremental innovation in pursuit of short-term performance. Accordingly, future research can further examine how a firm's absorptive capacity contributes to incremental innovation and radical innovation in different ways in dynamic and competitive environments (Jansen, Van Den Bosch, & Volberda, 2006).

Third, as we report in Table 1, the relationship between firm size and ACAP is negative and significant for public firms, but the same relationship is not significant for private firms. This finding may imply that firms may invest less in ACAP once they become public because they need to allocate the resources to realize short-term return to satisfy shareholders (Shleifer & Vishny, 1990). For example, the firms may invest less in R&D and invest more in market activities. Future research can examine how firms' investment in ACAP changes as they become public and how this change benefits or dampens firms' innovation output in the long run.

In our additional analysis we also examined factors that are commonly considered to influence the ACAP–innovation relationship. Surprisingly, we do not find that breadth of external search influences the ACAP–innovation relationship, in model 1 in Table 11. This may be because firms are increasingly relying on knowledge infrastructure (e.g., information systems and electronic databases) to search for external useful knowledge, which is a relevant factor, as we report in in model 3 in Table 11.

Social integration mechanisms have a positive and significant influence on the ACAP–innovation relationship, as we report in model 2 in Table 11, which provides a way for managers to improve knowledge sharing and recombination (Jansen et al., 2005). Management support also has a positive and significant influence on the ACAP–innovation relationship, as we report in model 4 in Table 11, which implies that mangers might play a more important

role in converting innovative products into financial returns, by providing employee support to enhance the ACAP–innovation relationship. As we report in model 5 in Table 11, when the environment is dynamic and external knowledge is changing rapidly, it becomes difficult for firms to convert knowledge to innovative outcomes. We do not find competitive intensity to influence the ACAP–innovation relationship, as we report in model 6 in Table 11, revealing that competitive pressure does not necessarily weaken the focal firm's ACAP–innovation relationship. Finally, relational capacity has positive and significant influence on the ACAP–innovation relationship as we report in model 7 in Table 11, which endorses the view that a firm's network has an influential role in accessing external knowledge and gaining external support to strengthen the ACAP–innovation relationship (Tsai, 2001).

Conclusion

We revisit the traditional assumptions of age and size on absorptive capacity. Our meta-analytic findings indicate that firms' ACAP does not increase with firm size and firm age, but that (a) the firm size–ACAP relationship is positive and significant for small firms and negative and significant for non-small firms; and (b) the firm age–ACAP relationship is negative and significant for mature firms and not significant for young firms. We also investigated, using MASEM, the relationship between ACAP and its performance implications. Our MASEM results suggest that the ACAP–financial performance is indirect, as mediated through innovation and knowledge transfer.

We used MARA to explore factors that can strengthen or weaken the relationships between ACAP and firm size, firm age, and its performance implications. Our results indicate the measurement of ACAP, whether the firm is public or private, and whether the innovation outputs being considered are radical in nature, are all related to the strength of the ACAP–innovation relationship.

Finally, we performed additional analyses using MARA to produce indicative results that social integration mechanisms, management support, and relational capabilities have a positive role to play in ACAP and innovation. The lack of significant results regarding some of the traditionally assumed proxies, such as firm age, firm size, and breadth of search on absorptive capacity, call for further clarity on the theoretical linkages between absorptive capacity and firm-level characteristics and strategies. We hope that our discussion and the empirical findings can clarify firm size–ACAP relationship, firm age–ACAP relationship, as well as the relationship between ACAP and its performance implications.

The emergence of new innovation processes such as lean-startups, design thinking, open innovation, crowdsourcing, and network-based forms of innovation, alongside our evidence, suggests a need to reflect on the underlying causal mechanisms of how organizational innovation has changed over the past few decades. Future research on innovation may consider some of our findings and causal arguments to challenge traditional views that younger and smaller firms may be more capable of innovation but are handicapped by lack of resources. Similarly, our evidence suggests that larger and mature firms may find it more difficult to invest in capability building, despite possessing the resources. This meta-analysis provides cumulative evidence on the relationship, but calls for a new conversation on how fundamental, organizational characteristics such as age and size matter in a changing innovation landscape.

