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Is the limited diffusion of management accounting innovations really a paradox? A meta-analysis of the relationship between product diversity and the adoption of Activity-Based Costing

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Abstract

This article addresses the paradox of the seeming limited diffusion of management accounting innovations. The relationship between product diversity and the adoption of Activity-Based Costing (ABC) is used as an illustrative example. Twenty-four studies were the subject of a meta-analysis. Overall, the results show a significant and positive relationship between product diversity and ABC adoption. However, product variety is the only type of diversity to be both significantly and positively associated with ABC adoption. The discussion of these results makes it possible to at least partially resolve the paradox of innovations in management accounting by proposing a new way of measuring their diffusion. Finally, we propose several original avenues for future research in management accounting innovations.

Key words: innovation, paradox, Activity-Based Costing, product diversity, meta-analysis.

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1. Introduction

Over the past thirty years or so, management accounting innovations (MAIs) have become the subject of focused research (Zawawi and Hoque 2010, Ben Ismail *et al.* 2015). This research is important because as managerial innovations, MAIs are a potential source of competitive advantage for the organizations that implement them (Hamel 2006, Birkinshaw *et al.* 2008). As a function of the organization and a set of practices, management accounting is regularly transformed by managerial innovations (Le Roy *et al.* 2013). Research on these innovations thus contributes to a better understanding of the evolution of practices and structures related to management accounting (Birkinshaw and Mol 2006, Mol and Birkinshaw 2009) by specifying the rationale, effectiveness and conditions for applying these innovations (David 2013). It is also necessary in order to distinguish “true” innovations from “false” ones (Bouquin and Nikitin 2003) and to better ascertain what is rational choice and what is mimicry (Abrahamson 1991).

Accounting historians have focused primarily on the diffusion of innovative management accounting tools such as budget control (Boyns and Berland 2002), standard costs (Zimnovitch 1996), allocation of indirect costs (Levant and Zimnovitch 2013) or GP and UVA (added value unit) equivalence methods (Levant and de La Villarmois 2001, 2004). More recently, numerous studies have focused on strategic MAIs (Malleret et al. 2015) such as Activity-Based Costing (Gosselin 1997), the Balanced Scorecard (Bourguignon *et al.* 2002) or Beyond Budgeting (Berland *et al.* 2015).

The literature on MAIs addresses three main issues: the diffusion of these innovations on the scale of a country or sector (Malmi 1999, Alcouffe *et al.* 2003, 2008), the organizational determinants of their adoption (Godowski 2003, 2004, Becker *et al.* 2015) and the consequences of their adoption on organizations and their stakeholders (Malmi 1997, Cagwin and Bouwman 2002). This literature has produced a great deal of knowledge, thanks in particular to the complementary nature of the methodological approaches used. Nevertheless, after the publication of several hundred articles on the subject and while research appears to have reached a certain maturity, two major knowledge gaps remain.

The first of these concerns the MAI “paradox” (Nixon and Burns 2012). This paradox refers to the significant discrepancy between what appears to be a relatively limited diffusion of most of these innovations in light of the benefits they are expected to bring to organizations. The second knowledge gap concerns the accumulated knowledge on factors driving the adoption of these same innovations. Studies in this field suffer from many limitations and the results are far from convergent, thus failing to build up a solid and cumulative knowledge base over time (Atkinson *et al.* 1997). Furthermore, these two gaps are related because the adoption and diffusion of an innovation are two interacting processes, the first forming a very part of the second (Alcouffe 2006).

The objective of this paper is therefore to address these two knowledge gaps in order to make a substantial contribution to the MAI literature and to propose new avenues for research. To do this, we have chosen to focus on the relationship between product diversity and the adoption of Activity-Based Costing, also known as the “ABC” method. There are several reasons for this choice. ABC is considered one of the most important managerial innovations of the late 20th century (Birkinshaw *et al.* 2008, Mol and Birkinshaw 2014) and is the most studied MAI (Gosselin 2007, Zawawi and Hoque 2010). In addition, it is an emblematic case of the limitations of the literature on MAIs. The many studies report diffusion rates perceived as disappointing, whereas this method has gradually become “institutionalized” in the

doctrine and teaching of costing system design. This “ABC paradox” (Brown *et al.* 2004, Gosselin 2007) has generated a significant number of studies on the determinants of its adoption. Among the many factors driving adoption, the decision to study product diversity is justified by the existence of a very broad theoretical consensus, while the association between the two variables does not appear to be empirically proven empirical (Alcouffe *et al.* 2016).

Given the limitations identified in the literature, we chose to implement a meta-analysis. This research design consists in aggregating the results of several studies addressing the same scientific questioning, in other words, the same relationship between two concepts, to produce a more general overall result (Berland and Piot 2014). The use of this design is therefore particularly justified when, as in the case of ABC, the results of research taken separately may suffer from sampling bias or measurement errors that are *a priori* harmful to the cumulative nature of their conclusions. By combining many different studies, a meta-analytical approach solves this difficulty by reducing the influence of these isolated biases.

Our study findings contribute to the literature in three ways. Firstly, by producing a comprehensive synopsis of the literature and robust results, our work substantially improves understanding of the relationship between product diversity and adoption of ABC. Overall, there is a significant and positive relationship between the two, but among the types of diversity, only diversity in product variety is significantly and positively associated with the adoption of ABC. Secondly, our results allow us to at least partially resolve the paradox of MAIs by showing in particular that the diffusion rates of these innovations should be calculated differently. Thirdly, our work opens up original and important perspectives for research focusing on MAIs.

To justify these contributions, the rest of this paper is organized as follows. The second section summarizes the literature and elaborates on the issue of the relationship between product diversity and the adoption of ABC. The third section is dedicated to research design. The fourth section presents the results. The fifth section provides a discussion of our results, followed by a conclusion.

2. Literature

The ABC method was designed to meet the needs of organizations in terms of calculating and managing their costs in a context of the greater complexity of the value chain and increasing diversity in the supply of products/services (Mévellec 1990, Lorino 1991, Bescos and

Mendoza 1994). Although interpretations sometimes diverge (Alcouffe and Malleret 2004), it is possible to speak of a “canonical” model of the method built around the three notions of resources, activities, and cost objects. The calculation rationale is as follows: activities consume resources, while cost objects (products, services, customers, etc.) consume activities. Two types of allocation bases are used to assign the cost of resources to activities and the cost of activities to cost objects. Although relatively close to the French method of “*Sections homogènes*” from a technical substrate point of view (Hatchuel and Weil 1992), the ABC method is further from it in terms of management philosophy and simplified vision of the organization (Bouquin 2011, Mévellec 2017).

Much research is focused on the determinants of ABC’s organizational adoption. This research is based on a “rational choice” perspective (Abrahamson 1991) and on contingency theory¹ (Chenhall 2003, Al-Omiri and Drury 2007). As Alcouffe *et al.* (2016) pointed out, no fewer than fifty adoption factors have been studied, but the results rarely converge. What is more, the literature is relatively unclear regarding the definition of what an ABC system actually is, whether theoretically (Alcouffe and Malleret 2004, Mévellec 2005, Gosselin 2007) or in terms of its operationalization (Bisbe *et al.* 2007, Brierley 2011, Schoute 2011). Several studies show that ABC can be implemented in very different ways (Gosselin and Mévellec 2003, Mévellec 2003, Al-Omiri and Drury 2007, Gervais *et al.* 2010, Pike *et al.* 2011). These differences may lie in the number of activities or processes, the variety of allocation bases used, etc. (Mévellec 2005, Alcouffe and Mévellec 2012). This heterogeneity among ABC systems actually put into practice is only very rarely taken into account in studies on the determinants of its adoption.

