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Building Micro-foundations for the Routines, Capabilities and,
Performance Links

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Abstract:

Micro-foundations have become an important emerging theme in strategic management. This paper addresses micro-foundations in two related ways. First, we argue that the kind of macro (or “collectivist”) explanation that is utilized in the capabilities view in strategic management — which implies a neglect of micro-foundations — is incomplete. There are no mechanisms that work solely on the macro-level, directly connecting routines and capabilities to firm-level outcomes. While routines and capabilities are useful shorthand for complicated patterns of individual action and interaction, ultimately they are best understood at the micro-level. Second, we provide a formal



model that shows precisely why macro explanation is incomplete and which exemplifies how explicit micro-foundations may be built for notions of routines and capabilities and for how these impact firm performance.

Key words: Routines, capabilities, micro-foundations, production function

Jel codes: L2, M1

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INTRODUCTION

Micro-foundations have become an important emerging theme in strategic management. Scholars increasingly realize that understanding such issues as value appropriation (Coff, 1999; Lippman and Rumelt, 2003a; Barney, 2001), resource value (Lippman and Rumelt, 2003b; Foss and Foss, 2005), strategy implementation (Barney, 2001), factor market dynamics (Makadok and Barney, 2001), inertia (Kaplan and Henderson, 2005), and firm-level heterogeneity (Felin and Hesterly, 2006; Gavetti, 2005) requires that substantial attention be paid to explanatory mechanisms that are located at the “micro-level,” that is, the level of individual action and (strategic) interaction. It seems that strategic management is now embarking on a micro-foundations project somewhat similar to similar projects in (macro)economics (Leijonhufvud, 1968; Lucas, 1977) and rational choice sociology (Elster, 1989; Coleman, 1990; Abell, 2003a&b).

This paper contributes to the emerging micro-foundations project theoretically and methodologically. Specifically, we address the emphasis placed upon routines and capabilities as key constructs in much of strategic management research and try to clarify the underlying logic of this emphasis. A central argument in much work in strategic management is that routines or capabilities are fundamental units of analysis, and that organizations should be conceptualized as repositories of routines and capabilities (e.g., Nelson and Winter, 1982; Kogut and Zander, 1992). It is, furthermore, asserted in this stream of research that routines and capabilities cause firm-level outcomes, such as financial performance, innovation, and the boundaries of the firm (e.g., Nelson and Winter, 1982; Kogut and Zander, 1992; Teece, Pisano and Shuen, 1997; Eisenhardt and Martin, 2000; Winter, 2003). Thus, it is argued that explaining firm-level outcomes should take place in terms of other firm-level variables.

Two explanatory gaps — of which we shall primarily concentrate on the second one — stand out in this research stream. First, there is little recognition of the need to explain the origins (or emergence) of routines and capabilities (except perhaps in terms of other routines and capabilities). Second, exactly how routines and capabilities are related to firm-level outcomes, such as performance, is seldom elaborated (cf. Argote and Ingram, 2000: 156). Thus, crucial explanatory theoretical mechanisms are left unexplored and implicit.

We argue that gaps related to underlying micro-foundations cannot be bypassed, they need to

be explicated, and that in addressing these gaps one must involve the level of individual action and interaction. The reason is fundamentally that the macro (or “collectivist”) mode of explanation that currently dominates large parts of the strategic management literature, and which asserts a causal relation running directly from routines and capabilities to firm-level outcomes, is incomplete. To be sure, firm-level concepts such as routines and capabilities may be (indeed, are) relevant to the explanation of firm-level outcomes. However, they are relevant because they are useful shorthand for complicated repetitive patterns of individual action and coordinated interaction. Thus, the micro-level (i.e., individual action and interaction) ultimately replaces the macro-level (i.e., the postulated direct link between routines/capabilities and performance) in the explanation of how routines/capabilities and performance are linked.

To clarify this argument, we develop a formal model that details the importance of the micro-level in explaining firm-level outcomes. The arguments, and the accompanying modelling effort, explain how micro-foundations can be built for capabilities and how they are linked to firm-level outcomes. Thus, the paper is offered as one way of furthering the received capabilities view in strategic management (cf. Zollo and Winter, 2001). Specifically, we argue that the nature of routines is to internalize externalities. This argument harmonizes with the emphasis in the literature on routines as coordinating devices (Nelson and Winter, 1982: Chapter 5). However, because of asymmetric information routines only imperfectly internalize externalities. This second-best argument harmonizes with the emphasis in the literature which suggests that routines are often not optimal (Nelson and Winter, 1982). However, we diverge from the literature, first, by explicitly modelling the micro-foundations of how routines impact performance; second, by embedding our arguments in a conventional production function framework; and third, by modelling production externalities as giving rise to prisoners’ dilemma situations rather than to coordination problems. Finally, we link routines and capabilities in a simple manner by arguing that a firm can be described as possessing the capability to realise a routine to the degree that it can repeatedly internalise such externalities (i.e., realize synergies).

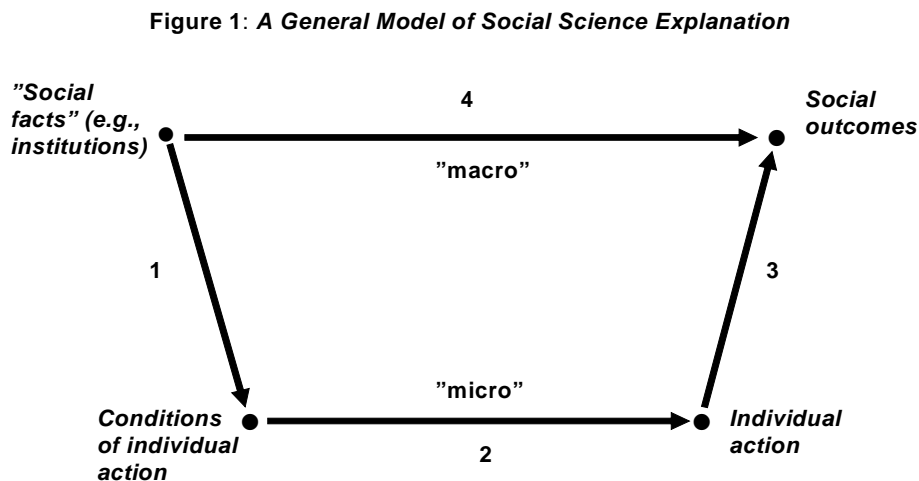
ANALYTICAL LEVELS IN STRATEGIC MANAGEMENT