Notes

1. As R&D intensity is a widely-used proxy of ACAP (Cohen & Levinthal, 1990), our discussion of the inconsistent relationships between firm size and ACAP as well as firm age and ACAP are based on the previous literatures that measure firms' R&D intensity.
2. The inverse variance of an effect size is the inverse of its squared standard error and the random effects variance component. The inverse variance of an effect size is $w_i^* = \frac{1}{SE(Z_{ri})^2+v}$. The squared standard error of each effect size is $SE(Z_{ri})^2 = \frac{1}{n_i-3}$, where n_i is the sample size of a study. The random effects variance component is $v = \frac{Q-(K-1)}{C}$, where K is the number of effect sizes. Q is Cochran's homogeneity test and is calculated as $Q = \sum_{i=1}^{K}(n_i - 3)(Z_{ri} - \bar{Z}_r)$. C is a constant and calculated as $C = \sum_{i=1}^{K}\left(n_i - 3\right) - \frac{\sum_{i=1}^{k}(n_i-3)^2}{\sum_{i=1}^{k}(n_i-3)}$.

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Appendix 1. Description of variables

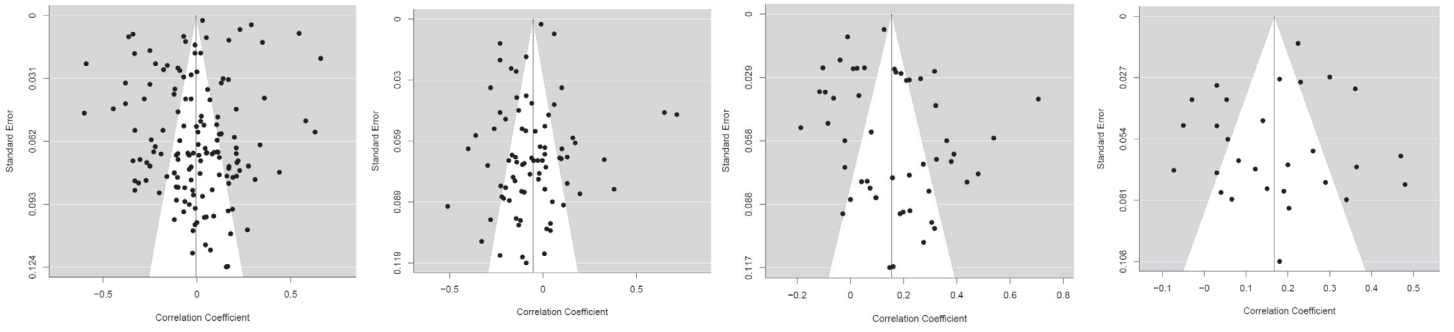
Variable	Description
ACAP measured by survey	A dummy variable, coded (1) if absorptive capacity is measured by survey
Public firm	A dummy variable, coded (1) if the firms in the sample are public firms
Panel design	A dummy variable, coded (1) if the data in the study is panel design
Median year of sample	A variable that indicates the median year of the sample
High technology industry	A dummy variable, coded (1) if the study is conducted in high technology industry
Mixed industry	A dummy variable, coded (1) if the study is conducted in more than one industry
Developed country	A dummy variable, coded (1) if the study is conducted in developed country(s)
Journal impact factor	A variable that is coded from Journal Citation Reports, which matches the year of the study in which the study in question was published
Radical innovation	A dummy variable, coded (1) if the innovation is radical
Absorptive capacity	A variable that measures firm's capability to recognize the value of external useful knowledge, assimilate it, and exploit the knowledge
Innovation	A variable that measures the adoption of an internally generated or purchased device, system, policy, program, process, product, or service that is new to the adopting organization
Knowledge transfer	A variable that measures the process through which organizational actors receive and are influenced by the experience and knowledge of others
Financial performance	A variable that measures firm's financial performance either by survey or by archival proxies (such as ROA and ROE)
Breadth of external search	A variable that measures the number of external sources or search channels that firms rely upon in their innovative activities
Social integration mechanism	A variable that measures as the creation of shared identity, the establishment of trusting relationships, and the absence of divisive conflicts between the members within the organization
Knowledge infrastructure	A variable that measures the technical systems within an organization that influence how knowledge travels throughout the organization and how knowledge is accessed
Management support	A variable that measures the degree to which top management understands the importance of innovation activities and the extent to which top management takes risks and provides adequate financial resources and other resources to support these activities
Environmental dynamism	A variable that measures the rate of change and instability of the external environment
Competitive intensity	A variable that captures the degree to which competition is high due to the number of competitors in the market and the lack of potential opportunities for further growth
Relational capability	A variable that measures firm's ability to build close relationships with other firms and utilize resources in its network

Appendix 2. Publication bias check results

Table A1. Publication bias results.

