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On the Relationship between Organizational Slack and the Level of Innovation of Firms

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Abstract--The concepts of organizational slack and innovation are central elements in the literature. Innovation is of central importance as it is vital for organizational renewal and survival. The literature stands divided on the effect of organizational slack, which can be defined as the pool of resources in organizations that is in excess of the minimum necessary to produce a given level of output, on innovation. Three conflicting views can be distinguished.

Proponents of slack argue that slack allows organizations to experiment and that it is a necessary condition for fostering innovation. Agency theory turns this perspective upside down. In this view, slack may be a source of agency problems, which breeds inefficiency. Therefore, it considers slack to be negatively related to innovation. Besides these two views there is also a group that takes a middle position: too little slack and too much slack are both bad for innovation, which leads to the prediction that there is a curvilinear relationship between slack and innovation.

The study uses an existing dataset, which contains information about 300 innovating South African organizations. Results show that higher levels of slack lead to higher levels of innovation. No evidence is found for either a negative or curvilinear relationship.

I. INTRODUCTION

The concepts of organizational slack and innovation are central elements in the strategic management literature and in organization theory [13]; [15]. Innovation is of central importance as it creates competitive advantage through organizational adaptation and product development [20]; [23], it is vital for organizational renewal [30], and ongoing innovation is regarded as a prerequisite for catching up with (international) competition [31]. Organizational slack has long been used to explain diverse organizational phenomena like goal conflict, effectiveness, and innovation itself [30]. However, there is no consensus regarding the relationship between organizational slack on innovation. In the literature, three theoretical perspectives on this relationship can be found: the first perspective considers the relationship between slack and innovation to be positive, the second perspective considers it to be negative, and the third perspective considers it to be curvilinear, or inverse U-shaped.

In other words, there seems to be no consensus about what the relationship between slack and innovation actually looks like. To get a clearer view of the relationship, this study empirically examines the relationship between organizational slack and innovation by carrying out a large-scale secondary data analysis on more than 300 South African organizations that reported innovative activities in the period 1998-2000. Based on the foregoing discussion, this paper tries to answer the following research question: *To what extent does level of organizational slack influence the level of innovation of an organization*?

The relation between organizational slack and innovation has been a frequent topic of speculation yet an infrequent subject of empirical scrutiny [32]. According to [8], the empirical evidence on the relation between slack and innovation comes largely from developed economies and has been inconclusive. Moreover, little effort has been made to test empirically whether such an impact is linear or curvilinear [8]. Reference [16] found that the handful of empirical studies directly examining this relationship [17]; [39]; [44] have produced conflicting results, thereby reflecting the theoretical debate. By covering more populations, such as the South African one, this study extends the empirical base in order to reach credible generalizations.

II. THEORETICAL FRAMEWORK

A. Defining organizational slack

There is no unequivocal answer to the question 'what is slack?'. As [36] mention, the definition of slack and its antecedents are subject to multiple interpretations. Or, as [30] put it: "the issue of measuring both these constructs… [i.e, slack and innovation] …is mired in acrimonious controversy". Owing to this conceptual confusion, first an overview will be given of several definitions, after which a considered choice for one definition will be made. To emphasize the diversity and unequivocality around slack, also different kinds of slack will be discussed.

Slack resources include "excess inputs such as redundant employees, unused capacity, and unnecessary capital expenditures, but also unexploited opportunities to increase outputs, such as increases in the margins and revenues that may be derived from customers and innovations that may push a firm closer to the technology frontier" [30]. To get a clearer view of what organizational slack means, some definitions of different authors will be given. Reference [9] for example define slack as "those resources which an organization has acquired which are not committed to a necessary expenditure. In essence, these are resources which can be used in a discretionary manner". Reference [4] defines slack as "a cushion of actual or potential resources which allow an organization to adapt successfully to internal pressures for adjustment or to external pressures for change in policy, as well as to initiate changes in strategy with respect to the external environment". Reference [30] consider

slack as "the pool of resources in an organization that is in excess of the minimum necessary to produce a given level of output", which is comparable to the definition of [3]: "the existence of excess resources to produce given outputs".

The inescapable conclusion seems to be that there is no general agreement on the definition of organizational slack (yet). However, comparing the various definitions, one recognizes that a crucial aspect of the term slack is that it is about something extra, about a certain surplus, or cushion. As [19] mention, all definitions reflect the notion of excess resources that both cushion the organization from environmental changes and represent an opportunity for discretionary allocations, such as to innovative activities. Because the term 'excess' is crucial to the understanding of slack, the definition for organizational slack used in this study is in accordance with the one of [30]: *The pool of resources in an organization that is in excess of the minimum necessary to produce a given level of output.*

This definition is used for two reasons. Firstly, this definition very clearly grasps the idea of a surplus very clear. It is explicitly about something extra, about excess resources. Secondly, because this study makes use of an already existing dataset, it is important that the (different aspects of the) definition can actually be measured with those date; something that the definition of [30] allows for.