Many phenomena of interest in the strategic management field, such as financial performance, diversification patterns, vertical integration, competitive rivalry, etc., are placed on a

level of analysis that is above that of the individual. In fact, *explananda* (i.e., the dependent variables) in strategic management are usually placed at the level of the firm. However, the *explanans* (i.e., the independent variables and the mechanisms that link them to the dependent variables) may involve other levels of analysis as well, such as the dyadic level, the industry level, or the level of individuals. Any theoretical and empirical effort to explain phenomena in strategic management has to make a choice that concerns the level(s) at which explanation takes place (Dansereau et al., 1999). A classic distinction in social science research is between the collective and the individual level (Coleman, 1990: 3-5; Lazarsfeld and Menzel, 1970), which in the context of organizational theory and strategic management corresponds to a distinction between “macro” and “micro.” We argue that strategic management research has too often located not only the *explanandum* (which is entirely legitimate) on the collective or macro level, but also all of the *explanans* (which is often problematic).

A General Model of Social Science Explanation

In order to clarify notions of “micro”/“individual level,” and “macro”/“collective level,” as well as examine the relations between these notions and levels, consider Figure 1 which builds on the framework popularized by James Coleman (1990). This framework organizes much of our discussion and modelling effort.



The figure makes a distinction between the macro-level and the micro-level. For example, it may be that the macro-level is organizational whilst the micro-level is that of individuals. As shown, there are links between macro-macro (arrow 4) and macro-micro (arrow 1), micro-micro (arrow 2), and micro-macro (arrow 3).¹ The figure also makes a distinction, perhaps more implicit, between what is to be explained (i.e., the *explanandum*) and its explanation (i.e., the *explanans*). In social science, the aim usually is to explain either a macro-level phenomenon (located in the upper right hand corner of figure 1), such as a firm-level outcome, or a link between macro-phenomena, as indicated by arrow 4. An example of the latter may be an observed correlation between the routines and the performance of firms in a population. To explain and understand a particular phenomenon (such as overall firm performance) the analyst makes use of theoretical mechanisms that are consistent with the arrows. Note that the arrows in Figure 1 are, from a theoretical perspective, empty boxes. They may be filled with different theoretical mechanisms, entirely dependent on theory development on the part of the analyst. (Our later modelling effort is an example of development of such concrete theoretical content).

Macro Explanation in Strategic Management

At first inspection, the framework depicted in Figure 1 would seem to formally allow for explanation that takes place solely in terms of arrow 4, that is, explanatory accounts that are wholly located on the macro level. However, whether arrow 4 explanation is deemed legitimate depends on (ontological) criteria related to an understanding of how the social world works (Mäki, 2001). Specifically, there are no conceivable causal mechanisms in the social world that operate *solely* on the macro level. There are no macro-level entities on the social domain that somehow possess capacities or dispositions to act (Cartwright, 1989) that make them capable of directly producing macro-level outcomes, and there are no processes of interaction between macro-entities that take place on this level. In short, there is no macro level causal mechanism that can be theoretically represented in terms of arrow 4.²

¹ Hedström and Swedberg (1996: 296-8) refer to arrow 1, 2 and 3 as “situational,” “individual action,” and “transformational” mechanisms, respectively. Hodgson and Knudsen (2004: Section 7) calls arrow “downwards causation.”

² Note that this point does not concern whether the *explanandum* can be placed on the macro level. Many (most)

However, arrow 4 explanation is not necessarily entirely ruled out. First, arrow 4 may be taken as no more than a representation of a correlation between macro variables in need of further explanation of the micro-level. This is entirely unproblematic. Second, arrow 4 may be used as convenient shorthand. “Convenient shorthand” here means that we can make use of arrow 4 explanations when we are convinced that they can be reduced to micro-mechanisms, but performing this reduction would not add anything in the explanatory context (cf. Stinchcombe, 1991). For example, there is no problem in asserting and showing that organizational culture perhaps is correlated with organizational performance. More generally, arrow 4 explanation may be legitimate when the relationship does not appear to be particularly puzzling, for example, because we have a good grasp of the underlying micro-mechanism (Abell, 2003b: 261).³ Be that as it may, it certainly is the case that several examples of arrow 4 “explanation” can be found, such as the arguments that routines are a direct cause of firm-level adaptation (Nelson and Winter, 1982), “combinative capabilities” cause firm-level innovativeness (Kogut and Zander, 1992), and different “absorptive capacities” cause differences in how well firms learn from partner firms in inter-organizational relations (Lane and Lubatkin, 1998).

It was briefly suggested above that macro explanation may be warranted under certain conditions. However, it would be hard to argue that these conditions are always met in strategic management research; in fact, it is rarely so. Thus, strategic management scholars do not have theories of why routines and capabilities impact firm performance that involve the micro-level, that is, at the level of individual action and interaction. Second, there is much reason to think that micro-level considerations add substantially to macro-level understanding. For example, a micro perspective suggests that macro-level heterogeneity can be an epiphenomenon of individual level self-selection. Further reasons why micro-foundations are in fact critical are given in the following.

explananda in social science are placed at this level (Coleman, 1990: 2) — notably, most of the phenomena that the strategic management field seeks to explain.

³ Moreover, it can be argued that for pragmatic reasons it is often times justified to do research *as if* arrow 4 causation existed. Thus, Stinchcombe (1991: 379-380) argues that “[w]here there is rich information on variations at the collective or structural level, while individual-level reasoning (a) has no substantial independent empirical support and (b) adds no new predictions at the structural level that can be independently verified, theorizing at the level of [individual level] mechanisms is a waste of time.”