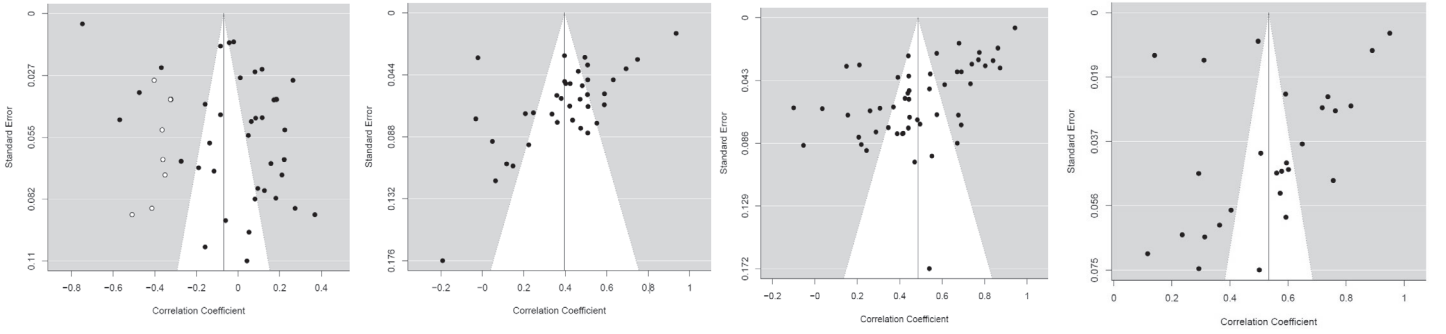
			Trim and fill						
			Before			After			
				95% CI			95% CI		Number of samples added
Factors	ACAP measurement	Bias	r_c	Lower	Upper	r_c	Lower	Upper	
Firm size			−0.004	−0.039	0.031	−0.004	−0.039	0.031	0
Firm age			−0.04	−0.069	−0.012	−0.04	−0.069	−0.012	0
Innovation	Archival proxies		0.135	0.094	0.176	0.135	0.094	0.176	0
Product innovation			0.172	0.123	0.223	0.172	0.123	0.223	0
Financial performance (Accounting-based)			−0.005	−0.117	0.108	−0.070	−0.177	0.037	8
Knowledge transfer			0.476	0.41	0.542	0.476	0.41	0.542	0
Innovation	Survey		0.529	0.443	0.615	0.529	0.443	0.615	0
Product innovation			0.394	0.322	0.466	0.394	0.322	0.466	0
Financial performance (Perceptual)			0.364	0.291	0.438	0.407	0.321	0.494	3
Financial performance (Accounting-based)			0.171	0.053	0.288	0.090	0.024	0.204	4

Note: r_c = sample size weighted mean effect size corrected for unreliability; 95% CI = 95% confidence intervals around the mean correlation.



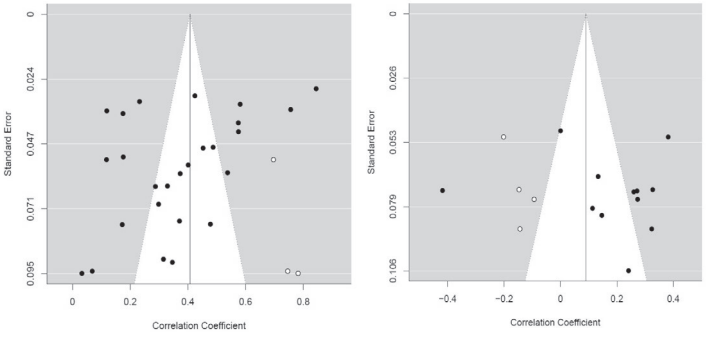
Relationship: firm size and ACAP Publication bias: No Correlation before fill: -0.004 Correlation after fill: -0.004 Number of studies imputed: 0	Relationship: firm age and ACAP Publication bias: No Correlation before fill: -0.04 Correlation after fill: -0.04 Number of studies imputed: 0	Relationship: archival-measured ACAP and innovation Publication bias: No Correlation before fill: 0.135 Correlation after fill: 0.135 Number of studies imputed: 0	Relationship: archival-measured ACAP and product innovation Publication bias: No Correlation before fill: 0.172 Correlation after fill: 0.172 Number of studies imputed: 0

Figure A1. Funnel plots.