Another point of divergence in the literature concerns the way in which the adoption of ABC is modeled. Some studies consider adoption as a process-based model with a greater or lesser number of steps. These steps range from ignorance of the very existence of the method to consideration of its adoption, adoption or rejection, its anchoring in organizational routines, or even abandonment. Other studies simply measure adoption in binary terms: adoption vs. non-adoption. However, when it comes to testing the influence of determinants on the adoption of ABC using a statistical model, the vast majority of studies group organizations into two categories: adopters/non-adopters. This forces researchers to make a choice in terms of grouping, and the main question focuses on the adoption consideration step. By definition, the companies considering adoption have not yet made their decision, and may either adopt it or

reject it. Empirical studies thus consider these companies as adopters or non-adopters without actually knowing the outcome of the process.

Among the many factors driving adoption of ABC, product diversity is both the most studied (Alcouffe *et al.* 2016) and the one with the most important explanatory power (Abernethy *et al.* 2001). Product diversity refers to the set of conditions under which an organization's cost objects consume activities and/or activities consume resources in different ways (Schoute 2011). The greater the diversity of products, the more resource consumption is likely to vary from one product to another (Foster and Gupta 1990, Banker and Johnson 1993, Datar *et al.* 1993), and the more sophisticated the cost calculation system must be in order to correctly measure these differences in consumption (Cooper 1988, Cooper and Kaplan 1991, Mévellec 2005, 2017, Bouquin 2011). An ABC system with more cost pools (activities and processes) and a greater diversity of allocation bases (volume-, transaction- or support-based cost drivers) is considered to better meet the need to measure differences in consumption (Kaplan 1984, 1986, Cooper 1987, Mévellec 2017). This reasoning underlies the hypothesis of a positive relationship between product diversity and the adoption of ABC tested in this meta-analysis.

Hypothesis: Adoption of the ABC method is associated with greater product diversity.

Research testing this hypothesis has given mixed results. Of the 48 studies reviewed by Alcouffe *et al.* (2016), only nine show a positive and statistically significant relationship. Bjørnenak (1997) found a significantly negative relationship, while the other 38 studies reported no relationship. The theoretical consensus on a positive relationship between product diversity and the adoption of ABC therefore seems far from being corroborated empirically when each study is viewed separately. The use of a meta-analysis to combine all the observations currently available is therefore particularly justified.

Different approaches can be considered to explain the heterogeneity of results from the literature. In addition to the differences in the operationalization of ABC and its adoption process, mentioned above, the operationalization of the very concept of diversity also appears to be a matter of debate. There are several types of diversity: diversity in the variety (number of different products), the volume (differences in volumes manufactured from one product to another), the support (differences in the use of support services from one product to another) and in product customization (Bouwens and Abernethy 2000). However, most studies use either of these types of diversity indiscriminately, or even merge them all into a composite score without questioning the specificity of the relationship between each of these different

types of diversity and the adoption of ABC. Other causes of heterogeneity may also be considered, such as a non-linear relationship between diversity and adoption, the factoring in of different levels of analysis, the scientific quality of the publication medium or the lack of statistical power due to the small size of some samples².

The apparent heterogeneity of results from the literature and the poor knowledge of the multiple factors that may explain this heterogeneity thus justify a meta-analysis of the relationship between product diversity and the adoption of ABC. The process of implementing this meta-analysis is explained in the following section.

3. Research design

3.1. Principles of meta-analysis

Berland and Piot (2014) recently highlighted the value of meta-analyses for accounting, control and audit research, especially in the field of management accounting, where meta-analyses are not only few and far between, but limited to the issue of the relationship between budget participation and managerial performance (Greenberg *et al.* 1994, Derfuss 2009, 2015, 2016, Bonache *et al.* 2010, 2012). As Schmidt and Hunter (2015) pointed out, meta-analysis integrates the results of all these studies to reveal simpler patterns of relationships underlying the literature, thus providing a basis for theoretical development. By empirically clarifying the nature of the relationships between different variables, meta-analysis may be used to corroborate or invalidate a theory, or to construct a more general theory that replaces what may be an explanation contingent upon excessively restrictive conditions. Technically, increasing the sample size by combining results from previous studies improves the statistical power of the estimates produced on the meaning and intensity of a relationship between variables (Lipsey and Wilson 2001). Meta-analysis thus enables the researcher to limit the influence of artifacts on the understanding of relationships between variables. It also provides an opportunity to explain the heterogeneity of results from the literature by testing the influence of different variables identified in previous research.

As mentioned in the previous section, the results of previous studies are contradictory on the meaning and intensity of the relationship between product diversity and the adoption of ABC, while the professional literature and the cost system design doctrine suggest a clearly positive and significant relationship. The probability that the ABC method will be adopted should be higher when many different products are manufactured, when these products are highly

customized, when the volumes produced change frequently and when various support activities are consumed at the same time. A meta-analysis of studies evaluating the relationship between product diversity and the adoption of ABC therefore seems relevant for three reasons: (1) to understand the heterogeneity of empirical results, (2) to provide an average estimate of the meaning and intensity of the relationship and (3) to discuss the reality of the positive theoretical relationship highlighted in the literature.

3.2. Data collection

To constitute our sample of studies, we first conducted an exhaustive inventory of articles published in French and English on the broad topic of the adoption of ABC. We started by working on the main electronic databases published by ScienceDirect, EBSCO-Business Source Premier, Emerald and JSTOR. These databases were searched several times during 2015 with the following queries and keywords: “activity” and “costing” in the title of the paper then “ABC” in the title and “activity” in the body. In order to supplement this work on the databases, we manually consulted the bibliographies of the studies already selected as well as those of the literature reviews on ABC (Gosselin and Ouellet 1999, Gosselin and Pinet 2002, Gosselin 2007, Zawawi and Hoque 2010).

We also published a first version of this draft article on Ideas RePEc which was then referenced on Google Scholar. This procedure, which was identical to that used by Bonache *et al.* (2012), enabled us to select a number of potentially interesting and unidentified studies. It also enabled us to expand our sources beyond published articles and thus include conference papers, theses, book chapters and working papers.

Of the 159 studies initially identified, we only kept quantitative studies that examined the relationship between product diversity and the adoption of ABC while providing sufficient information to allow for the processing required for quantitative meta-analysis. The final corpus is composed of 24 studies that meet these selection criteria. To reduce the risk of selection errors, two of the authors of this paper conducted the study collection and selection process separately before pooling and discussing their results in order to achieve perfect convergence.

Appendix 1 presents the characteristics of the 24 studies selected, representing a total cumulative sample of 5,253 organizations. Several meta-analyses were conducted using this same sample: a main meta-analysis regardless of the type of diversity measured and meta-

analyses in sub-groups by specific type of diversity. All the statistical processing operations carried out are presented in detail in Appendix 2.

4. Results

This section first present the results of the overall meta-analysis and homogeneity tests before detailing those of the meta-analyses conducted in sub-groups by type of diversity and other control variables.

4.1. Overall meta-analysis

The first main result of our meta-analysis is based on the 24 studies in the sample, with the statistical elements shown in bold in Appendix 1. As the homogeneity tests for effect sizes revealed heterogeneity ($Q = 58.29$ and $I^2 = 60.5\%$, rejection of the homogeneity hypothesis with a p -value < 0.001), we used the random effects model to estimate the average effect size. As shown in Table 1, the average effect size is positive and significant but small, being less than 0.20 (Cohen 1988).

Table 1. Average effect size and confidence interval for the overall meta-analysis

<i>N = 24 studies, 5,253 observations</i>	Average effect size	Standard deviation	95% confidence interval		Z	p-value
Random effects	0.109	0.035	0.041	0.178	3.116	0.002

This led us to retain the hypothesis whereby there is a positive relationship between product diversity and the adoption of ABC. This initial result is thus as follows:

Result 1. On the basis of previous studies representing a cumulative sample of 5,253 observations, the diversity of a company's products is, on average, positively and significantly associated with the decision to adopt the ABC method.