Why Micro-Foundations Are Critical

We take the position — associated with “methodological individualism” — that the explanation of firm-level (macro) phenomena in strategic management must ultimately be grounded in explanatory mechanisms that involve individual action and interaction (cf. Hayek, 1952; Ullman-Margalitt, 1978; Elster, 1989; Coleman, 1990; Boudon, 1998). We also take it that the ultimate aim of scientific endeavour in the field of strategic management should be to identify and theorize the causal mechanisms — the “cogs and wheels” (Elster, 1989: 3) — that produce the observed associations between events (Cowan and Rizzo, 1996; Hedstrom and Swedberg, 1998).⁴

Combining methodological individualism with an emphasis on causal mechanisms implies that strategic management should fundamentally be concerned about how intentional human action and interaction causally produce strategic phenomena. It is implicit in this view that explanatory black boxes be avoided (Boudon, 1998). Admittedly, black boxes may sometimes be justified in terms of explanatory parsimony (Hedström and Swedberg, 1998:12; also see Coleman, 1990: 16), as indeed happens in much of arrow 4-type explanation. Strategic management scholars know (or should know) that when they speak of a firm appropriating a revenue stream, this is shorthand for a complicated underlying process of bargaining between numerous individual resource-owners and other stakeholders (Coff, 1999; Lippman and Rumelt, 2003). In a related vein, to say that a firm has a certain capability is essentially shorthand for a complex set of underlying individual actions and interactions, and associated characteristics or skills which make the realization of these capabilities possible. Because scholars may not always want to make explicit reference to complicated underlying patterns of actions, they often prefer to make use of explanatory shorthand in the form of collective concepts. This is completely legitimate. However, a fundamental methodological (and ultimately theoretical and managerial) problem in contemporary strategic management research is that it seems to be too often forgotten that explanation in strategic management should nevertheless have a micro-foundation.

Before proceeding to our modelling effort, we delineate, building on Coleman’s (1990: 3-4) insight, a number of reasons why micro-foundations are critical for strategic management. First, A

⁴ For an elaboration of mechanism-based explanation for a management audience, see Felin and Foss (2006). There is a huge literature in the theory of science on the nature and role of mechanisms in explanation. The interested reader may consult Cartwright (1989), Bunge (1997), Glennan (1996), and Machamer, Darden and Craver (2000).

problem with macro-level explanation is that there are likely to be many alternative lower-level explanations of macro-level behaviour which cannot be rejected with macro-analysis alone. Even if a large sample can be constructed on the basis of macro units of analysis, a problem of alternative explanations may persist. As indicated above, alternative explanations at lower levels are readily apparent in, notably, the capabilities view, which seeks the explanation of differential firm performance in firm-level heterogeneity, that is, heterogeneous routines and capabilities. However, heterogeneity may be located at the individual level, notably when individuals self-select into particular firms.

An argument for the importance of understanding micro-foundations lies in the fundamental mandate of strategic management: to enable managers to gain and sustain competitive advantage. To achieve this, managerial intervention is required, which inevitably has to take place with an eye to the micro-level.⁵ Coleman (1990: 3) convincingly argues that explanations that involve the micro level have the properties of being more stable, fundamental, and general than macro level explanations:

An explanation based on *internal analysis* [i.e., micro-foundations] of system [organization] behaviour in terms of action and orientations of lower-level units is likely to be more stable and general than explanation which remains at the system level. Since the system's behaviour is in fact *resultant* of the actions of its component parts, knowledge of how the actions of these parts combine to produce systematic behaviour can be expected to give greater predictability than will statistical relations of surface characteristics of the system.

To the extent that strategic management is concerned not just with explaining past performance but also with being prescriptive, Coleman's point raises an important concern: The ability to predict is a condition for putting forward prescriptions. Micro-foundations are therefore an important part of strategic management as a prescriptive enterprise.

⁵ . For example, a correlation between collective culture and collective outcomes inherently tells the manager very little of what should be done to change culture. Similarly, it makes little sense to argue that managers can directly intervene on the level of, for example, capabilities. Perhaps, however, managers can *influence* capabilities, for example, by hiring key employees (in which case the micro-level is directly involved) or by changing overall recruitment policies, reward systems, etc., all of which involves the micro-level.

ROUTINES AND CAPABILITIES

The seminal and in many ways founding contribution to the capabilities view is Nelson and Winter (1982). Their conceptualizations and insights have been fundamental to the way subsequent work on routines and capabilities has developed (Foss, 2003; Becker, 2004), not the least in strategic management (e.g., Teece, Pisano and Shuen, 1997; Dosi, Nelson and Winter, 2000; Eisenhardt and Martin, 2000).⁶ In this section we look at routines, first, as dependent variables (i.e., as *explananda*), and, second, as independent variables (i.e., part of the *explanans*). We argue that in both cases the extant literature has a problem with missing micro-foundations.

Explaining Routines

Nelson and Winter begin their analysis of routines from the notion of skill (Nelson and Winter 1982: chapter 4), which they define as "... a capability for a smooth sequence of coordinated behavior that is ordinarily effective relative to its objectives, given the context in which it normally occurs" (1982: 73).⁷ There are a number of reasons why the skill metaphor is attractive to Nelson and Winter (see Foss, 2003), but the one that is of interest in the present context is that the notion of skills is used to establish a link between individual action and organizational routines, even if that link is merely metaphorical. Routines are conceptualized by Nelson and Winter (1982: 124) as the "skills of an organization" and as "a repetitive pattern of activity in an entire organization" (ibid.: 97). Routines refer to repetitive interaction that is somehow patterned, typically (but not necessarily) in the form of fixed sequences of individual actions where the specific sequence and the contents thereof are organization-specific (i.e., firm A

⁶ Note that there is a fundamental difference in terms of levels of analysis between Nelson and Winter (1982) and later writers in strategic management: Nelson and Winter were interested in building (evolutionary) theories that would be rival to the dominant neoclassical approach with respect to explaining and predicting outcomes at the level of the industry (i.e., evolutionary price theory) and the level of the economy (i.e., evolutionary growth theory). Routines and capabilities were parts of this analytical enterprise, but the aim was not to explain them *per se*. This also explains why in Nelson and Winter's treatment, quite a lot is packed into the notion of organization routine, including a variety of behaviors (e.g., heuristics and strategies), organizational processes and arrangements, cognitive issues (e.g., "organizational memories"), and incentives ("truces"). The reason for this all-inclusiveness arguably is that "routine" is a catch-all concept for those collective-level aspects of an organization that may contribute to the relative rigidity of firm-level behavior that is so important in evolutionary theory. In contrast, strategic management is mainly interested in explaining and predicting competitive advantage, that is, a phenomenon that is placed on a level of analysis below that of the industry (or the economy), namely the level of the firm.

⁷ In their discussion of routines, Cohen et al. (1996) echo this definition almost verbatim when they define a routine as "... an executable *capability* for repeated performance in some *context* that has been *learned* by an organization in response to *selective pressures*" (Cohen et al., 1996: 683).