Relationship: archival-measured ACAP and accounting based financial performance Publication bias: Yes Correlation before fill: -0.005 Correlation after fill: -0.070 Number of studies imputed: 8	Relationship: ACAP and knowledge transfer Publication bias: No Correlation before fill: 0.476 Correlation after fill: 0.476 Number of studies imputed: 0	Relationship: survey-measured ACAP and innovation Publication bias: No Correlation before fill: 0.529 Correlation after fill: 0.529 Number of studies imputed: 0	Relationship: survey-measured ACAP and product innovation Publication bias: No Correlation before fill: 0.394 Correlation after fill: 0.394 Number of studies imputed: 0

Figure A1. (*Continued*).



Relationship: survey-measured ACAP and perceptual-measured financial performance	Relationship: survey-measured ACAP and archival-measured financial performance
Publication bias: Yes	Publication bias: Yes
Correlation before fill: 0.364	Correlation before fill: 0.171
Correlation after fill: 0.407	Correlation after fill: 0.090
Number of studies imputed: 3	Number of studies imputed: 4

Figure A1. (*Continued*).

Appendix 3. Studies included in the meta-analysis

Author	Journal
Ahuja & Morris Lampert (2001)	Strategic Management Journal
Aljanabi, Noor, & Kumar (2014)	Information Management and Business Review
Anh, Baughn, Hang, & Neupert (2006)	International Business Review
Ap Sahadevan & Jedin (2014)	The South East Asian Journal of Management
Arvanitis & Bolli (2013)	Review of Industrial Organization
Azadegan (2011)	Journal of Supply Chain Management
Baba, Shichijo, & Sedita (2009)	Research Policy
Bapuji, Loree, & Crossan (2011)	Journal of Engineering and Technology Management
Barnett & Salomon (2012)	Strategic Management Journal
Bellamy, Ghosh, & Hora (2014)	Journal of Operations Management
Belussi, Sammarra, & Sedita (2010)	Research Policy
Ben-Oz & Greve (2012)	Journal of Management
Berchicci (2013)	Research Policy
Berchicci, de Jong, & Freel (2013)	Working paper
Berghman, Matthyssens, & Vandenbempt (2012)	Industrial Marketing Management
Bertrand & Mol (2013)	Strategic Management Journal
Biedenbach & Müller (2012)	International Journal of Project Management
Bierly, Damanpour, & Santoro (2009)	Journal of Management Studies
Blalock & Simon (2009)	Journal of International Business Studies
Bock, Suh, Shin, & Hu (2009)	The Journal of Computer Information Systems
Bolívar-Ramos, García-Morales, & Martín-Rojas (2013)	Technology Analysis and Strategic Management
Brettel, Greve, & Flatten (2011)	Journal of Managerial Issues
Bruneel, d'Este, & Salter (2010)	Research Policy
Camisón & Forés (2011)	Scandinavian Journal of Management
Cegarra-Navarro, Cepeda Carrión, & Wensley (2015)	Journal of Intellectual Capital
Cegarra-Navarro, Eldridge, & Wensley (2014)	European Management Journal
Cepeda-Carrion, Cegarra-Navarro, & Jimenez-Jimenez (2012)	British Journal of Management
Cepeda-Carrión, Gabriel Cegarra-Navarro, & Leal-Millán (2012)	Management Decision
Chang, Chang, Chi, Chen, & Deng (2012)	Technovation
Chang, Chen, & Lin (2014)	R&D Management

Author	Journal
Chang, Gong, & Peng (2012)	Academy of Management Journal
Chang, Gong, Way, & Jia (2013)	Journal of Management
Chen & Chang (2012)	Contemporary Management Research