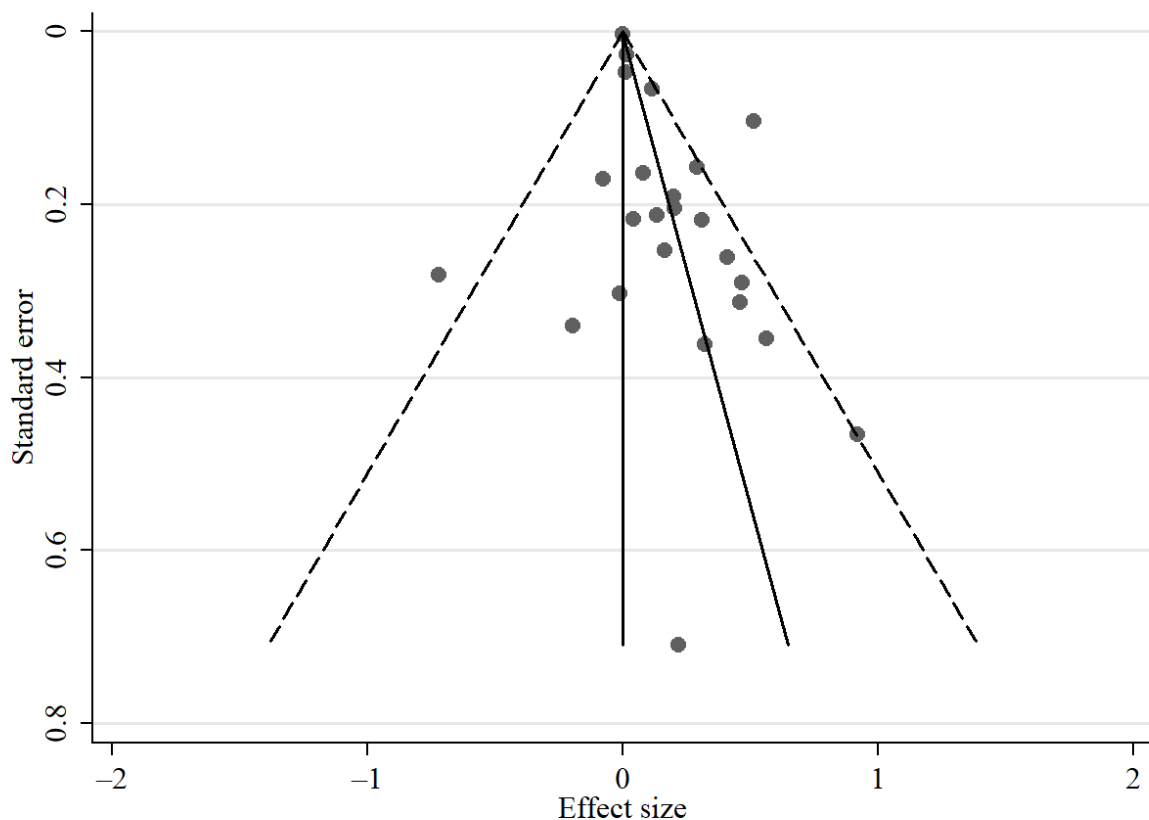
A graphical illustration (forest plot) of this result is provided in Appendix 3.

Validity of the overall meta-analysis

The random effects model is used to monitor sampling errors and some differences between the studies included by assuming that these variations are random. However, given the heterogeneity observed, it was necessary to check whether all these variations were indeed

random or the result of a confounding factor. Several confounding factors, such as publication bias and small samples, could threaten the validity of a meta-analysis and must therefore be adjusted as needed. The funnel plot is used to test the existence of confounding factors by visualizing asymmetry³. Figure 1 presents the funnel plot for our meta-analysis with a confidence interval of 95% and the regression line from the test on the effect of small samples described by Egger *et al.* (1997). Since the regression line is significantly different from the central vertical line, we can conclude that the funnel plot's asymmetry is significant (p -value of the Egger test = 0.004). It was therefore necessary to determine whether this asymmetry was the result of bias or of actual heterogeneity in the studies due to explicit differences (Sterne and Harbord 2004).

Figure 1. Funnel plot for the overall meta-analysis with a 95% confidence interval and Egger's regression line



The two main sources of publication bias can be ruled out, namely the tendency of journals to publish only studies with significant results, and the tendency to favor studies using certain research methods. Indeed, most of the studies included in our meta-analysis report a non-significant relationship between the two variables of interest yet they were still published. In addition, the research methods used were often different. Furthermore, given our collection procedure, we were also able to check whether other studies had been published in a language

other than French or English. Finally, pipeline bias due to publication delays is possible, but it is unlikely that studies already in the publication pipeline would offset the funnel plot's asymmetry. We identified a maximum of two studies published each year on the subject since 1997, suggesting that few studies are currently in the submission process since the last one we included dates from 2015.

To confirm the absence of publication bias, the trim-and-fill method may be used, as it was designed to assess and correct publication bias (Duval and Tweedie 2000a,b)⁴. By applying this method to our sample, we obtained a non-significant average effect size of 0.019 (p -value = 0.615) with the random effects model for a reconstituted total of 33 studies. On the other hand, since heterogeneity is much higher with these new studies ($Q^{(33)} = 102.78$ versus $Q^{(24)} = 58.29$), this confirms that factors other than publication bias explain the asymmetry of the funnel plot and the heterogeneity of the initial sample's effect sizes (Sterne and Harbord 2004). The following paragraph presents the results of the analyses carried out to identify these other sources of heterogeneity.

4.2. Meta-analyses in sub-groups

In an exploratory analysis approach (Gilboa *et al.* 2008), we conducted several meta-analyses in sub-groups to shed light on the heterogeneity of the initial sample's effect sizes, highlighted in the previous paragraph.

4.2.1. Meta-analyses by type of product diversity

The first possible source of heterogeneity is the type of product diversity studied. As shown in Appendix 1, several types of diversity were studied within the sample: diversity in terms of variety (number of different products), volume (differences in volumes produced), support (differences in use of support services), customization (differences in the degree of customization) and complexity (differences in the degree of complexity). In addition, some studies prefer to use a composite measurement adding together different types of diversity. The most studied type of diversity in the sample is diversity in variety (15 studies), followed by customization (6) and volume (5). We conducted a specific meta-analysis (Table 2) for each of these three types of diversity.

Table 2. Meta-analyses by type of product diversity

	Average effect size	Standard deviation	95% confidence interval		Z	p-value	$Q (I^2)$	Bias
Variety – Random effects (15 studies; 3,944 observations)	0.22	0.062	0.098	0.342	3.526	0.000	49.52 (71.7%)	Yes
Customization – Random effects (6 studies; 770 observations)	-0.345	0.366	-1.062	0.373	-0.942	0.346	62.12 (92%)	No
Volume – Fixed effects (5 studies; 2,803 observations)	-0.047	0.043	-0.132	0.038	-1.086	0.277	4.26 (6.1%)	No

Notes: the “Bias” column reports the result of Egger’s test on publication bias and the effects of small samples. For the meta-analysis on diversity in variety, we obtained the same conclusions as for the overall meta-analysis, so other sources of heterogeneity had to be found. The results of the other two meta-analyses (customization and volume) were reliable (no publication bias or effects due to small samples). The random effects model of the meta-analysis on the diversity in customization was used to check the heterogeneity found, which was accounted for by purely random differences between the studies included.

On the basis of Table 2, we can state the following results:

Result 2a. Out of a sample of 3,944 observations, diversity in variety is, on average, positively and significantly associated with the decision to adopt the ABC method.

Result 2b. Out of a sample of 770 observations, diversity in customization is, on average, not significantly associated with the decision to adopt the ABC method.