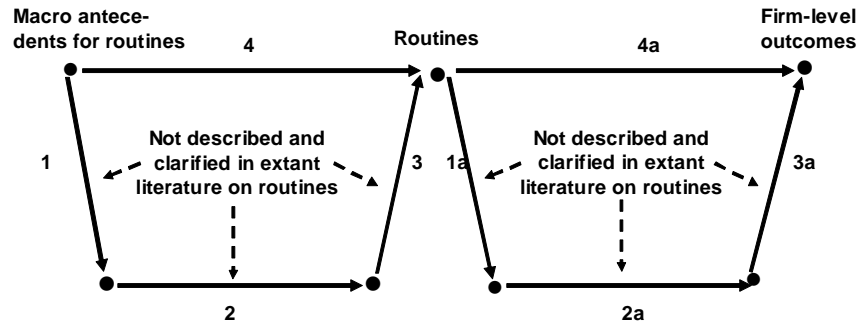
may do things in a different order than firm B) (Cohen et al., 1996; Dosi et al., 1999; Becker, 2004).

While Nelson and Winter spend considerable time on developing the notion of a routine, they are less forthcoming about the notion of capability, which is loosely defined as “associated with” “individual members’ repertoires ... particular collections of specialized plant and equipment ... [and]... the ability to operate that plant and equipment” (Nelson and Winter, 1982: 103). Unfortunately, they do not clarify how routines and capabilities are related, and much the same may be said of the subsequent literature that has taken its cues from Nelson and Winter.⁸ Because of this lack of clarity with respect to the capability construct, we shall primarily make reference to the less ambiguous routines construct, but later suggest a specific interpretation of what a capability may entail.

Neither Nelson and Winter, nor subsequent writers in strategic management, have (to our knowledge) offered a rigorous analysis of why and how actions taken by different individuals in an organizational setting should come to mesh into orderly and repetitive (reproducible) sequences (employee A doing X after employee B has done Y, etc.), that is, routines. It is arguable that the reason for our understanding of routines being incomplete in this manner is the lack of an explicit starting point in individual action and interaction. Specifically, it is necessary to examine the actions that an individual can take (e.g., routine action or non-routine action) and the payoffs associated with these actions before it is possible to ascertain whether the actions individually taken will constitute a routine.

⁸ It has been suggested, however, that there is a hierarchy in firms involving routines, capabilities and dynamic capabilities and that routines, representing, “static” sequences of actions, are somehow at the bottom of this hierarchy (e.g., Teece, Pisano and Shuen, 1997; Winter, 2003).

Figure 2: Explaining Routines and Explaining By Means of Routines



Consider the left hand side of the diagram depicted in figure 2, which is concerned with the explanation of routines (i.e., routines as *explanandum*). In terms of the diagram, arrows 1, 2 and 3 are not given theoretical content in extant work on routines. Instead, routines at time t_1 are explained directly in terms of routines at t_0 . For example, Nelson and Winter (1982) argue that routines change through the operation of other routines (“dynamic routines”). This is explanation in terms of arrow 4. A similar neglect of the micro level arises in connection with explanation that involves routines, not as *explananda*, but as part of the *explanans*.

Explaining by Means of Routines

Among the reasons why routines have proved attractive to strategic management scholars is that they are seen as representing the outcomes at a given time of a firm’s knowledge development path (e.g., Teece, Pisano and Shuen, 1997; Eisenhardt and Martin, 2000). They are therefore relevant to the understanding of such important knowledge-based phenomena as heterogeneity, competitive advantage, inertia, diversification patterns, and patterns of innovation. However, as Argote and Ingram (2000: 156) lamented, to the extent that there has been progress in studying knowledge as the foundation of competitive advantage, “... it has been at the level of identifying consistencies in organizations’ knowledge development paths and almost never at the level of human interactions that are the primary source of knowledge and knowledge transfer.” In other

words, explanations of (for example) competitive advantage that involve notions of routines in the *explanans* typically reason directly from these to competitive advantage. In terms of the right-hand side of Figure 2, this amounts to explanation using arrow 4(a). Again, however, arrows 1(a), 2(a) and 3(a) are not given theoretical content.

Understanding the firm-level consequences of actions being routinized — for example, why a certain routine may be a source of superior performance — requires taking a starting point in individual action and interaction: The routine may be associated with a high-productivity equilibrium (Leibenstein, 1987), for example, because it leads to superior coordination of actions (Camerer and Knez, 1996) (*sans* incentive conflicts) or because it leads to agents choosing actions that overcome latent prisoners dilemma situations. Thus, the causal links from routines to firm-level outcomes are never direct (arrow 4a in Figure 1); rather, they involve individual skills, motivations, and actions. Unfortunately, these individual level considerations have been consistently blackboxed in the received capabilities view.⁹ The following section is an attempt to open up this black box.

EXPLAINING THE LINKS BETWEEN ROUTINES, CAPABILITIES, AND PERFORMANCE

Conceptualizing Routines and Capabilities

As noted the relation between the core constructs of routines and capabilities is far from clear in the literature, and definitions of these constructs tend to be vague. We suggest the following simple definition of routines and capabilities and how they relate: *A firm can be described as possessing the capability to realise a routine to the degree that it can repeatedly internalise a pattern of individual level external productivity effects.*¹⁰

This definition seems to capture important parts of what many scholars — not only Nelson and Winter — imply by routines and capabilities (e.g., Cyert and March, 1963: 120-133).¹¹

⁹ For example, Nelson and Winter (1982: 107) *assume* that routines represent organizational truces.

¹⁰ It is possible to conceive of units of analysis (e.g., groups) lying between the firm and the individual, and, thus, group externalities, but we abstract from this complexity as group-level phenomena also invite reduction to the individual level. We use the term “productivity effect” to cover all possible functions.

¹¹ However, some scholars pack much more into these notions, see, e.g., Levitt and March (1988) for an extremely expansive definition of routines.

Notably, there is more to a routine than merely sequentially organizing the productive effort of a number of independent productive agents. Their efforts are interdependent (as manifested in external productivity effects), and these interdependent efforts can be repeated (Cohen et al., 1996). Also note the cross-level nature of this definition referring, as it does, to both a firm (collective level) and individuals.

One might ask why the routine should not be attributed to the (collective action of) individuals rather than to the organisation (thus obviating the need for an awkward cross level conceptualization). The reason for taking this route is that the literature appears to make it a requirement of routines that they are replicable by mechanisms operating at the organisational level (Nelson and Winter, 1982: 117; Cohen et al., 1996).¹² To put it somewhat differently, routines are deemed to be institutionalised to the extent that they are not overly sensitive to the turnover of employee and management turnover (and perhaps depreciation of substitutable capital assets) in realising the capability (Nelson and Winter, 1982). This feature must, of course, be a matter of degree and it is difficult to precisely characterise it.