B. Defining innovation outcomes

Innovations are, by definition, unique [7]. In the research literature, the definition of innovation includes the concepts of novelty, commercialization and/or implementation (e.g., [10]; [27]; [34]). In other words, if an idea has not been developed and transformed into a product, process or service, or has not been commercialized, then it should not be classified as an innovation [35]. Reference [43] defines innovation as "a new idea, which may be a recombination of old ideas, a scheme that challenges the present order, a formula, or a unique approach which is perceived as new by the individuals involved". Reference [30] defines innovation very broadly to include "any policy, structure, method or process, product or market opportunity that a manager of an innovating unit perceived to be new". The last two definitions are clearly outcome oriented definitions of innovation.

Other definitions are also possible, such as [37] definition of making "new combinations", that clearly have a process element. Reference [42] reflects this process view when he argues that: "Innovation consists of the generation of a new idea and its implementation into a new product, process or service, leading to the dynamic growth of the national economy and the increase of employment as well as to a creation of pure profit for the innovative business enterprise. Innovation is never a one-time phenomenon, but a long and cumulative process of a great number of organizational decision-making processes, ranging from the phase of generation of a new idea to its implementation phase. Through the implementation process the new idea is developed and commercialized into a new marketable product or a new process with attendant cost reduction and increased productivity."

In sum, definitions of innovation have in common that they refer to something new, be it products, services or processes. But they differ in their focus on the process of innovation (of making new combinations) or the outcomes of the process (the new combinations themselves). This paper looks at innovation as an outcome as it aims to explain the effect of slack on innovation. Slack itself is closely related to the process, so in order to avoid running into a tautology, the dependent variable must be defined as an outcome. In accordance with the European Community Innovation Survey innovation is defined as "new or substantially improved services, products or processes". This definition will aid the operationalization of innovation, as will be discussed later.

C. A positive relationship between slack levels and innovation outcomes

According to [6], slack provides resources for innovation and change, which improves an organization's ability to adapt to environmental changes and its long-term performance. Innovation and change are more acceptable when there are excess resources because they protect the organization from downside risks [2]; [28]. Organizations are more likely to support special projects in the presence of slack, because slack allows an organization to experiment with new postures in relation to a changing environment [4]. In case of little slack managerial options are restricted, which reduces an organization's flexibility [29]. Reference [5] argue that organizations with slack are more likely to respond aggressively to shifting environmental demands than those without slack.

In the case for a positive relationship between slack and innovation, slack is treated as a buffer between organizations and external contingencies [6]; [12]; [41]. According to this view, organizations try to buffer environmental influences by surrounding their technical cores with input and output components [5]. This allows the production process to proceed at a constant rate in the event of discontinuity in supplies (input) and demand (output), thus reducing the need for organizations to respond to every environmental fluctuation [5]). In sum, when there is a surplus of resources, there is more room for experimenting, and innovation and change are more acceptable, so new products, processes and/or services have more chance of being realized. These ideas lead to the first hypothesis:

Hypothesis 1: *Higher levels of organizational slack are positively related to innovation outcomes.*

D. A negative relation between slack levels and innovation outcomes

In the case for a negative relationship between slack and innovation, it is argued that slack is an analogue for inefficiency - a buffer which shields the firm and, in some cases, blinds it from changes which are needed to meet

external demands [25]; [41]; [45]. In line with this reasoning, [5] argue that the presence of slack may actually weaken a company's adaptive response to environmental shifts. Rather than providing managers the leeway to pursue new strategic opportunities, slack may actually dull a firm's strategic response (e.g., slow its reaction to competitor's moves or to sudden market shifts).

According [38], this role played by slack facilitates suboptimal behaviour such that in the presence of slack, strategic decision-makers may be more inclined to satisfice [5]. Moreover, [5] argue that even the threshold for acceptability is likely to be influenced by the level of slack present, saying that options which are unacceptable in the absence of slack may actually be satisfactory in the presence of excess resources.

Reference [25] and [45] propose that when slack is high, organizations can afford to adopt structures that do not match their environments, because the excess resources can be used to pay the price of the mismatch. When slack is low, however, organizations cannot afford to be unresponsive to external demands, and thus structures are more likely to be contingent on contextual requirements. These ideas suggest that the presence of slack might actually reduce a firm's aggressiveness in responding to environmental shifts, and they are in direct opposition to the view of slack as resources for innovation and change [5].