Result 2c. Out of a sample of 2,803 observations, diversity in volume is, on average, not significantly associated with the decision to adopt the ABC method.

In view of these results, it therefore appears that the type of diversity studied is a factor explaining the heterogeneity of the results obtained during the overall meta-analysis. Among these different types of diversity, only diversity in variety is significantly associated with adoption of the ABC method.

4.2.2. Other possible causes of heterogeneity

In order to determine other causes of inter-study heterogeneity, we performed a meta-analytical ANOVA test (detailed in Appendix 2) on five variables that could cause

heterogeneity in the overall meta-analysis (Table 3). These five variables are the inclusion (or not) of companies considering adopting ABC in the “adopter” group; the study’s level of analysis (does the answer concern the company as a whole or only the respondent’s business unit?); the business sector of organizations in the sample (all sectors or only industry?); the use (or not) of a step-by-step model to measure the adoption of ABC; and the quality of the study’s publication medium (journal ranked by CNRS section 37 or not).

Table 3. Meta-analytical ANOVA on the Q statistic of the fixed effects model of the overall meta-analysis by control variable

	Variance	<i>Q</i>	df	<i>p</i> -value	
Consideration included in “adopter” group^a	Inter-study	3.105	1	0.078	Homogeneity not rejected^b
	Intra-study	54.774	20	0.000	Homogeneity rejected
	Total	57.879	21	0.000	Homogeneity rejected
Level of analysis	Inter-study	3.603	1	0.058	Homogeneity not rejected
	Intra-study	54.691	22	0.000	Homogeneity rejected
	Total	58.294	23	0.000	Homogeneity rejected
Business sector	Inter-study	1.569	1	0.210	Homogeneity not rejected
	Intra-study	56.725	21	0.000	Homogeneity rejected
	Total	58.294	23	0.000	Homogeneity rejected
Step-by-step adoption model	Inter-study	10.206	1	0.001	Homogeneity rejected
	Intra-study	48.088	22	0.001	Homogeneity rejected
	Total	58.294	23	0.000	Homogeneity rejected
Quality of the publication medium	Inter-study	5.9	1	0.015	Homogeneity rejected
	Intra-study	52.394	22	0.000	Homogeneity rejected
	Total	58.294	23	0.000	Homogeneity rejected

Notes:

- a. The two studies that did not provide this information were excluded from the analysis (see Appendix 1).
- b. When the homogeneity hypothesis cannot be rejected for the inter-study variance, the variable considered makes it possible to explain part of the heterogeneity of the overall meta-analysis by leaving only one intra-study heterogeneity that can be controlled by the random effects model.

Based on the results in Table 3, it is possible to perform meta-analyses per sub-group with the random effects model to reveal differences in effect size for each value of the variables considered. The results of the sub-group meta-analyses for the three variables explaining heterogeneity (in bold in Table 3) are presented in Table 4.

**Table 4. Meta-analyses per variable explaining heterogeneity
(sub-groups, random effects model)**

		Average effect size	95% confidence interval		Weight as a percentage	Z	p-value
Consideration included in “adopter” group ^a	No	0.143**	0.017	0.268	57.66	2.23	0.026
	Yes	0.106**	0.002	0.210	35.28	1.99	0.046
Level of analysis	Company	0.139**	0.024	0.255	51.76	2.37	0.018
	Business Unit	0.119*	-0.019	0.256	48.24	1.69	0.092
Business sector ^b	All	0.127	-0.041	0.294	27.64	1.48	0.139
	Industry	0.132**	0.027	0.238	70.64	2.47	0.014

Notes: * indicates a significant effect size at 10% and ** a significant effect size at 5%.

- a. The two studies that did not provide this information were excluded from the analysis (see Appendix 1).
- b. The only study whose sample concerns only service companies was excluded (Pavlatos and Paggios 2009).

On the basis of Table 4, we can state the following results:

Result 3a. Including consideration of adoption as actual adoption does not reduce the size of the effect between product diversity and the adoption of ABC. Whether or not companies considering adoption are included in the “adopter” group, the average effect size remains significantly different from zero.

Result 3b. The level of analysis does not have a significant impact on the size of the effect between product diversity and the adoption of ABC. Whether the study focuses on the operational entity or the company as a whole, the average effect size remains significantly different from zero⁵.

Result 3c. The effect size is positive and significant for companies in an industrial sector, and not significant when the study is multi-sectoral.

Of the three variables explaining heterogeneity, the business sector is therefore the only confounding factor in the association between product diversity and the adoption of ABC.

5. Discussion

This section is dedicated to the discussion of our results, which contribute to the literature in three ways. Firstly, by producing a comprehensive synopsis of the literature and robust results, this meta-analysis significantly improves understanding of the relationship between product diversity and the adoption of ABC. Secondly, this discussion of the results allows us to at least partially resolve the paradox of MAIs. Thirdly, this paper suggests original avenues of research to develop our understanding of the diffusion of MAIs.

5.1. Relationship between product diversity and adoption of the ABC method

First of all, this article contributes to the literature on the ABC method by deepening and improving understanding of the relationship between product diversity and the adoption of ABC. Our results show that 1) the diversity of a company's products is positively and significantly associated with adoption of the ABC method; 2) among the different types of diversity, only diversity in variety is positively and significantly associated with adoption of the ABC method; and 3) the business sector is this association's only moderating (confounding) factor.

The first result is important because it reverses the conclusions of previous literature reviews, which stated that there is no relationship between product diversity and adoption of the ABC method. By using a meta-analysis that increases the sample size by combining the results of previous studies, we have improved the statistical power of the estimates produced and are able to propose a scientifically robust result. This suggests that the use of meta-analysis should be extended to other determinants of the adoption of ABC, as well as to other MAIs, in order to obtain more robust conclusions than those proposed so far in non-quantitative literature reviews on the subject (Gosselin 2007, Zawawi and Hoque 2010).

The second result shows that among the three types of diversity tested, only diversity in variety is significantly associated with the adoption of ABC. The more a company manufactures and sells different products, the more likely it is to adopt the ABC method. This is in line with the theoretical consensus on the overall relationship between diversity and the adoption of ABC. On the other hand, the other two types of diversity (volume and customization) are not statistically significantly associated with the adoption of ABC. These results may be interpreted as follows. Diversity in volume — i.e. the difference in the volume of each product manufactured — may not be a real source of difficulty for cost allocation,

since studies carried out in different countries show that the allocation bases generally used by companies are mainly related to volume (Bhimani 1996, Lamminmaki and Drury 2001). It is therefore likely that diversity in volume is already properly taken into account by the systems used in organizations, which reduces the benefit to be obtained by adopting the ABC method. It is possible that diversity in customization is just a smaller division of diversity in variety. Indeed, we can imagine that the degree of customization is correlated to the number of products: a product that has been highly customized for a customer will be considered as an additional product in the range. It would therefore be desirable to verify that these two types of diversity — variety and customization — are indeed different constructs. Finally, it is possible that the link between customization and the adoption of ABC may not be significant due to the relatively small number of observations available in the literature: 770 versus 2,803 and 3,944 respectively for diversity in volume and in variety.

The use of meta-analysis also allowed us to test the influence of different moderator variables to explain the heterogeneity of results. The third result of our study thus shows that only the business sector has a moderating effect on the relationship between product diversity and adoption of the ABC method. The relationship between product diversity and the adoption of ABC is only significant within the group of studies whose sample is limited to industrial companies. When samples mix industrial, distribution and service sectors, the association between diversity and adoption of the ABC method is not significant. This result may appear surprising insofar as the concept of product diversity applies to both industry and services or distribution, and the usefulness of the ABC method in a context of high diversity is potentially the same, regardless of the business sector. Nevertheless, it is possible that the use of ABC may be more appropriate to take into account high diversity in an industrial environment due to the nature of the indirect costs to be handled (Drury and Tayles 2005). A large proportion of these costs may be related to the consumption of technological resources and by activities with transaction-based cost drivers, which is more easily taken into account by the ABC method. In services, on the other hand, a large proportion of costs are often related to wages and time spent on activities with support-based cost drivers. These costs are particularly difficult to allocate in a non-arbitrary way, even with the ABC method, thus greatly reducing the advantages in using it. Nevertheless, the time-driven variant of the ABC method (TDABC) has been specifically designed to address this problem of cost allocation in service activities (Kaplan and Anderson 2008). It would therefore be interesting to further research specifically on the adoption of TDABC in the service sector.