Author	Journal
Chen & Chang (2012)	The Journal of Human Resource and Adult Learning
Chen, Lin, & Chang (2009)	Industrial Marketing Management
Chen, Lin, Lin, & Hsiao (2016)	Journal of Business Research
Choi (2014)	Information Technology and Management
Clausen (2013)	Technology Analysis and Strategic Management
Coombs & Bierly (2006)	R&D Management
Cooper & Molla (2014)	Australasian Journal of Information Systems
Cruz-González, López-Sáez, & Navas-López (2015)	Industrial Marketing Management
D'Souza (2012)	Dissertation
Dahlin (2010)	Dissertation
Daspit & D'Souza (2013)	Journal of Managerial Issues
Daspit, Ramachandran, & D'Souza (2014)	Journal of Managerial Issues
De Faria, Lima, & Santos (2010)	Research Policy
Debrulle, Maes, & Sels (2013)	International Small Business Journal
del-Corte-Lora, Molina-Morales, & Vallet-Bellmunt (2016)	Technology Analysis and Strategic Management
Desyllas & Hughes (2010)	Research Policy
Díaz-Díaz & De Saa-Perez (2014)	Journal of Knowledge Management
Díaz-Díaz, Aguiar-Díaz, & De Saá-Pérez (2008)	Research Policy
Dobrzykowski, Leuschner, Hong, & Roh (2015)	Journal of Supply Chain Management
Ebers & Maurer (2014)	Research Policy
Eggers & Kaplan (2009)	Organization Science
Engelen, Kube, Schmidt, & Flatten (2014)	Research Policy
Expósito-Langa, Molina-Morales, & Tomás-Miquel (2015)	Scandinavian Journal of Management
Fang & Zou (2010)	Journal of International Business Studies
Fernhaber & Patel (2012)	Strategic Management Journal
Ferreras-Méndez, Newell, Fernández-Mesa, & Alegre (2015)	Industrial Marketing Management
Flatten, Adams, & Brettel (2014)	Journal of World Business
Flatten et al. (2011)	European Management Review
Fogg (2012)	The International Journal of Entrepreneurship and Innovation
Forés & Camisón (2011)	International Journal of Technology Management
Forés & Camisón (2016)	Journal of Business Research
Gao, Xu, & Yang (2008)	Asia Pacific Journal of Management
García-Morales, Lloréns-Montes, & Verdú-Jover (2008)	British Journal of Management
Garcia-Morales, Ruiz-Moreno, & Llorens-Montes (2007)	Technology Analysis and Strategic Management

Author	Journal
Gong, Zhou, & Chang (2013)	Personnel Psychology
Griffith & Sawyer (2010)	Journal of Organizational Behavior
Haase & Franco (2010)	International Journal of Business Environment
Harrington & Guimaraes (2005)	Information and Organization
Hayton & Zahra (2005)	International Journal of Technology Management
He & Wei (2013)	International Marketing Review
Helena Chiu & Lee (2012)	Innovation
Henry (2014)	Journal of Management and Marketing Research
Hernández-Perlines, Moreno-Garcia, & Yáñez-Araque (2015)	Journal of Business Research
Hervas-Oliver & Sempere-Ripoll (2014)	Working paper
Ho & Wang (2015)	International Business Review
Hodgkinson, Hughes, & Hughes (2012)	Journal of Strategic Marketing
Horng, Tswei, & Chen (2009)	Asia Pacific Management Review
Huang, & Rice (2012)	International Journal of Innovation Management
Huang, Lin, Wu, & Yu (2015)	Journal of Business Research
Hughes, Morgan, Ireland, & Hughes (2014)	Strategic Entrepreneurship Journal
Hull & Covin (2010)	Journal of Product Innovation Management
Hurmelinna-Laukkanen & Olander (2014)	Technovation
Hurmelinna-Laukkanen (2012)	Management Decision