The keyword for this view is inefficiency. Excess resources are seen as a waste that lead to diminishing discipline, and this results in less new or substantially improves services, products, or processes. These ideas lead to a second, competing, hypothesis:

Hypothesis 2: *Higher levels of organizational slack are negatively related to innovation outcomes.*

E. A curvilinear relation between slack levels and innovation outcomes

Besides the proponents and opponents of the innovation-enhancing benefits of slack, there is a third group that suggests the relationship between slack and innovation is curvilinear, or inverse U-shaped. According to [21], at some point excess slack will actually reduce innovation because it allows for undisciplined investment in R&D activities. Reference [30] researched whether slack is good or bad for innovation and came to the conclusion that too little and too much slack are both detrimental to innovation. This proposition rests on the following series of interrelated observations and arguments.

For innovations to occur, organizations must cope with the uncertainty associated with innovative projects [26]. This intrinsic uncertainty makes it difficult to gauge ex ante the net present value of such projects. Persistence and 'patient money' can not only foster innovation, but can also provide the flexibility necessary to adopt resource allocation levels as projects progress over time. Slack provides a pool of resources that can ease adaptation to the ebbs and flows of the innovation process. Slack also frees managerial attention, another scarce resource [6]. In organizations that have little slack, managerial attention is likely to be focused first and foremost on short-term performance issues rather than on more uncertain projects. For all of the abovementioned reasons, the number of innovation projects undoubtedly increases as slack increases. The positive relationship between slack and experimentation, thus, is one factor that determines the relationship between slack and innovation [30].

An opposing dynamic that needs to be considered simultaneously is the diminishing discipline that is placed on increasing experimentation as slack increases. As slack increases, the discipline that is exercised in the selection, ongoing support, and termination of projects becomes lax (e.g., [21]; [24]). With increasing slack, projects with high risk and negative net present value may be funded simply because the resources exist to indulge agents for whom these are pet projects. Not only may bad projects be initiated, continual, or escalating, commitment to these projects might occur because the existence of slack makes it difficult to justify termination of someone's pet project [40]. As [6] pointed out, in times of slack, negotiations are not as intense and managers tend to be less stringent in demanding that projects meet their forecasted milestones. The lax discipline around resource allocation that slack fosters increases both the risk that poor projects will not be terminated even in the face of negative information, and the risk that projects will be abandoned simply because someone ran out of energy, got bored, or ran into a tough problem. In sum, this argues for a negative relationship between slack and discipline [30].

To summarize the ideas of [30], slack promotes greater experimentation but also promotes diminishing levels of discipline. Since adequate levels of both experimentation and discipline are requisites for innovation, [30] expect the relationship between slack and innovation to be curvilinear. These ideas lead to the third hypothesis:

Hypothesis 3: *The relationship between organizational slack and innovation outcomes is curvilinear such that too little and too much slack has a negative correlation with innovation outcomes and that a moderate level of slack has a positive correlation with innovation outcomes.*

Now that the hypotheses are formulated the next section discusses the methodology and explains how the central research question will be answered.

III. METHOD

To test our hypotheses empirically we make use of the South African Innovation Survey 2001 (SAIS2001). The SAIS2001 questionnaire was based on the European Community Innovation Survey but adapted to the South African context. Alterations concerned a stronger focus on engineering activities as a form of innovative behavior and

more attention for non-innovating organizations. The population of firms in the survey consisted of all South African firms in manufacturing and services with 10 or more employees and that conducted economic activities in the period 1998-2000. As a sampling frame the Reedbase Kompass database (August 2000 version) was used. This database contains 16,931 South African firms with a known number of employees.

In SAIS 2001 *stratified sampling* was used as the sampling technique. The population of South African firms was divided into three different *size classes*. About 7,000 questionnaires were mailed to sampled South African firms in manufacturing and services. A total of 617 firms of the 7,339 in the sample filled in and returned the questionnaire. The percentage of firms that responded was thus 8.4%. This is a rather low figure, even when we consider that response figures in organizational research are generally low. Therefore, the non-response group was surveyed in order to determine whether this group differed from the response group. A telephonic interview of 462 firms was conducted. Some questions were asked about specific reasons not to respond and about some firm characteristics, such as R&D activity. The response to the non-response survey was very high (90%). Non-responding firms indicated that their reasons for not participating in the survey fell into two categories. Either they stated that their organization did not receive a copy of the questionnaire (52%), or that non-response resulted from a lack of time (33%). Amongst others, non-responding firms were asked whether they had technological innovations in the period 1998-2000 and to what extent their R&D activities were of a continuous nature – the same questions that were asked to the responding organizations. A comparison of the response and the non-response group revealed no statistically significant differences. For the sake of validation, some population estimates of the survey were compared to external estimates produced by Statistics South Africa. All survey estimates were very close to the population estimates. In particular, the population estimate of the yearly growth of employment in the period 2000-2003 is 1.2%. This is exactly the same as the estimate given by Statistics South Africa. These results give reason to believe that the external validity of the survey results is high.