Among the other moderator variables tested, the fact that companies that were considering the adoption of ABC were included in the group of adopters has no impact on the size of the effect between product diversity and the adoption of ABC. This seems a surprising result. Considering companies thinking about adoption as actual adopters appears to us inappropriate. There is no indication that these companies will finally adopt the ABC method after careful consideration. Indeed, several studies show that a certain proportion actually decide not to adopt the method (Bjørnenak 1997, Alcouffe and Guedri 2008). To measure the influence of a factor on the decision to adopt an innovation, it is better to compare companies that have adopted the innovation with those that have rejected it after due consideration, and to leave aside those still in the process of considering adoption because it is impossible to know in which of the two groups (adopter/non-adopter) they will find themselves after the consideration step. However, this result may be due to the fact that the proportion of companies still in the consideration phase is relatively low in the studies included in our sample and that, among them, only an even smaller proportion go on to reject ABC. Companies wrongly considered as adopters would thus represent a very small proportion of the total sample, explaining why this moderator variable is not significant in our results.

Finally, our results show that focusing the study on a business unit or the company as a whole does not have a significant impact on the size of the effect between product diversity and the adoption of ABC. Like when companies still considering adoption were counted as adopters, we found this result somewhat surprising. It contradicts the arguments put forward by some authors (Krumwiede 1998, Al-Omiri and Drury 2007, Al-Sayed and Dugdale 2015) justifying a focus on individual business units by the fact that product diversity may very well differ between two entities in the same organization, and that ABC may also be adopted within a restricted organizational scope. As these two variables may have different values from one entity to another within the same organization, it would be more logical to study their relationship entity by entity, and not organization by organization. The results of our meta-analysis do not support this reasoning, which leads us to encourage future research to address this issue.

5.2. Towards a resolution of the paradox of management accounting innovations

This article has allowed us to raise a number of issues that we believe justify a review of the paradox concerning ABC and MAIs. This paradox is based on the apparent contradiction between the limited diffusion of MAIs observed in the literature and the promises of these

innovations to meet the growing management needs of organizations. Poole and Van de Ven (1989) propose four strategies for addressing management paradoxes and drawing out theoretical contributions. One strategy is to introduce a new way of defining concepts in order to solve the paradox. We believe that it is possible to mobilize this strategy to solve the paradox of MAIs and thus make an important contribution to the literature on MAIs. In our opinion, the paradox can only be solved by a better specification of adoption factors as well as a new approach to the concepts of adoption and successful diffusion.

A paradox consists of two contrary or even contradictory propositions (Poole and Van de Ven 1989)⁶. The two propositions constituting the paradox of MAIs are as follows: a) MAIs meet the needs of organizations, so they should be adopted and b) the diffusion of MAIs is a failure; their diffusion is very limited.

The second result of this article highlights that among the different types of product diversity, only diversity in variety is significantly associated with the adoption of ABC. This result makes it possible to better specify the type of organizations that ABC addresses, and encourages us to modify proposition a) of the paradox applied to ABC. This proposition thus becomes: ABC is geared to organizations with a wide variety of products, and should be adopted by these organizations⁷. Accordingly, proposition (b) of the paradox is no longer necessarily in contradiction with reformulated proposition (a), because organizations with a wide variety of products represent only a subset of the total population of organizations. An overall diffusion rate of 15% presented as a “failure” could ultimately turn out to be a “success” if it actually corresponds to 60% of organizations having a wide variety of products. In other words, the assessment of the success or failure of an innovation’s diffusion is relative. We now propose to assess it by using a diffusion rate calculated using only those organizations most likely to benefit from the adoption of the innovation in question as a denominator, rather than using all the organizations in a sample or population. In our opinion, this first argument is sufficient for the literature on MAIs to reconsider the paradoxical nature of their diffusion and free itself as much as possible from the “pro-innovation” bias (Rogers 1995) which often leads it to consider that the adoption of an MAI is always beneficial to all organizations.

Another way of solving the paradox is to change the way in which the adoption of MAIs is defined and operationalized. The vast majority of studies model adoption either as a multi-step process or as a binary phenomenon (adoption/non-adoption). As we saw in our literature review, studies that use a multi-step model most often end up reducing the phenomenon to

two steps in their statistical tests. The measurement of a diffusion rate based on this binary representation of adoption lacks information and only very imperfectly reflects the complexity of the phenomenon. It does not factor in the fact that an innovation can be used to varying degrees and in different ways. Askarany and Yazdifar (2011), for example, show that ABC diffusion rates in Australia, New Zealand and the United Kingdom are higher when organizations are asked about how they use ABC principles rather than when they are asked the binary question of whether or not they have adopted this method. This question is of particular importance considering that the definition of MAIs is often unclear.

It is not easy to answer the question “what is an ABC system?” or “what is a Balanced Scorecard?”. In the absence of a definition that is known and recognized by the vast majority of practitioners, it is quite possible for an organization to use an innovation without knowing it, and declare itself as a “non-adopter” in a diffusion survey. The company studied by Jorgensen and Messner (2010), for example, uses many strategic management accounting tools without ever calling them that. Several consultants interviewed by Alcouffe (2004) stated that they do not mention the term “ABC method” when they implement it for their clients. The opposite is also possible: some survey respondents may report having adopted ABC, but it is not possible to determine the “truth” of this statement with any certainty in the absence of a standard definition.

In our opinion, this second set of arguments justifies reconsidering proposition (b) of the paradox, because it is possible that MAI diffusion rates may be higher than they appear to be⁸. In addition, the fact that the results of our meta-analysis show that including consideration of adoption as adoption has no impact on the relationship between product diversity and adoption of the ABC method suggests that the measurement of adoption as a step is likely to be less relevant than that which would take into account the degree to which the innovation is used. It would be interesting to test this hypothesis. This brings us to the third part of the discussion, which corresponds to future avenues of research.

5.3. New avenues of research in management accounting innovations

The ABC systems adopted in organizations can take different forms, but this variety is rarely taken into account in the literature. This observation may be generalized to all MAIs (Günther and Gäbler 2014). However, the failure to take into account the varying degrees of use and the different forms that the implementation of these innovations can take is not only a source of heterogeneity in the study of their adoption factors (cf. §5.1.) but also leads to the false

assumption that their diffusion is paradoxical (cf. §5.2.). We therefore believe that it would be beneficial to invite future research to deepen our knowledge of the different forms that MAIs can take once adopted and implemented, as well as their different uses.

The main priority for further developing this line of research would be to carry out in-depth case studies that can be used to develop better hypotheses than those currently tested on large samples. We agree with Nixon and Burns (2012) that such studies are still too rare. In the case of ABC, exploratory research (Gosselin and Mévellec 2003, Mévellec 2003, Bertrand and Mévellec 2008) has shown, for example, that the systems implemented may vary with regard to the introduction of transversality into activities and/or processes, but little is yet known about the factors that lead organizations to make such choices.

A second avenue of research concerns product diversity and its relationship to the adoption of MAIs. By clarifying the relationship between diversity and adoption of ABC, our study suggests that future research should focus on using diversity in variety as a control or moderator variable in the study of other adoption factors. It would also be beneficial to empirically verify that the adoption of ABC really does have a positive effect on the performance of organizations with substantial product diversity. This is not in fact limited to ABC (Ittner *et al.* 2002, Zawawi and Hoque 2010) and is an interesting focus for all studies on the consequences of MAI adoption.