Author	Journal
Hurmelinna-Laukkanen, Olander, Blomqvist, & Panfilii (2012)	European Management Journal
Iyengar, Sweeney, & Montealegre (2015)	MIS Quarterly
Jabar, Soosay, & Santa (2011)	Journal of Manufacturing Technology Management
Jane Zhao & Anand (2009)	Strategic Management Journal
Jantunen (2005)	European Journal of Innovation Management
Jasimuddin, Li, & Perdikis (2015)	Thunderbird International Business Review
Jiang (2008)	Dissertation
Joshi, Chi, Datta, & Han (2010)	Information Systems Research
Jun (2009)	Dissertation
Junni & Sarala (2013)	Thunderbird International Business Review
Kang & Kang (2010)	Technology Analysis and Strategic Management
Kapoor & Klueter (2015)	Academy of Management Journal
Keupp & Gassmann (2013)	Research Policy
Khoja & Maranville (2009)	Academy of Strategic Management Journal
Kim, Akbar, Tzokas, & Al-Dajani (2013)	International Small Business Journal

Author	Journal
Kim, Kim, & Kim (2016)	Technology Analysis and Strategic Management
Kim, Zhan, & Krishna Erramilli (2011)	Journal of Asia Business Studies
Kohlbacher, Weitlaner, Hollosi, Grünwald, &Grahsl (2013)	Competitiveness Review
Kostopoulos, Papalexandris, Papachroni, &Ioannou (2011)	Journal of Business Research
Kotabe, Jiang, & Murray (2011)	Journal of World Business
Kotabe, Jiang, & Murray (2014)	Journal of Management
Kumar, Rose, & Muien (2011)	Journal of Applied Business Research
Kyoon Yoo, Vonderembse, & Ragu-Nathan (2011)	Journal of Knowledge Management
Lane & Lubatkin (1998)	Strategic Management Journal

Author	Journal
Adriansyah & Afiff (2015)	The South East Asian Journal of Management
Ahuja & Morris Lampert (2001)	Strategic Management Journal
Aljanabi, Noor, & Kumar (2014)	Information Management and Business Review
Anh, Baughn, Hang, & Neupert (2006)	International Business Review
Ap Sahadevan & Jedin (2014)	The South East Asian Journal of Management
Arvanitis & Bolli (2013)	Review of Industrial Organization
Azadegan (2011)	Journal of Supply Chain Management
Baba, Shichijo, & Sedita (2009)	Research Policy
Bapuji, Loree, & Crossan (2011)	Journal of Engineering and Technology Management
Barnett & Salomon (2012)	Strategic Management Journal
Bellamy, Ghosh, & Hora (2014)	Journal of Operations Management
Belussi, Sammarra, & Sedita (2010)	Research Policy
Ben-Oz & Greve (2012)	Journal of Management
Berchicci (2013)	Research Policy
Berchicci, de Jong, & Freel (2013)	Working paper
Berghman, Matthyssens, & Vandenbempt (2012)	Industrial Marketing Management
Bertrand & Mol (2013)	Strategic Management Journal
Biedenbach & Müller (2012)	International Journal of Project Management
Bierly, Damanpour, & Santoro (2009)	Journal of Management Studies
Blalock & Simon (2009)	Journal of International Business Studies
Bock, Suh, Shin, & Hu (2009)	The Journal of Computer Information Systems
Bolívar-Ramos, García-Morales, & Martín-Rojas (2013)	Technology Analysis and Strategic Management
Brettel, Greve, & Flatten (2011)	Journal of Managerial Issues
Bruneel, d'Este, & Salter (2010)	Research Policy
Camisón & Forés (2011)	Scandinavian Journal of Management
Cegarra-Navarro, Cepeda Carrión, & Wensley (2015)	Journal of Intellectual Capital
Cegarra-Navarro, Eldridge, & Wensley (2014)	European Management Journal
Cepeda-Carrion, Cegarra-Navarro, & Jimenez-Jimenez (2012)	British Journal of Management
Cepeda-Carrión, Gabriel Cegarra-Navarro, & Leal-Millán (2012)	Management Decision
Chang, Chang, Chi, Chen, & Deng (2012)	Technovation
Chang, Chen, & Lin (2014)	R&D Management
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Kumar, Rose, & Muien (2011)	Journal of Applied Business Research
Kyoon Yoo, Vonderembse, & Ragu-Nathan (2011)	Journal of Knowledge Management
Lane & Lubatkin (1998)	Strategic Management Journal
Larrañeta, Zahra, & González (2012)	Journal of Business Venturing
Lau & Lo (2015)	Technological Forecasting and Social Change
Laursen & Salter (2014)	Research Policy
Lawson & Potter (2012)	International Journal of Operations and Production Management
Lawson, Tyle, & Potte (2014)	Journal of Product Innovation Management
Leal-Rodríguez & Roldán (2013)	Revista Europea de Dirección y Economía de la Empresa
Leal-Rodríguez, Ariza-Montes, Roldán, & Leal-Millán (2014)	Journal of Business Research
Leal-Rodríguez, Roldán, Ariza-Montes, & Leal-Millán (2014)	International Journal of Project Management
Lee & Kang (2015)	Industry and Innovation
Lee & Song (2014)	International Journal of Logistics Management
Leiponen (2005)	International Journal of Industrial Organization
Lev, Fiegenbaum, & Shoham (2009)	European Management Journal
Li, Wang, & Liu (2013)	International Business Review
Liao & Yu (2013)	The Journal of Technology Transfer
Liao, Fei, & Chen (2007)	Journal of Information Science
Liao, Wu, Hu, & Tsui (2010)	Journal of Information Science
Lin & Chang (2015)	Technology Analysis and Strategic Management
Lin & Chang (2015)	Technological Forecasting and Social Change
Lin (2006)	Dissertation
Lin (2014)	Technological Forecasting and Social Change
Lin (2015)	Journal of Knowledge Management
Lin, Su, & Higgins (2015)	Journal of Business Research
Liu & Buck (2007)	Research Policy
Liu, Ke, Wei, & Hua (2013)	Decision Support Systems
Lord (2015)	Frontiers in Psychology