This paper focuses on a subset of the response group, namely firms with technological innovations[1], that is, organizations that reported process, product or service innovations in the period 1998-2000. In the response group 319 of the 617 firms (51.7%) reported technological innovations in this period.

[1] Technological innovation was defined in accordance with the Oslo Manual: it concerns a new or substantially improved product, process or service, which means that an innovated product, process or service was improved (or new) in relation to the essential characteristics of comparable, earlier versions.

Measurements

1) Dependent variables. Innovation outcomes are regarded as a multi-dimensional construct in which an internal and an external component are distinguished. Innovation can have internal effects, like changed production processes, and an external effect, like increased sales due to innovated products and services. The internal component describes to what degree product/service innovations caused changes of other products, services or processes (scale ranges from 1 (no changes) to 5 (drastic changes)), and to what degree process innovations caused changes of other products, services or processes (scale ranges from 1 (no changes) to 5 (drastic changes)) in the own organization. Reliability analysis showed a Cronbach alpha of .781, so these items are combined which creates the new variable 'level of internal innovation'.

The external component describes the percentage of total sales of products and/or services that were technologically improved and the percentage of total sales of products and/or services that were technologically new. The scores on these two items are added up and together they form the variable 'level of external innovation'.

2) Independent variables: Most studies ([1]; [39]; [4]) measure organizational slack by using financial ratios, like for example 'working capital as a percentage of sales', 'debt as a percentage of equity', or 'current ratios'. Although such measurements are appropriate when evaluating overall firm performance, the study of the relationship between slack and innovation outcomes asks for alternative and more specific measures. Generating (re)new(ed) products, services, and processes asks for the allocation and availability of human and financial resources to innovation on the one hand, whereas innovations can be regarded as embedded knowledge on the other hand. This knowledge can be contributed by different functions in the organizations (e.g. R&D, engineering). To capture this, two sets of variables were developed to measure organizational slack. The first set takes the use of internal information and knowledge sources into account. The basic idea is that an abundance of contributions and ideas (i.e. of knowledge) present in an organization indicates a high level of slack, which is relevant to innovation. The second set of slack variables comprises of items describing the availability of innovation related resources (R&D personnel, innovation costs) and human capital (specialists and highly educated employees), with more resources indicating more slack.

The definition of organizational slack that was discussed in the above stresses the idea that slack refers to the resources present in an organization that are in excess of a certain minimum. To capture this 'excess' idea, all slack indicators were corrected for their industry averages. It is assumed that the industry average is a proxy of such a minimum. In other words, for each firm it is determined to what extent a certain indicator of organizational slack for this firm is above or below the corresponding industry average. An additional

advantage of this approach is that industry variations in innovation are taken into account [33].

The level of organizational slack I: The first set of variables indicating organizational slack refers to the use and importance of a number of intra-organizational functions that contributed to technological innovations. The South African Innovation Survey contains questions about six internal information sources: the purchasing function; the marketing and/or sales function; the research function; the development function; the engineering function; and the production function. Firms were asked to indicate which internal information resources have been used for the firm's technological innovations in the period 1998-2000[2]. The six items were entered in a factor analysis (principal components), which resulted in a two-factor solution[3]. The items 'purchase function' and 'marketing/sales function' load high on the first factor. This factor can be labelled 'Slack knowledge resources generated by boundary spanning functions' (Cronbach's alpha = 0.56). The other four items load high on the second factor and reflect 'Slack knowledge resources generated by technical functions' (Cronbach's alpha = 0.81). The two/four items were added up and divided by two/four to preserve the original scale. Next, for each of the two new variables averages per industry were calculated. Dependent on industry membership of a firm, this industry average was subtracted from the score of a firm. Therefore, the two variables described to what extent a firm scores below or above an industry average. The higher/lower this score, the more/less organizational slack available to a firm.

The level of organizational slack II: The second set of organizational slack variables refers to items describing the availability of innovation related resources (R&D personnel, innovation costs) and human capital (specialists and highly educated employees). This alternative measure contains questions on 'traditional resource indicators', namely: R&D effort, innovation costs, percentage of higher educated personnel and percentage of specialists. Respondents were asked to give:

- An estimate of the firm's R&D effort in persons for the year 2000;
- The innovation costs of the firm in the year 2000, including personnel costs and related investment expenditures;
- The percentage of employees who could be considered as highly trained specialists;
- The percentage of employees educated on a tertiary level.