The production of new knowledge about the consequences of adopting MAIs would also confirm or refute proposition (a) of the paradox, namely that they are correctly geared to the needs of the organizations that adopt them. Negative results, although probably unsatisfactory in the eyes of a large part of the community, would resolve the paradox.

In addition, we believe that the relationship between the adoption of MAIs and product diversity deserves to be better theorized and explored empirically to a greater extent. Diversity is a complex and multi-dimensional concept, as we saw in our meta-analysis. It would be beneficial, for example, to shed more light on the initial work focusing on the relationship between customization diversity and the adoption of strategic management accounting tools in the development processes of new products (Bouwens and Abernethy 2000, Abernethy *et al.* 2001). The study by Jorgensen and Messner (2010) shows, for example, that management accounting tools play a fundamental role in resource allocation decisions and the operational management of new product development activities. It can therefore be assumed that the adoption of MAIs influences the diversity of an organization's products, while studies on adoption factors are based on the opposite assumption. Future

studies would benefit from considering a two-way relationship between product diversity and the adoption of MAIs.

Finally, the average level of product diversity is probably not the same from one business sector to another (Messner 2016) and does not have the same management accounting consequences in an industrial or service sector (Modell 1996, Malleret 2006). It would be useful if future research on MAIs could address this issue, especially since the results of our meta-analysis show that the relationship between product diversity and adoption of ABC is only significant within studies that are limited to companies from an industrial sector. Again, it would be valuable to explore this issue through in-depth case studies.

Conclusion

The literature on MAIs is a major field of research that has continued to develop over the past thirty years or so. Although it has produced a great deal of knowledge, this abundant literature suffers from two major knowledge gaps. The diffusion of MAIs seems paradoxically limited, and studies on adoption factors have so far failed to build a solid and cumulative knowledge base over time (Atkinson *et al.* 1997). By addressing these two limitations through the implementation of a meta-analysis of the relationship between product diversity and adoption of ABC, this article represents an important contribution to the literature. Our focus on this emblematic case in the literature has allowed us to highlight the current state of knowledge, its limitations and avenues for future research. In addition, at managerial level, we have tried to enlighten practitioners on the type of product diversity that best justifies implementation of the ABC method.

As with any research, this paper has its own limitations. First of all, only sampling errors and publication bias could be controlled in the meta-analysis due to the sometimes limited information available in the studies included. The imperfect validity of the constructs could not, for example, be corrected. In addition, other confounding factors may exist (size of the company, training of managers, etc.) but could not be included in the analysis due to a lack of information in the articles. Secondly, the quantitative meta-analysis carried out does not, by its very design, allow the results of case studies on the subject to be integrated. As previously indicated, future research initiatives need to include such qualitative studies in order to produce new knowledge on the heterogeneity of MAIs. Thirdly, the causal relationship between product diversity and adoption of the ABC method cannot be assessed by a quantitative meta-analysis based on cross-sectional studies. Future research based on

(possibly longitudinal) case studies is therefore needed to determine the extent to which diversity fosters adoption or, on the contrary, the extent to which adoption encourages (or discourages) product diversity. It is actually possible that, by making the cost of different kinds of diversity visible, the adoption of ABC will encourage companies to reduce diversity.

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NB: The studies included in the meta-analysis are preceded by an asterisk.

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Appendices

Appendix 1. Characteristics of the 24 studies included in the meta-analysis

Authors	CNRS-ranked journal	Country	Sample size	Type of diversity ^a	Consideration included in “adopter” group	Level of analysis	Business sector	Step-by-step model	Effect size (Hedges' <i>g</i>) ^b	Standard deviation	Weight (inverse-variance weighting)	Meaning of the relationship
Ahmadzadeh <i>et al.</i> (2011)	No	Iran	57	Variety	No	Company	All	Yes	0.175	0.191	27.45	+
			57	Volume	No				-0.177	0.130	59.21	-
			57	Support	No				-0.034	0.160	38.86	-
			57^c	Average	No				-0.012	0.304	10.86	-
Al-Omiri and Drury (2007)	Yes	United Kingdom	153	Volume	N/A	Business Unit	All	Yes	-0.018	0.097	106.06	-
			153	Support	N/A				-0.134	0.104	92.05	-
			153	Average	N/A				-0.076	0.171	34.32	-
Al-Sayed and Dugdale (2015)	Yes	United Kingdom	152	Composite	N/A	Business Unit	Industry	Yes	0.082	0.163	37.44	+
Bjørnenak (1997)	Yes	Norway	53	Variety	No	Company	Industry	Yes	1.607	0.315	10.11	+
			53	Customization	No				-3.050	0.403	6.16	-
			53	Average	No				-0.721	0.282	12.58	-
Brierley (2011)	No	United Kingdom	186	Customization	No	Business Unit	Industry	Yes	-0.195	0.340	8.63	-
			169	Customization	No				-0.204	0.341	8.59	-
			73	Customization	No				-0.318	0.353	8.02	-
Brown <i>et al.</i> (2004)	Yes	Australia	150	Composite	Yes	Business Unit	All	Yes	0.046	0.021	2,376.41	+
			150	Composite	Yes				0.018	0.026	1,451.40	+
			46	Composite	No				0.103	0.160	39.13	+
Charaf and Bescos (2013)	No	Morocco	62	Composite	No	Company	All	Yes	0.460	0.314	10.17	+
Chen <i>et al.</i> (2001)	No	Hong Kong	90	Variety	Yes	Company	All	Yes	0.526	0.291	11.82	+
			90	Customization	Yes				0.414	0.290	11.88	+
			90	Average	Yes				0.470	0.291	11.85	+
Chongruksut and Brooks (2005)	No	Thailand	61	Complexity	Yes	Company	All	Yes	0.770	0.265	14.25	+
			61	Variety	Yes				0.434	0.259	14.95	+
			59	Variety	Yes				0.027	0.292	11.73	+
			61^d	Average	Yes				0.410	0.261	14.64	+
Clarke <i>et al.</i> (1999)	Yes	Ireland	204	Variety	No	Company	Industry	Yes	0.646	0.417	5.74	+
			204	Variety	Yes				0.311	0.218	21.02	+

Authors	CNRS-ranked journal	Country	Sample size	Type of diversity ^a	Consideration included in “adopter” group	Level of analysis	Business sector	Step-by-step model	Effect size (Hedges' g) ^b	Standard deviation	Weight (inverse-variance weighting)	Meaning of the relationship
Dahlgren <i>et al.</i> (2001)	No	Sweden	145	Variety	No	Company	Industry	Yes	0.202	0.204	23.96	N/A
			145	Customization	No				0.251	0.204	23.92	N/A
			145	Complexity	No				0.186	0.204	23.98	N/A
			145	Volume	No				0.171	0.204	23.99	N/A
			145	Average	No				0.203	0.204	23.96	N/A
Groot (1999)	No	Netherlands	116	Variety	Yes	Company	Industry	Yes	0.135	0.212	22.16	+
			116	Variety	No				0.071	0.315	10.07	+
Ismail and Mahmoud (2012)	No	Egypt	82	Composite	No	Company	Industry	Yes	0.221	0.709	1.99	+
Ittner <i>et al.</i> (2002)	Yes	United States	2,328	Variety	No	Business Unit	Industry	No	0.093	0.064	244.65	+
			2,328	Volume	No				-0.068	0.056	322.71	-
			2,328	Average	No				0.012	0.047	448.06	+
Jusoh and Miryazdi (2015)	Yes	Iran	188	Variety	Yes	Company	Industry	Yes	0.118	0.066	226.53	+
			188	Variety	No				0.372	0.123	66.10	+
			188	Variety	No				0.329	0.143	49.06	+
Kallunki and Silvola (2008)	Yes	Finland	105	Customization	No	Company	All	No	-0.004	0.217	21.30	-
			105	Variety	No				0.093	0.217	21.28	+
			105	Average	No				0.045	0.217	21.30	+
Khalid (2005)	No	Saudi Arabia	39	Variety	No	Company	All	Yes	0.921	0.466	4.60	+
Krumwiede (1998)	Yes	United States	225	Composite	No	Business Unit	Industry	Yes	0.513	0.103	93.61	+
Maelah and Ibrahim (2007)	No	Malaysia	108	Composite	No	Company	Industry	No	0.564	0.355	7.95	+
Malmi (1996)	No	Finland	271	Variety	No	Business Unit	Industry	Yes	0.292	0.157	40.48	+
Nguyen and Brooks (1997)	No	Australia	120	Complexity	Yes	Company	Industry	Yes	0.475	0.222	20.22	+
			120	Complexity	Yes				0.451	0.222	20.26	+
			120	Variety	Yes				0.326	0.221	20.44	+
			120	Volume	Yes				0.255	0.221	20.51	+
			120	Complexity	Yes				0.113	0.220	20.61	+
			120	Average	Yes				0.324	0.361	7.66	+