Firms as Averaging Mechanisms

The way we propose to address these issues is by conceiving a firm as an averaging mechanism. This notion may be exemplified in terms of a principal-agent setting with one principal and a number of agents that cooperate in a team (as in Alchian and Demsetz, 1982). Information is asymmetric in the specific sense that the principal cannot observe individual efforts and outputs. He can only observe the team's output; however, basing the remuneration of individual team members on team output introduces a prisoners' dilemma-problem. Resort to some kind of monitoring is therefore necessary. Although he cannot observe individual effort, the principal/manager can, based on various signals, form an estimate of the *average* of input productivities and therefore an estimate of output, given the average. Moreover, we assume that managers can implement this average and that the means to such implementation is a routine.¹³

¹² Of course, this might be a surrogate for a management group.

¹³ This assumption is a very strong simplification and therefore also a significant limitation of the analysis. Essentially we work with a n-person PD game, but solve the game by dictatorial fiat, introducing an exogenous routine which captures the extent to which the firm internalizes externalities. In the *present* analysis the routine is not the explicit result of individual action and interaction. A full analysis would require also incorporating the left hand side of the diagram in figure 2. However, considerations of space prevent such an analysis (for an attempt to model routine

The average mechanism conception implies that firms (i.e., management) do(es) not have the information to internalise the full micro complexity of external effects, which is why resort to some averaging procedure is necessary. This conception is consistent with the notion that routines assist in coordinating dispersed, tacit knowledge (Kogut and Zander, 1992; Cohen et al., 1996; Dosi et al., 1999), that is, knowledge that cannot be fully centralized in the management team. Second, it is consistent with the notion that routines whilst conferring potentially high financial performance may not be optimal (Nelson and Winter, 1982: 126).¹⁴ Finally, it harmonizes with the key idea in the literature that an important function of firms is to simplify the micro complexity of inter-individual external productivity effects by means of routines and standard operating procedures (cf. Cyert and March, 1963).¹⁵

Fundamental Notions

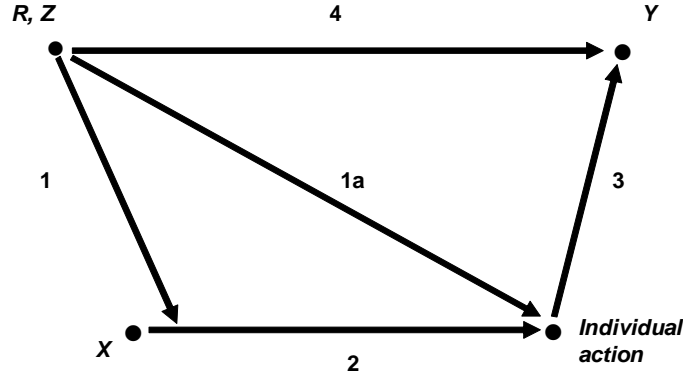
The following modelling exercise gives some substance to the explanatory skeleton represented by the diagram in Figure 1. Specifically, Figure 3 which is simply an application of the Coleman diagram in Figure 1 to the present model introduces some of the notation and terminology used here.

emergence, see Dosi et al., 1999).

¹⁴ A pertinent question is why a routine, if it is relatively easily replicable, is best coordinated in an organisation rather than by markets or by multilateral or distributed bilateral bargaining (Coase, 1937). The preliminary answer is that the efficiency losses introduced by averaging in organisation procedures are less than those associated with these alternative mechanisms. We leave the exploration of this for treatment elsewhere.

¹⁵ One could go on to study productivity losses by introducing averaging under different assumptions about the distribution of these effects across the individuals/positions in the routine. For instance, if they are distributed normally then averaging will not introduce significant distortions though if they were to follow a power distribution (which they may well if the structure of external effects contains hubs) then the average will not capture well the impact of the effects.

Figure 3: Explaining the Routines/Performance Link



The basic analytical procedure is as follows. N individuals exerting certain skills at a certain level of motivation, X , could — in the absence of externalities in production — operate independently producing an aggregate output $Y_{\text{indep.}}$. Under standard assumptions about production costs (which we shall leave implicit for the sake of clarity), there is in this case nothing to be gained from routinization. In order to provide a rationale for routines, we introduce production externalities as a network (i.e., a di-graph). Optimal output, $Y^*_{\text{dep.}}$, now requires micro-level internalization of these effects. Consistent with the theory of the firm literature (e.g., Alchian and Demsetz, 1972; Holmström, 1982; Grossman and Hart, 1986) we assume that it is beyond the individuals, acting independently, to achieve such internalization.

In this context, the firm (i.e., management) may be seen as a mechanism for attending to the external effects when the output is $Y_{\text{dep.}}$. Because of asymmetrical information, not all external effects can be (efficiently) internalized; hence, the notion that only average external effects are internalized. The application of a routine results in an output level that lies somewhere in the interval, $]Y_{\text{indep.}}, Y^*_{\text{dep.}}[$.¹⁶

¹⁶ Thus, it is assumed that the routine will always improve output relative to the prisoners' dilemma output (i.e., the minimum output), but will never be able to reach the first-best output level (the level that could be reached if information was symmetric).

In the following, routine impact on firm performance is defined as the *explanandum*, that is, we primarily look at the the right hand side of the diagram in figure 2 (and black-boxing the left hand side) .If a firm is conceived as a repository of routines, they are not necessarily independent of one another, as , reflected in notions of routine hierarchies (Nelson and Winter, 1982; Winter, 2003). The capability to realise one routine may depend upon the capacity to realise other routines (i.e., inter-routine synergies). For the sake of expository convenience, however, we abstract away from such interdependence and deal with / independent routines.

Individual Level Considerations

To introduce individual level considerations, let the productive output of individual $i = (1, 2, \dots, N)$ in the routine be Y_i . Further, let the exogenous individual (micro) level variable be X (i.e., the bottom node to the left in Fig. 2). To ease presentation, X_i represents an interactive (choice) variable of individual i 's motivation and skills (i.e., “motivated skill”). More specifically, we can represent an individual level (arrow 2) production function as a simplified Cobb-Douglas function:

$$(1) \quad Y_i = b_0 X_i^{b_1} r_i$$

where r_i represent stochastic factors. In logs, this becomes

$$(2) \quad \log Y_i = \log b_0 + b_1 \log X_i + \log r_i$$

r_i has the usual stochastic interpretation (i.e., normally distributed with mean zero, uniform variance, and zero co-variance among the residuals) across the N individuals. b_0 is the total factor productivity of the routine. Again, to avoid notational complexities we have suppressed other productive factors (notably capital) which may be regarded as embodied in b_0 .