The R&D effort in persons in 2000 is divided by the total number of employees in 2000 and multiplied by 100. Similarly, the innovation costs in 2000 are divided by the total sales in 2000 and multiplied by 100. This way all four items are scaled as percentages. The four items were entered in a factor analysis (principal components) resulting in a two-factor solution[4]. R&D intensity and innovation costs as a percentage of sales loaded high on one factor (Cronbach's alpha = 0.724). This factor reflects the amount of resources invested in innovation. The second factor (Cronbach's alpha = 0.712) comprises of the percentage of highly trained specialists and of highly educated employees. Clearly, this factor describes the availability of high quality human resources. The variables used in the analysis were calculated in the same way as with 'the level of organizational slack I'.

3) Control variables: To reasonably assess the relationship between innovation outcomes and organizational slack, it is essential to include control variables that are known or expected to affect innovation outcomes.

- **Firm size**: The relationship between firm size and innovativeness already is long debated in the literature. Reference [37], for example, argues that innovation is a matter of larger size. The reason for this relationship is mainly because large firms have more resources and profit more from economies of scale in innovation processes and projects. On the other hand, [11] states that smaller firms are better innovators. Smaller firms have an advantage, because they are more flexible and faster in recognizing opportunities.
- **Technology strategy**: The existence of a technology strategy indicates a firm's attitude towards technology and innovation. Firms in the South African Innovation Survey are asked to indicate whether or not the firm had a technological strategy. Reference [18] denoted that having a technology strategy influences innovation. Clear goals can be set along with instruments or people that have to come up with new ideas, leading to a well-organized innovation process and probably higher innovation outcomes.
- **Training in technology and innovation management**: Training employees in the functional areas they are responsible for is very important as it will improve their efficiency and effectiveness. The same can be argued for employees who are responsible for a firm's innovation activities. Employees of 40% of South African firms attended training courses in technology and/or innovation management during the period 1998-2000. Training in technology and innovation management makes people aware that innovation is important and provides them with tools to manage knowledge and innovation more efficiently.
- **Affiliations to other firms**: Many scholars suggest that being member of a larger group of firms enhances firm value because such a group can provide an internal

[2] The answering possibilities ranged from (1) source not used, to (2) source used and was of little importance, (3) source used and was important, and (4) source used and was very important.

[3] KMO-test = 0.748; Bartlett's Test of Sphericity = 505.914 ($p < 0.000$); Total percentage of variance explained = 65.8%.

[4] KMO-test = 0.588; Bartlett's Test of Sphericity = 231.271 ($p < 0.000$); Total percentage of variance explained = 79.2%.

market to overcome the problems arising from market failures [22]; [14]. Business groups also represent a type of business network in which affiliated firms can exchange resources and cooperate to promote their innovative activities. To check whether a firm was part of a larger group of firms, they were asked to their affiliations, on the expectation that affiliation would result in higher innovation outcomes.

For testing our hypotheses, we used multivariate ordinary least square analysis. To check for multicollinearity problems, the VIF value (Variance Inflation Factor) is considered. VIF-values larger than ten are an indication of serious multicollinearity problems of the regressor. The largest VIF-value encountered in the empirical analyses was 5.557, which leads to the conclusion that no considerable problems occurred.

IV. RESULTS

Combining the two dimensions of the dependent variable, innovation outcomes (external and internal innovation outcomes), and the two alternative measures of organizational slack results in four main models. For each of the four models, three estimates are generated (see Tables 1 and 2). The models 1, 4, 7, and 10 include the control variables only. Next, the linear effects (hypotheses 1 and 2) are tested (models 2, 5, 8, and 11), whereas the addition of squared terms of the independent variables allows for the testing of hypothesis 3 (models 3, 6, 9, and 12). As the F-values and their significance indicate, all models under consideration are statistically significant. R squares range from 5.4% (model 1) to 18.6% (model 6).

A. Organizational slack I variables as the independent variables

1) Dependent variable: External innovation outcomes. Table 1 shows that higher levels of organizational slack are positively associated with external innovation outcomes. In other words, the more innovating firms have slack levels of knowledge resources generated by boundary spanning functions and by technical functions that deviate positively from their industry averages, the higher their innovative sales. The squared terms of these variables are statistically insignificant, which implies that no curvilinear effect was found. Therefore, hypothesis 1 is confirmed for models 1-3, whereas hypothesis 2 and 3 are rejected. Moreover, there is a size effect: smaller firms tend to generate higher innovative sales. In model 1 (control variables only), having a technology strategy seems to be beneficial to innovation outcomes, but this effect disappears when other variables are included (models 2 and 3).