Author	Journal
Luo (1997)	Organization Science
Lyles, Li, & Yan (2014)	Management and Organization Review
Lyles, von Krogh, & Aadne (2003)	Governing Knowledge-Processes
Maes & Sels(2014)	Journal of Small Business Management
Mahnke, Pedersen, & Venzin (2005)	Management International Review
Makri, Hitt, & Lane (2010)	Strategic Management Journal
Malshe (2005)	Dissertation
Martelo-Landroguez & Cegarra-Navarro (2014)	Journal of Knowledge Management
Martinez-Senra, Quintás, Sartal, & Vázquez(2015)	IEEE Transactions on Engineering Management
Matusik & Heeley (2005)	Journal of Management
Merok Paulsen & Brynjulf Hjertø (2014)	The Learning Organization
Meyer & Subramaniam (2014)	Journal of Business Research
Moilanen, Østbye, & Woll (2014)	Small Business Economics

Author	Journal
Molina-Morales, Belso-Martinez, & Mas-Verdú (2015)	Journal of Business Research
Moon (2014)	Seoul Journal of Business
Moon-Goo, Dongsoo, & Guk-Tae (2011)	GSTF Business Review
Moos, Beimborn, Wagner, & Weitzel (2013)	International Journal of Innovation Management
Moreno, Pinheiro, & Joia (2012)	Journal of Global Information Management
Nagati & Rebolledo (2013)	Supply Chain Forum
Nair, Demirbag, & Mellahi (2015)	International Business Review
Najafi Tavani, Sharifi, & Ismail (2013	International Journal of Operations and Production Management
Nambisan (2013)	Research Policy
Nemanich, Keller, Vera, & Chin (2010)	IEEE Transactions on Engineering Management
Nguyen (2011)	Dissertation
Nooteboom, Van Haverbeke, Duysters,Gilsing, & Van den Oord (2007)	Research Policy
Olivas-Luján (2003)	Dissertation
Oliveira, Curado, Maçada, & Nodari (2015)	Computers in Human Behavior
Ouyang (2008)	International Journal of Technology Management
Pak & Park (2004)	Management International Review
Parra-Requena, Ruiz-Ortega, & Garcia-Villaverde (2013)	Industry and Innovation
Patel, Kohtamäki, Parida, & Wincent (2014)	Strategic Management Journal
Patel, Terjesen, & Li (2012)	Journal of Operations Management
Pavlou (2004)	Dissertation
Peltokorpi (2017)	International Business Review