Authors	CNRS-ranked journal	Country	Sample size	Type of diversity ^a	Consideration included in the adoption	Level of analysis	Business sector	Step-by-step model	Effect size (Hedges' <i>g</i>) ^b	Standard deviation	Weight (inverse-variance weighting)	Meaning of the relationship
Pavlatos and Paggios (2009)	No	Greece	85	Variety	No	Company	Services	Yes	0.165	0.254	15.55	+
Rbaba'h (2013)	No	Jordania	82	Variety	No	Company	Industry	No	0.001	0.003	134,105.22	+
Schoute (2011)	Yes	The Netherlands	191	Composite	No	Company	Industry	Yes	0.428	0.192	27.17	+
			191	Customization	No				-0.027	0.191	27.54	-
			191	Composite	No				0.201	0.191	27.44	+
			178	Overall	No				0.448	0.238	17.73	+
			178	Customization	No				-0.243	0.237	17.85	-

Notes:

- Some articles test the association between the adoption of ABC and several specific types of diversity separately. Table 1 thus gives the details of effect sizes by type of diversity. When the study did not measure diversity in a composite way, we calculated the arithmetic mean of the effect sizes for the different types of diversity to include it in the main meta-analysis.
- When coding the articles, Cohen's *d* was calculated from the statistical information available by following the procedures of Lipsey and Wilson (2001), then transformed into Hedges' *g* by multiplying it by the following correction factor, *J*:

$$J = 1 - \frac{3}{4df-1}$$
where *df* is the study's degree of freedom (Borenstein *et al.* 2009). The variance of *g* is thus calculated such that: $V_g = J^2 \times V_d$.
- The bold lines represent the effect sizes selected for each study in the main meta-analysis.
- The arithmetic mean of the effect size was calculated over the article's five diversity measurements, even though one of them was based on a sample of 59 companies rather than 61.

Appendix 2. Methodological details on the data processing applied

The meta-analyses carried out during this study were performed with the macros “MeanES.ado” and “MetaF.ado” for Stata by David Wilson (available at the following URL: <http://mason.gmu.edu/~dwilsonb/ma.html>) and with Stata 13 meta-analysis packages. The coding of articles was first carried out on Excel, once individually by each of two researchers from the team, and a second time collectively in order to resolve all the disparities revealed during the first coding.

Studies on the relationship between product diversity and adoption of the ABC method are based on the comparison of independent samples of companies that are either an “adopter” or a “non-adopter.”

The effect size statistic suited to this meta-analysis is the standardized mean difference (Lipsey and Wilson 2001, Cooper *et al.* 2009). Two statistics are available in the literature: Hedges’ g corrects Cohen’s d of an overestimation of absolute value in the case of small samples (Cooper *et al.* 2009).

For each study included, Cohen’s d and its variance were calculated for each diversity measurement using the conversion procedures described by Lipsey and Wilson (2001) based on available statistics⁹. Cohen’s d and its variance were then corrected to obtain Hedges’ g as the effect size for the meta-analysis. For the calculation of the average effect size, each study was assigned a weight equal to the inverse of the variance of its effect size to favor studies with more accurate results due to a larger sample size. To assess the significance of the average effect size, a z test was calculated using $Z = \frac{|\overline{TE}|}{ET_{\overline{TE}}}$, where \overline{TE} is the average effect size and $ET_{\overline{TE}}$ its standard deviation. Cohen (1988) observes that an effect size based on a standardized mean difference (such as d or g) is considered small if it is less than 0.2, medium if it is around 0.5 and large if it is greater than 0.8 (Lipsey and Wilson 2001).

In order to have only one effect size per study (independent statistical unit), we calculated the arithmetic mean of the effect sizes when the (different) diversity measurements focused on the same sample as recommended by Schmidt and Hunter (2015)¹⁰ (e.g. for Ahmadzadeh *et al.* 2011). In the other cases, we selected the effect sizes corresponding to the largest sample in the study (e.g. for Brierley 2011), a multivariate rather than univariate model (e.g. for Brown *et al.* 2004) and the inclusion of companies considering adopting ABC in the “adopter” company group (e.g. for Clarke *et al.* 1999, Groot 1999, Jusoh and Miryazdi 2015). Appendix 1 shows in bold type the effect sizes chosen for the main meta-analysis.

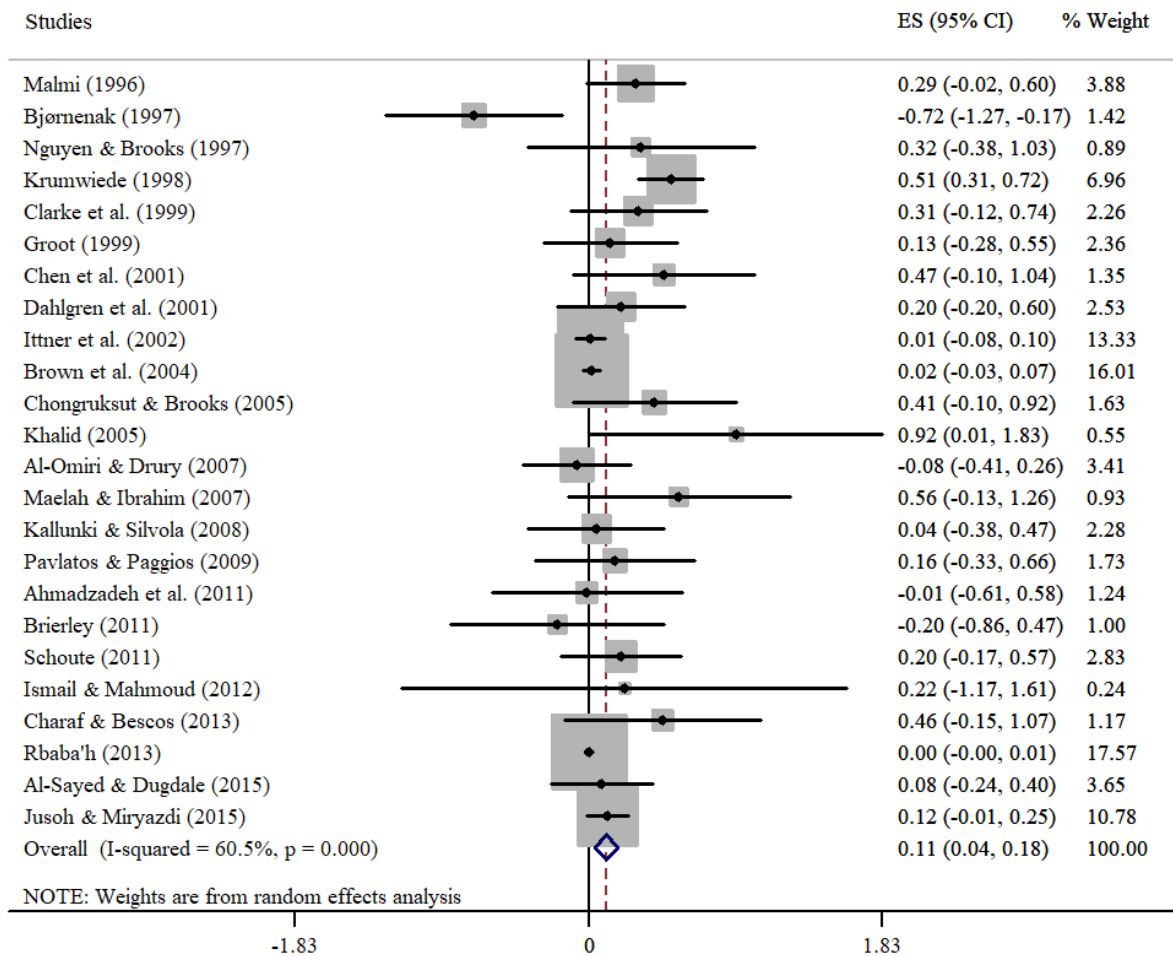
The average effect size, its standard deviation and its confidence interval — the main result of the meta-analysis — can be estimated by two models: a fixed effects model or a random effects model. If the effect sizes are homogeneous, i.e. if they are derived from the effect size of a single population, then the fixed effects model can be considered. Should the effect sizes be heterogeneous, the random effects model should be preferred. The latter limits bias in estimating this average effect size by taking into account the sampling errors of studies included, as well as other sources of variation assumed to be randomly distributed (Lipsey and Wilson 2001). Two measurements of heterogeneity are used in the literature. The first is based on a Q statistic following a chi-square with $(k - 1)$ degrees of freedom, where k is the number of studies included in a meta-analysis. When there is only a small number of studies, statistic I^2 is sometimes preferred, and calculated such that $I^2 = 100 \% \cdot \frac{Q - df_Q}{Q}$.