2) Dependent variable: Internal innovation outcomes. In models 4 to 6 the same independent variables are used, but now with internal innovation outcomes as the dependent variable. It can be concluded that the more innovating firms have slack levels of knowledge resources generated by their technical functions that deviate positively from their industry averages, the higher their innovative sales. The other slack variable is not statistically significant. Again, the squared terms of these independent variables do not produce significant results. Interestingly, two of the control variables impact positively on the level of internal innovation outcomes: 'technology strategy' and 'training in technology and innovation management'. For this specification of our model, it turns out that higher levels of organizational slack impact positively on innovation outcomes, thus confirming hypothesis 1.

TABLE 1: SLACK MODELS WITH 'EXTERNAL INNOVATION OUTCOMES' AND 'INTERNAL INNOVATION OUTCOMES' AS THE DEPENDENT VARIABLES AND ORGANIZATIONAL SLACK I VARIABLES (SQUARED) AS INDEPENDENT VARIABLES

	Dependent = external innovation outcomes			**Dependent = internal innovation outcomes**		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	38.58***	43.35***	42.21***	2.28***	2.48***	2.54***
Technology strategy?	0.16**	0.11	0.11	0.27***	0.21***	0.22***
TIM-training?	0.10	0.08	0.09	0.16**	0.16**	0.16**
Affiliated to other firms?	0.01	-0.02	-0.02	-0.03	-0.06	-0.06
Size (ln)	-0.16**	-0.20***	-0.20***	-0.01	-0.05	-0.05
Rel_IBS		0.14**	0.15**		0.08	0.07
Rel_ITF		0.15**	0.16**		0.20***	0.19***
Rel_IBS (squared)			0.02			-0.07
Rel_ITF (squared)			0.04			0.01
R square	5.4%	10.9%	11.1%	12.9%	18.1%	18.6%
R square change	n.a.	+5.6%	+0.2%	n.a.	+5.3%	+0.5%
F-value	3.324**	4.748***	3.599***	9.149***	9.086***	6.969***
F-change	n.a.	+7.242***	+0.248	n.a.	+7.937***	+0.688
N	239	239	239	253	253	253

** = p < 0.10; ** = p < 0.05; **** = p < 0.01*

B. Organizational slack II variables as the independent variables

Dependent variable: External innovation outcomes. In the models 7-9, our second set of indicators of organizational slack is regressed on external innovation outcomes. The estimates show that higher levels of organizational slack impact positively on the level of innovative sales. That is to say: the higher the amount of resources invested in innovation (R&D efforts and innovation costs), the higher the external innovation outcomes. The same is true for the availability of high quality human resources: the more these human resources are available (relative to industry average), the higher the innovative sales of firms. In sum, this implies that hypothesis 1 is confirmed and hypothesis 2 is rejected. In model 9, the predicted inverted U-shape relationship is found, but only for the amount of resources invest in innovation. Again, having a technology strategy proves to be beneficial to innovation. In all three models, this variable impacts positively on the level of external innovation outcomes.

TABLE 2: SLACK MODELS WITH 'EXTERNAL INNOVATION OUTCOMES' AND 'INTERNAL INNOVATION OUTCOMES' AS THE DEPENDENT VARIABLES AND ORGANIZATIONAL SLACK II VARIABLES (SQUARED) AS INDEPENDENT VARIABLES

	Dependent = external innovation outcomes			**Dependent = internal innovation outcomes**		
	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Constant	35.76***	34.70***	32.12***	2.24***	2.20***	2.18***
Technology strategy?	0.18**	0.14**	0.15**	0.26****	0.23***	0.24***
TIM-training?	0.10	0.07	0.07	0.12*	0.10	0.10
Affiliated to other firms?	0.03	0.01	0.04	0.01	-0.01	0.01
Size (ln)	-0.14**	-0.10	-0.09	0.01	0.04	0.05
Innovation investments (II)		0.01	0.34**		0.04	0.18
Human resources (HR)		0.21***	0.17**		0.13*	0.13*
II (squared)			-0.36**			-0.16
HR (squared)			0.03			-0.02
R square	5.9%	10.1%	12.6%	11.0%	13.0%	13.6%
R square change	n.a.	+4.3%	+2.5%	n.a.	+2.1%	+0.5%
F-value	3.422***	4.084***	3.889***	6.992***	5.616***	4.373***
F-change	n.a.	5.148***	3.071**	n.a.	2.660*	0.691
N	224	224	224	232	232	232

** = p < 0.10; ** = p < 0.05; **** = p < 0.01*

Dependent variable: Internal innovation outcomes. In the models 10-12, the second set of indicators of organizational slack is regressed on the internal innovation outcomes of firms. It is found that higher slack levels of human resources impact positively on internal innovation outcomes, whereas the squared terms of the independent variables are not statistically significant. For this specification of the model, hypothesis 1 is confirmed. Moreover, having a technology strategy and providing training in technology and innovation management has a positive effect on internal innovation outcomes.