Aggregating Up

Under standard assumptions about the value (benefits) of Y and the cost of motivated skill (X) to each individual, the optimal levels of Y_i , $i = 1, 2, \dots, i, \dots, N$, are easily definable in terms of equalizing costs and benefits at the margin. Then the total output, $Y_{indep.}$, is given by

$$(3) \quad Y_{indep} = \sum_i Y_i$$

where “indep.” stands for independent individual maximisation. Thus, the firm-level outcome is

reached by simple addition (i.e., arrow 3 in Figure 2). However, the notion of routines imply more than equation (3). In order to better capture the meaning and implications of routines, assume now that the individual production functions potentially take the form

$$(4) \quad Y_i^* = b_0 (X_i \sum_k a_{ik} X_k)^{b_1} e_i,$$

where e_i represent stochastic factors. In logs, this becomes

$$(5) \quad \log Y_i^* = \log b_0 + b_1 \log X_i + b_1 \log \sum_k (a_{ik} X_k) + \log e_i$$

$k = 1, 2, \dots, N; k \neq i$. e_i has the usual stochastic interpretation across the N individuals. a_{ik} is the weighting of the external effect of individual k 's motivated skill (X_k) upon individual i 's output performance (i.e., "Hawthorne effects"). In other words, a_{ik} represents externalities in production. In this context, the notion of "institutionalization" can be interpreted to refer to the extent to which the effects represented by a_{ik} can be maintained in the face of turnover; for example, strong institutionalization implies that a_{ik} is rather invariant to personnel turnover.

It is convenient to interpret the matrix, A , of binary coefficients a_{ik} across the N actors as a network, or more formally, a di-graph, $R = (N; A)$, where N represent the nodes and A the arcs. In fact, given our earlier remarks about the institutionalised capacity of routines it may be useful to regard the graph R as running across institutionalised positions rather than specific individuals. This conceptualization links capability and routines: The more an organization has institutionalised such positions, the better its capability of repeatedly realising the routine.¹⁷ It is as if the organization has a ready blueprint for organizational design (including task allocation) and HRM policy that it can efficiently and repeatedly implement in the face of even substantial personnel turnover (cf. Nelson and Winter, 1982).

The significance of A is that it marks the potential for collective action in the following sense: To the degree each individual, k , sets her level of motivated skill at X_k , taking account of, not only her own output Y_k , but also the impact she has on the other individuals in R , the value of

$$(6) \quad Y_{dep} = \sum_i Y_i^*$$

¹⁷ Thus, R solves (sub-optimally) a repeated game with turnover of actors. Note that individual incentives will not do this in a repeated or one-shot situation. Repeated game equilibria require a stable population of players for folk theorems to apply.

will be optimal. In general,

$$(7) \quad Y_{\text{dep}} > Y_{\text{indep}}$$

if, for at least one pair i and k , $a_{ik} > 0$, and individuals take account of their impact on other individuals in R .

Production in Routines

If, as before, we assume conventional individual cost functions in X , it is intuitive that the individual level production functions (i.e., equation (4)) establish an N -person prisoner's dilemma. Thus, the (Pareto) optimum is achieved when all players internalise their external effects in setting their respective X values (Holmström, 1982). Each has, however, an incentive to free ride and then Y (indep) will be realised, supporting the (sub-optimal) N person Nash equilibrium.¹⁸ The firm tries to prevent this problem by institutionalising a routine.¹⁹

We now allow both parameters in equations of the form (4) to vary across routines j . Assume, without any loss of generalisation, that they take, respectively, the simple linear forms

$$(8) \quad \log b_{0j} = c_{01} Z_j + \log u_{0j}$$

$$(9) \quad b_{1j} = c_{11} R_j + u_{1j}$$

where again the u terms are both stochastic with the standard interpretation. Z_j and R_j are variables which vary across routines, but not across individuals within a routine. These are firm-level variables that impact/moderate the relation between individual level motivated skill and individual output performance. Thus, Z_j measures the variation in total factor productivity across routines (that is, effects in output that are not caused by inputs of motivated skill), while R_j is a measure of the extent to which the routine internalizes externalities. (We will return to this below). By making these stochastic functions we signal that arrow 1 in Figure 3 is empirical rather than definitional.²⁰

¹⁸ This is akin to the familiar team production problem (Alchian and Demsetz, 1972; Holmström, 1982).

¹⁹ This may be taken as an interpretation of Nelson and Winter's (1982: 107-112) notion of routines-as-truces.

²⁰ We here deviate slightly from the Coleman diagram; R_j impacts the coefficient relating the micro level variables X and Y rather than the value of X itself, which appears to be Coleman's intention. This is captured in Figure 3 where the arrow 2 is drawn as incident into arrow 3 rather than into X . It does seem sensible to allow macro variables to modify the impact of micro motivational variables.

Introducing variation across j and combining (2) with (8) and (9) we obtain an expression for individual i 's productivity in routine j :

$$(10) \quad \log Y_{ij} = c_{01} Z_j + c_{11} R_j \log X_{ij} + \log u_{0j} + u_{1j} \log X_{ij} + \log r_{ij}$$

Note the dependence of the “error” on the value of X which in the context of empirical estimation would call for special treatment.

Variables Z and R are under the control of the firm (i.e., in practice management). Z is any variable, like size influencing economies of scale, which impact upon total factor-productivity. In respect of Z (our concern here) management has at its disposal three basic mechanisms for determining the aggregate input, X (i.e., motivated skill) — namely, firstly, an incentive system; secondly, monitoring and direct supervision; and, thirdly, the creation and maintenance of firm level cultural norms.

It is reasonable to assume that management does not possess the detailed information on inputs (X) and the strength of the external effects (a_{ikj}) in order to design individual specific incentive contracts which would optimally internalise these effects. Management could offer a collective incentive contract (e.g., profit or gain sharing), but this is open to free-riding (Alchian & Demsetz, 1972). Indeed, we assume, in the first place, that individual coordination cannot be achieved, thus necessitating management (i.e., the firm). Management will, of course, expend resources on supervision and monitoring, but once again the details of complex routines will fall beyond their grasp. Failing sharp incentives and monitoring the establishment of norms (i.e., corporate culture) may provide a partial solution (cf. Miller, 1992)

In the round we conjecture that management can only be the recipients of noisy signals about the potential of the routine.