Several confounding factors, such as publication bias and small-study effects, are likely to threaten the validity of a meta-analysis that must therefore be adjusted if necessary (Rücker *et al.* 2011). Publication bias results from the failure to take into account all available studies on the subject insofar as: (1) at the time of the meta-analysis, some studies are still in the publication process (pipeline bias), (2) it is difficult to access some studies because of their publication language or availability, (3) only (or only the majority of) studies with significant results are published and (4) only (or only the majority of) studies applying certain research methods are published. The effects of small samples imply that some of the studies included in the meta-analysis report strong and significant effects that are due only to the poor quality of the research protocol, inappropriate analyses or even fraud (Egger *et al.* 1997, Sterne *et al.* 2011). We tested the existence of these confounding factors in the results section.

In order to determine other causes of inter-study heterogeneity, we used a meta-analytical ANOVA. This test consists in breaking down the meta-analysis's total variance (the Q statistic) into inter-study variance and intra-study variance according to a variable that may explain the heterogeneity. If the variable in question does explain the heterogeneity, then the inter-study variance resulting from its inclusion should tend towards zero and not be significant. This implies that the total variance is explained mainly by the intra-study variance, with heterogeneity being controllable by the random effects model. We performed this meta-analytical ANOVA on five variables that could cause heterogeneity in the overall meta-analysis (see Table 3).

Indeed, one of the contributions of meta-analytical designs is to allow the discovery of variables that moderate the relationship of interest (Shadish and Sweeney 1991, Steel and Kammeyer-Mueller 2002, Cortina, 2003). This discovery is possible through meta-analyses in sub-groups or, more relevantly (Steel and Kammeyer-Mueller 2002), through meta-regressions (weighted least squares). Since our potential moderator variables are mostly categorical or dichotomous, it is not possible to use meta-regressions. We therefore based our tests for moderator variables on meta-analyses in sub-groups, the results of which are presented in section 4.

Appendix 3. Forest plot of the overall meta-analysis



The effect sizes for each study (Hedges' g) are represented by the black dots. The horizontal black lines represent the 95% confidence interval for the effect size, and the gray square the weight of the study in the total sample (in %). The average effect size is represented by the discontinuous vertical line, and its confidence interval by the diamond at the bottom of the plot.

End notes

¹ The key concept in this research topic is that of “fit,” according to which a cost calculation system must be well-matched to certain contextual variables for an organization to be efficient. The literature reports two approaches to the concept of fit: selection and interaction (Gerdin and Greve 2004). The vast majority of studies on the determinants of the adoption of ABC — as well as the 24 studies in our sample — adopt the first approach. These studies assume that it is unlikely that an inefficient costing system will be adopted and used for a long time in a rational organization.

² Our thanks to one of the two anonymous reviewers for having suggested this idea.

³ This plot shows the effect size of each study on the x-axis and, using an inverted scale on the y-axis, the precision of the study in the meta-analysis, often measured by the standard deviation of the effect size (Sterne *et al.* 2011). The more robust the results of a study, the closer it will be to the top of the plot and vice versa. In the absence of bias, the plot is symmetrical and looks like an inverted funnel (Sterne and Harbord 2004). Asymmetry tests are often associated with this visual inspection of the funnel plot (Begg and Mazumdar 1994, Egger *et al.* 1997, Harbord *et al.* 2006, Peters *et al.* 2006).

⁴ This non-parametric method consists in estimating the number of missing studies and correcting the average effect size until a symmetrical funnel plot is obtained (Rücker *et al.* 2011).

⁵ For studies focusing only on business units, the relationship between diversity and adoption of the ABC method is only significantly positive for a first-order error of 10%. There may be an interaction between the business sector and level of analysis. This interaction could be detected using a meta-regression but, as specified at the end of Appendix 2, this method is impossible to implement with categorical or dichotomous variables. We must therefore remain cautious about the inference we draw from Table 4 (result 3b).

⁶ This definition of the concept of paradox has been criticized (see in particular Lewis 2000) because it corresponds to what is generally considered to be a contradiction. However, it is possible to extricate yourself from a contradiction by choosing one of the two alternative branches, whereas a paradox increasingly confines you. We nonetheless chose to use the term “paradox” in this article because it echoes the term “ABC paradox” used in the management accounting literature. We would like to thank the co-editor for drawing our attention to this point.

⁷ It should be remembered that a large proportion of the literature on the diffusion of managerial innovations, including that on management accounting, adopts a rational vision of the behavior of organizations according to which the adoption of innovations meets technical needs. This is the case for all the articles that constitute the corpus of our meta-analysis. This rational-technical outlook on the adoption phenomenon is necessarily limited, and several studies have shown that other forms of rationality can intervene (mimetic and coercive isomorphisms, the influence of actors, and power rationales, etc.).

⁸ These arguments remain to be explored on an empirical basis. Furthermore, we are talking here about diffusion rates without prejudging the use of the ABC method within the organizations that adopt it. As the literature has already pointed out, it is possible that this adoption is only symbolic or that it responds to mimetic pressures, and that the tool adopted is not actually used substantially by the organization's stakeholders — or that its use is limited to a very small number of actors, and possibly even a single actor.

⁹ The detailed calculations of effect sizes per article are available from the authors upon request.

¹⁰ Bijmolt and Pieters (2001) recommend using the method suggested by Raudenbush *et al.* (1988), which consists in considering the multiple effect sizes of a study as dependent replications. This has the advantage of limiting bias and increasing the power of meta-analytical tests. However, to apply this method it is necessary to have correlations between dependent variables (in this case, the different types of diversity), which were not available in the articles in our sample.