V. CONCLUSIONS AND DISCUSSION

This paper adds to the relatively small, but growing empirical literature on the relationship between organizational slack and performance. More specifically, this paper focused on the association between organizational slack and innovation outcomes. A literature review revealed that competing views exist on this relationship. To capture these differing views, three hypothesis were formulated in which a positive, a negative, and an inverted U-shaped association are proposed.

To test these hypotheses, we developed measurements that, on the one hand, acknowledge the fact that innovation outcomes is a multidimensional construct, and, on the other hand, stress that suitable innovation-oriented indicators of organizational slack are needed. Moreover, our measures of organizational slack correct for relevant industry averages, which, we believe, results in a more valid operationalization of the concept. Using data from the South African Innovation Survey, multiple regression analysis generated findings that lead to two main conclusions:

- Organizational slack is positively related to innovation outcomes. No matter how innovation outcomes (internal and external innovation outcomes) and organizational slack are measured, each model basically shows this positive relationship. In other words, it is a rather robust result. Moreover, no support was found for non-linear effects, which leads to the conclusion that overall hypothesis 1 is confirmed, whereas hypotheses 2 and 3 are rejected;
- The variable 'technology strategy' is statistically significant in most models indicating that innovating firms with such a strategy perform better than firms without one.

Our findings support the theoretical idea that slack resources are beneficial to innovation as they allow for experimentation. In other words, slack can be a facilitator of strategic behavior, like innovation, which allows firms to experiment with new strategies such as introducing new products and entering new markets. It also implies that the benefits of slack seem to outweigh its costs, and that a zero-slack organization is not realistic. However, it seems to be necessary that an excess of resources has to be accompanied by a technology strategy, which guides their deployment. Experimentation without direction does not result in higher outcomes.

REFERENCES

[1] Alvarez-Gil, M. J., Berrone, P., Husillos, F. J. & Lado, N. (2007). Reverse logistics, stakeholders' influence, organizational slack, and managers' posture. *Journal of Business Research, 60*, 463-473.

[2] Baird, I. S., & Thomas, H. (1985). Toward a contingency model of strategic risk taking. *Academy of Management Review*, *10*, 230-243.

[3] Bogetoft, P., Färe, R., & Obel, B. (2006). Allocative efficiency of technically inefficient production units. *European Journal of Operational Research*, *168*(2), 450-462.

[4] Bourgeois, L. J. (1981). On the measurement of organizational slack. *Academy of Management Review*, *6*, 29-39.

[5] Cheng, J. L. C., & Kesner, I. F. (1997). Organizational slack and response to environmental shifts: The impact of resource allocation patterns. *Journal of Management*, *23*, 1-18.

[6] Cyert, R. M., & March, J. G. (1963). *A Behavioural Theory of the Firm*. Englewood Cliffs, New York: Prentice Hall.

[7] Damanpour, F. (1987). The adoption of technological, administrative, and ancillary innovations: Impact of organizational factors. *Journal of Management*, *13*, 675-688.

[8] Das, T. K., & Teng, B.-S. (2003). Partner analysis and alliance performance. *Scandinavian Journal of Management*, *19*(3), 279-308.

[9] Dimmick, D., & Murray, V. V. (1978). Correlates of substantive policy decisions in organizations: The case of human resource management. *Academy of Management Journal*, 21, 611-613.

[10] Fischer, M. M. (2001). Innovation, knowledge creation and systems of innovation. *Annals of Regional Science*, *35*, 199-216.

[11] Freel, M. (2003). Sectoral patterns of small firm innovation, networking and proximity. *Research Policy*, *32*, 751-770.

[12] Galbraith, J. (1973). *Designing Complex Organizations*. Reading, Massachusetts: Addison-Wesley.

[13] Geiger, S. W., & Cashen, L. H. (2002). A multidimensional examination of slack and its impact on innovation. *Journal of Managerial Issues*, *14*(1), 68-54.

[14] Ghemawat, P. & Khanna, T. (1998). The nature of diversified business groups: A research design and two case studies. *Journal of Industrial Economics, 46*, 35-61.

[15] Gopalakrishnan, S., & Santoro, M. D. (2001). Do size and slack matter? Exploring the multi-dimensions of organizational innovation. *Management of Engineering and Technology*, *20*(1), 48.

[16] Greenley, G., & Okemgil, M. (1998). A comparison of slack resources in high and low performing British companies. *Journal of Management Studies, 35*, 377-398.

[17] Hambrick, D. C., & D'Aveni, R. A. (1988). Large corporate failures as downward spirals. *Administrative Science Quarterly*, *33*, 1-23.

[18] Hays, R. H., & Abernathy, W. J. (1980). Managing our way to economic decline. *Harvard Business Review*, *58*(4), 67-77.