In light of this earlier analysis let,

$$(11) \quad R_j = 1/N(N-1) \sum_i \sum_k a_{ikj} X_{ik}$$

That is to say, R_j is the mean value of the institutionalised external effects in routine j .

So (10) becomes

$$(12) \quad \log Y_{ij} = c_{0j} Z_j + c_{1j} \left(\frac{1}{N(N-1)} \sum_i \sum_k a_{ijk} X_{kj} \right) \log X_{ij} + \log u_{0j} + u_{1j} \\ \log X_{ij} + \log r_{ij}$$

The firm by averaging over the external effects institutionalises the production functions across routines:

$$(13) \quad Y_{ij} = Z_j^{c_{0j}} \left(X_{ij} \right)^{c_{1j} \left(\frac{1}{N(N-1)} \sum_i \sum_k a_{ijk} X_{kj} \right)} u_{0j} r_{ij} X_{ij}^{u_{1j}}$$

With an averaging assumption the total output will be Y (mean) for any j , where

$$(14) \quad Y_{dep.}^* > Y_{mean} > Y_{indep.}$$

Notice that the collective/macro level variables, Z_j and R_j , enter the explanation of the routines-performance link, not through arrow 4 in Figure 2, but by moderating the relationship between the exogenous individual level variable and performance (c_{1j} ; arrow 2), or directly by influencing Y_{ij} (i.e., $c_{0j} Z_j$; arrow 1a).

Although the purpose of this paper is rather general, pointing to the necessity of a micro foundational model in any theory of routines, there are some possible empirical tests of our particular model. First, in so far as firm performance is attributable to institutionalised routines, then collective incentives are likely to be absent. Second, payment by results is also likely to prove ineffective. Third, for routines to be effective they will probably need to be complemented by strong norms (We return to empirical issues in the Concluding Discussion).

Collectivist Explanation is Incomplete

Armed with the above analysis, we can now examine somewhat more rigorously the claim made earlier that collectivist explanations are, in the present context, not tenable. Specifically, we can ask whether it would ever prove sensible to explain the capabilities-performance link only in terms of arrow (4).

Assume (2), introducing variation across j , is changed to

$$(15) \quad \log Y_{ij} = \log b_{0j} + \log r_{ij}.$$

This is equivalent to saying that all the individual level exogenous variables, embodied in r_{ij} , bear a

random relationship to individual performance; there is no generalisable impact on performance of any micro-level variables. This is of course highly unlikely, but this is the only meaning we can attach to the idea whereby arrow 4 can constitute a *sui generis* form of explanation (Abell, 2003b).

Given this change, (10) also undergoes change, namely to

$$(16) \quad \log Y_{ij} = c_{0i} Z_j + \log r_{ij} + \log \mu_{0j}$$

But (16) is depicted as arrow 1a in Figure 3. Given (6), arrow 4 in Figure 3 is a transitive closure of arrows 1a and 3.

Thus, the above demonstrates that we can use collective level, arrow 4 explanations at best as shorthand or “reduced form” explanation. Arrow 4 must always be either a conjunction of mechanisms indicated by arrows 1, 2 and 3 or/and arrows 1a and 3. Thus, in explaining collective level phenomena, reference *must* be made to the level of the individual. A further interpretation is that individual-level/micro explanation replaces collective-level/macro explanation.

CONCLUDING DISCUSSION

Towards Micro-foundations

The field of strategic management seems to be increasingly aware of the need to embark upon a micro-foundations project. Scholars increasingly strive to build individual-level foundations for firm-level phenomena, such as heterogeneity, inertia, and superior financial performance. However, the perhaps dominant approach to firm-level heterogeneity in strategic management, the capabilities view, has seen virtually no attempts to build explicit micro-foundations. As a result, it is unclear how crucial collective or macro-level constructs, such as routines and capabilities, impact firm-level performance (and it is unclear how they emerge from individual action and interaction). This is unsatisfactory from the point of view of theory building in strategic management theory, because crucial underlying mechanisms remain unspecified. Similarly, the “reduced form” approach of work on routines and capabilities also means that applied work will suffer from a great deal of indeterminacy in the sense that multiple, potentially rival stories on the micro-level can explain a macro-correlation.

Finally, we are worried that the absence of micro-foundations in the capabilities view may contribute to a disappearing mandate for strategic management. In other words, the possibility of

strategic action may become obscured by a too strong emphasis on firm-level constructs, such as routines and capabilities. It would often seem critical to management scholars as well as to strategic managers to understand and be able to impute actions to individuals, rather than collective variables. And if indeed routines and capabilities are meaningful variables, both strategic management scholars and managers should take an interest in the micro-level mechanisms through which they exert their influence on firm performance. Performance improvements may come about not just through selecting new routines and capabilities (as in Nelson and Winter, 1982), but also through changing or influencing the micro-mechanisms through which routines work their influence on performance.

The main argument in this paper has, accordingly, been that micro-foundations must be built, and a simple formal model has been offered as an example of how micro-foundations may be built for the case of understanding how routines impact performance. In terms of the theories that strategic management research draws upon, an implication of this work is that routines can be meaningfully interpreted within a standard production function framework (in contrast, Nelson and Winter [1982] are strongly critical of this framework), and that key insights from the economic theory of the firm (Alchian and Demsetz, 1972; Holmström, 1982) on firms as vehicles for internalizing externalities may have a significant bearing on the understanding of the nature of routines. A theoretical contribution that emerges from the latter conceptualization is the notion we have proposed of firms as averaging mechanisms.

Limitations and Future Work

The aim of this research has been to make a fundamental methodological point, that collectivist or macro explanation is incomplete, and to indicate that it is possible to build micro-foundations for how routines and capabilities impact performance. Because of this overall focus, a number of specific points have (deliberately) not been developed. For example, we have refrained from directly discussing the micro-foundations of routines themselves, and have taken routines to be rather *deus ex machina* like. The present approach may therefore strike some readers as not going sufficiently far in the direction of micro-foundations. Ultimately, a satisfactory treatment should explain both the emergence of routines and their impact on performance (i.e., the whole of figure 2). One reason is that how routines impact performance may be related to which routines

are allowed to emerge and such a feedback loop may be a crucial part of the dynamics of routines (Nelson and Winter, 1982).