Author	Journal
Petersen, Pedersen, & Lyles (2008)	Journal of International Business Studies
Petroni & Panciroli (2002)	European Journal of Purchasing and Supply Management
Phelps (2010)	Academy of Management Journal
Popaitoon & Siengthai (2014)	International Journal of Project Management
Puranam & Srikanth (2007)	Strategic Management Journal
Puranam, Singh, & Chaudhuri (2009)	Organization Science
Quintana-García, & Benavides-Velasco (2008)	Research Policy
Reiche (2011)	Human Resource Management
Rhee (2008)	Asian Business and Management
Richards (2004)	Dissertation
Riikkinen, Kauppi, & Salmi (2017)	International Business Review
Ritala & Hurmelinna-Laukkanen (2013)	Journal of Product Innovation Management
Roberts (2015)	Journal of Business Research
Rodríguez-Serrano & Martín-Velicia (2015)	Journal of Promotion Management
Rothaermel & Alexandre (2009)	Organization Science
Saenz, Revilla, & Knoppen (2014)	Journal of Supply Chain Management
Saenz, Revilla, & Knoppen (2014)	Journal of Supply Chain Management
Salge, Bohné, Farchi, & Piening (2012)	International Journal of Innovation Management
Schildt, Keil, & Maula (2012)	Strategic Management Journal
Schleimer & Pedersen (2013)	Journal of Management Studies
Schleimer, Coote, & Riege (2014)	Journal of Business Research
Schulze, Brojerdi, & Krogh (2014)	Journal of Product Innovation Management
Sciascia, D'oria, Bruni, & Larrañeta (2014)	European Management Journal
Setia & Patel (2013)	Journal of Operations Management
Shekhar Mishra & Saji (2013)	Journal of Product and Brand Management
Sheng & Chien (2016)	Journal of Business Research
Song (2015)	Chinese Management Studies
Spanos (2012)	International Journal of Information Technology and Management
Stam (2009)	Research Policy
Steensma & Corley (2000)	Academy of Management Journal
Stock, Greis, & Fischer (2001)	The Journal of High Technology Management Research
Strese, Adams, Flatten, & Brettel (2016)	International Business Review
Su & Tsang (2015)	Academy of Management Journal
Su, Ahlstrom, Li, & Cheng (2013)	R&D Management
Su, Dhanorkar, & Linderman (2015)	Journal of Operations Management

Author	Journal
Sugheir (2006)	Dissertation
Talke, Salomo, & Rost (2010)	Research Policy
Tang, Hull, & Rothenberg (2012)	Journal of Management Studies
Thérin (2007)	Gestion
Tiwana & Mclean (2005)	Journal of Management Information Systems
Tomlinson (2010)	Research Policy
Torugsa & Arundel (2013)	International Journal of Innovation Management
Tsai & Wu (2011)	African Journal of Business Management
Ujari (2002)	Dissertation
Ungan (2007)	Journal of Manufacturing Technology Management
Van de Vrande, Vanhaverbeke, & Duysters (2011)	Journal of Product Innovation Management
Verbeke & Nguyen (2013)	Management International Review
Vicente-Oliva, Martínez-Sánchez, & Berges-Muro (2015)	International Journal of Project Management
Vieira, Briones-Peñalver, & Cegarra-Navarro (2015)	Knowledge and Process Management
Wagne (2011)	Journal of Engineering and Technology Management
Wales, Parida, & Patel (2013)	Strategic Management Journal
Wang & Han (2011)	Journal of Knowledge Management
Wang, Senaratne, & Rafiq (2015)	British Journal of Management
Warner (2003)	International Journal of Innovation Management
Watts (2008)	Dissertation
Wei, Lowry, & Seedorf (2015)	Information and Management
Weng & Huang (2012)	Journal of Management and Organization
Willoughby & Galvin (2005)	Knowledge, Technology and Policy
Winkelbach & Walter (2015)	Industrial Marketing Management
Wu & Wu (2014)	International Business Review
Wu, Lii, & Wang (2015)	Journal of Business Research
Wu, Lin, & Chen (2013)	IEEE Transactions on Engineering Management
Wu, Lupton, & Du (2015)	Chinese Management Studies
Xia (2013)	R&D Management
Xie & Li (2015)	Journal of International Management
Yao & Chang (2017)	Strategic Management Journal
Yayavaram & Chen (2015)	Strategic Management Journal
Yu (2013)	Technological Forecasting and Social Change
Zahra & Hayton (2008)	Journal of Business Venturing
Zhang, Venkatesh, & Brown (2011)	Journal of the Association for Information Systems
Zhang, Zhong, & Makino (2014)	Journal of International Business Studies