[19] Herold, D. M., Jayaraman, N., & Narayanaswamy, C. R. (2006). What is the relationship between organizational slack and innovation? *Journal of Managerial Issues*, *18*(3), 372-392.

[20] Hitt, M. A., Hoskisson, R. E., & Hicheon, K. (1997). International diversification: Effects on innovation and firm performance in product-diversified firms. *Academy of Management Journal*, *40*(4), 767-798.

[21] Jensen, M. C. (1993). The modern industrial revolution, exit, and the failure of internal control systems. *Journal of Finance*, *48*, 831-880.

[22] Khanna, S. & Palepu, K. (2000). Is group affiliation profitable in emerging markets? An analysis of diversified Indian business groups. *Journal of Finance, 55*, 867-891.

[23] Lengnick-Hall, C. A. (1992). Innovation and competitive advantage: What we know and what we need to learn. *Journal of Management*, *18*(2), 399-429.

[24] Leibenstein, H. (1969). Organizational or frictional equilibria, X-efficiency, and the rate of innovation. *Quarterly Journal of Economics*, *83*, 600-623.

[25] Litschert, R. J., & Bonham, T. W. (1978). A conceptual model of strategy formation. *Academy of Management Review*, *3*, 211-219.

[26] Mansfield, E. (1963). Size of firm, market structure, and innovation. *Journal of Political Economy*, *41*, 556-576.

[27] McDermott, C. M., & O'Connor, G. C. (2002). Managing radical innovation: An overview of emergent strategy issues. *Journal of Product Innovation Management*, *19*(6), 424-438.

[28] Mohr, L. B. (1969). Determinants of innovation in organizations. *American Political Science Review*, *63*, 111-126.

[29] Miles, R. E. (1982). *Coffin Nails and Corporate Strategies*. Englewood Cliffs, New York: Prentice-Hall.

[30] Nohria, N., & Gulati, R. (1996). Is slack good or bad for innovation? *Academy of Management Journal*, *39*, 1245-1264.

[31] Nonaka, I., & Takeuchi, H. (1995). *The Knowledge-creating Company: How Japanese Companies Create the Dynamics of Innovation*. New York: Oxford University Press.

[32] Özcan, S. (2005). Dynamics of industry and innovation: Organizations, networks and systems. Examining slack – innovation relationship: Longitudinal evidence from the US farm equipment industry (1996-2000). Paper presented at the DRUID Tenth Anniversary Summer Conference 2005 (June 27-29).

[33] Pavitt, K. (1984). Sectoral patterns of technical change: Towards a taxonomy and a theory. *Research Policy, 13*, 343-374.

[34] Pedersen, C. R., & Dalum, B. (2004). Incremental versus radical change—the case of the digital north Denmark program. International Schumpeter Society Conference, Italy. DRUID/IKE Group, Department of Business Studies, Aalborg University. Http://www.schumpeter2004.unibocconi.it/papers.php?tric=Pedersen&cric=author&Invia= SEARCH&Invia=SEARCH.

[35] Popadiuk, S., & Choo, C. W. (2006). Innovation and knowledge creation: How are these concepts related? *International Journal of Information Management*, *26*, 302-312.

[36] Sharfman, M. P., Wolf, G., Chase, R. B., & Tansik, D. A. (1988). Antecedents of organizational slack. *Academy of Management Review*, *13*, 601-614.

[37] Schumpeter, J. A. (1983). *The Theory of Economic Development*. New Brunswick, New York: Transaction Publishers.

[38] Simon, H.A. (1955). A behavioral model of rational choice. *Quarterly Journal of Economics, 69*, 99-118.

[39] Singh, J. V. (1986). Performance, slack, and risk taking in organizational decision making. *Academy of Management Journal*, *29*, 562-585.

[40] Staw, B. M., Sandelands, L. E., & Dutton, J. E. (1981). Threat-rigidity effects in organizational behaviour: A multi-level analysis. *Administrative Science Quarterly*, *26*, 501-524.

[41] Thompson, J. D. (1967). *Organizations in Action*. New York: McGraw-Hill.

[42] Urabe, K. (1988). Innovation and the Japanese management system. In K. Urabe, J. Child, & T. Kagono (Eds.), *Innovation and management international comparisons*. Berlin: Walter de Gruyter.

[43] Ven, A. H. van de (1986). Central problems in the management of innovation. *Management Science*, *32*, 590-607.

[44] Wiseman, R. M., & Bromiley, P. (1996). Toward a model of risk-taking by declining organizations. *Organization Science*, *7*, 524–543.

[45] Yasai-Ardekani, M. (1986). Structural adaptations to environments. *Academy of Management Review*, *11*, 9-21.