Another limitation resides in our focus on prisoners' dilemma games. The usual treatments of routines tend to see them as solving coordination rather than cooperation problems (Nelson and Winter, 1982). However, recent work has suggested that resolving incentive problems (i.e., problems of cooperation) may be an important part of what routines accomplish (Gavetti, 2005; Kaplan and Henderson, 2005). Our model illustrates exactly this feature of routines. Obviously, however, such a treatment leaves out a host of other possible aspects of routines (for catalogues of these, see Levitt and March [1988] and Becker [2004]). For example, routines may contribute to shaping cognition in a firm. This aspect is left out of consideration in the present treatment. Similarly, we remain agnostic on the issue of whether (or to which extent) routines are emergent or designed entities (cf. Dosi et al., 1999).

Developing a clear picture of what routines accomplish arguably requires discussing one thing at a time. Still, it should be noted that although the reasoning in this paper draws on ideas from economics, it is consistent with a broad set of behaviours. In particular, the arguments and modelling effort in this paper are not tied to rational choice theory; learning and adaptive behaviours are entirely consistent with the model. However, we recognize that the view held by a scholar of what a routine accomplishes, and what are the underlying behaviours and how these aggregate will ultimately influence by which means he will explain the routines-performance link. For example, those who take a more cognitive approach to routines and capabilities (e.g., Levitt and March, 1988) may favour alternative approaches.²¹ We welcome such work. In order to make a micro-foundations project viable in such a relatively diverse field as strategic management, alternative micro-foundations should be tried out.

Finally, although the main purposes of this research are methodological and theoretical in nature, the issue of how to make micro-foundations testable and accountable to observed performance facts must be briefly raised. Recall the definition of a "capability" (to realize a routine) in this paper as the ability to repeatedly internalise a pattern of individual level external

²¹ Indeed, much work on routines, particularly in economics, apply simulation methods (e.g., Marengo, 1996; Hodgson and Knudsen, 2004; Gavetti, 2005).

productivity effects. Thus, metaphorically the firm possesses a “blueprint” which can carry the firm, without drop in performance, through turnover (in all the functions that are connected to the routine) (cf. Nelson and Winter, 1982). Testing this idea, while linking it to the level of individuals, may involve starting from a certain sampling frame of firms and search for stable interaction patterns amongst personnel (perhaps across functions) through turnover. The resulting set of independent variables must then be related to some measure of sustained performance as the dependent variable. Organizations without routines would need to search and exhibit a dislocation in interaction patterns.

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Figure 1: A General Model of Social Science Explanation

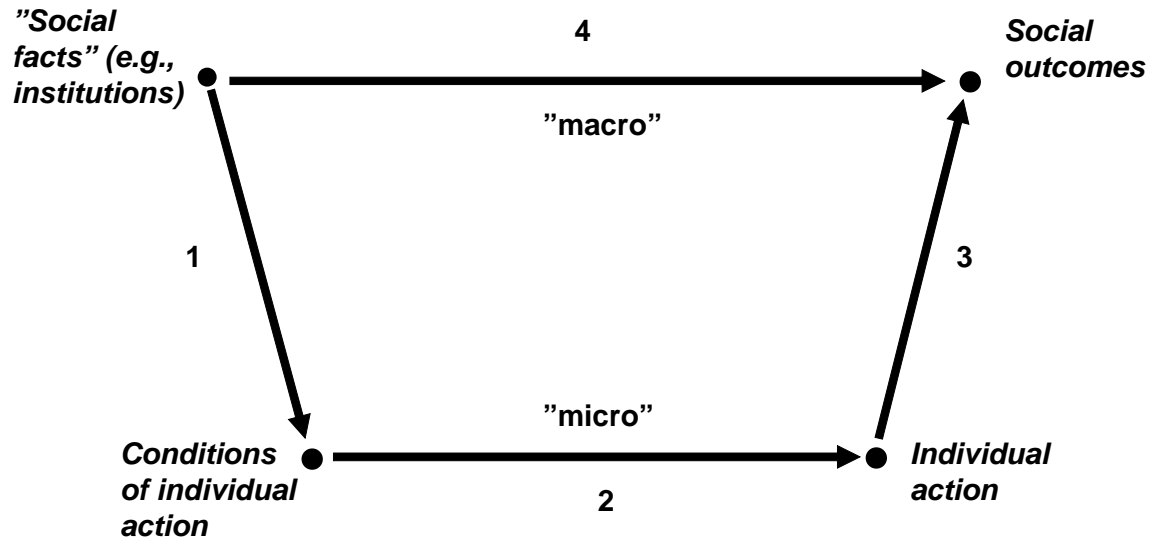


Figure 2: *Explaining Routines and Explaining By Means of Routines*

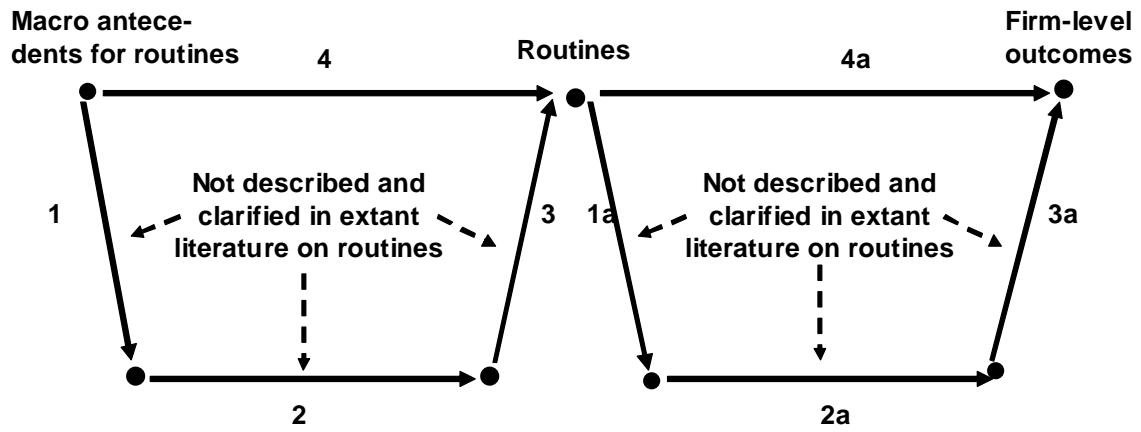


Figure 3: *Explaining the Routines/Performance Link*

